Załącznik nr 2 do ZW 121/2020

PROGRAM STUDIÓW

WYDZIAŁ: **MECHANICZNY**

KIERUNEK STUDIÓW: **MECHANIKA I BUDOWA MASZYN**

Przyporządkowany do dyscypliny: **D1 INŻYNIERIA MECHANICZNA**

POZIOM KSZTAŁCENIA: **studia pierwszego stopnia inżynierskie**

FORMA STUDIÓW: **stacjonarna**

PROFIL: **ogólnoakademicki**

JĘZYK PROWADZENIA STUDIÓW: **polski, angielski**

OBOWIĄZUJE OD CYKLU KSZTAŁCENIA: **2023/2024**

Zawartość:

1. Zakładane efekty uczenia się – zał. nr 1 do programu studiów
2. Opis programu studiów – zał. nr 2 do programu studiów
3. Plan studiów – zał. nr 3 do programu studiów

*niepotrzebne skreślić

Załącznik nr 3 do ZW 121/2020

Załącznik nr 1 do programu studiów

ZAKŁADANE EFEKTY UCZENIA SIĘ

Wydział:	***Mechaniczny***
Kierunek studiów:	***MECHANIKA i BUDOWA MASZYN***
Poziom studiów:	***studia I stopnia***
Profil:	***ogólnoakademicki***

Umiejscowienie kierunku

Dziedzina nauki: nauki inżynieryjno-techniczne

Dyscyplina: inżynieria mechaniczna

Objaśnienie oznaczeń:

P6U – charakterystyki uniwersalne odpowiadające kształceniu na studiach pierwszego stopnia - 6 poziom PRK

P6S – charakterystyki drugiego stopnia odpowiadające kształceniu na studiach pierwszego stopnia studiów - 6 poziom PRK

W – kategoria „wiedza”

U – kategoria „umiejętności”

K - kategoria „kompetencje społeczne”

KMBM_W…- efekty kierunkowe dot. kategorii „wiedza”

KMBM_U…- efekty kierunkowe dot. kategorii „umiejętności”

KMBM_K…- efekty kierunkowe dot. kategorii „kompetencje społeczne”

…_inż. – efekty uczenia się umożliwiające uzyskanie kompetencji inżynierskich

Symbol kierunkowych efektów uczenia się	Opis efektów uczenia się dla kierunku studiów: Mechanika i Budowa Maszyn Po ukończeniu kierunku studiów absolwent:	Odniesienie do charakterystyk PRK		
		Uniwersalne charakterystyki pierwszego stopnia (U)	Charakterystyki drugiego stopnia typowe dla kwalifikacji uzyskiwanych w ramach szkolnictwa wyższego (S)	
			Charakterystyki dla kwalifikacji na poziomie 6 PRK	Charakterystyki dla kwalifikacji na poziomach 6 i 7 PRK, umożliwiających uzyskanie kompetencji inżynierskich
WIEDZA (W)				
KMBM _W01	Zna zagadnienia i metody z wybranych działów matematyki wyższej oraz rozumie zależności między nimi.	P6U_W	P6S_WG	
KMBM _W02	Ma podstawową wiedzę z zakresu fizyki umożliwiającą wyjaśnienie faktów oraz zjawisk zachodzących w świecie przyrody i w technice.	P6U_W	P6S_WG	P6S_WG_inż.
KMBM _W03	Ma elementarną wiedzę w zakresie chemii obejmującą definiowanie podstawowych pojęć i objaśnianie zjawisk fizykochemicznych.	P6U_W	P6S_WG	
KMBM _W04	posiada wiedzę z zakresu funkcjonowania i architektury współczesnych komputerów, ich systemów, języków programowania oraz oprogramowania aplikacyjnego	P6U_W	P6S_WG	
KMBM _W05	Ma wiedzę dotyczącą odwzorowania na płaszczyźnie rysunku tworu geometrycznego (w tym brył) metodą rzutów Monge'a. Ma elementarną wiedzę z zakresu aksonometrii.	P6U_W	P6S_WG	P6S_WG_inż.
KMBM _W06	Zna podstawowe zasady zapisu konstrukcji oraz wymiarowania elementów i zespołów maszyn. Ma podstawową wiedzę w zakresie odwzorowania 2D i 3D. Zna zasady procesu projektowania inżynierskiego również z wykorzystaniem współczesnych metod komputerowych	P6U_W	P6S_WG	P6S_WG_inż.
KMBM _W07	Ma elementarną wiedzę na temat podstawowych materiałów konstrukcyjnych, ich właściwości i możliwości zastosowania w budowie maszyn, urządzeń i pojazdów.	P6U_W	P6S_WG	P6S_WG_inż.
KMBM _W08	Ma wiedzę z zakresu mechaniki technicznej ukierunkowaną na zagadnienia inżynierii mechanicznej	P6U_W	P6S_WG	P6S_WG_inż.
KMBM _W09	Posiada elementarną wiedzę z wytrzymałości materiałów ukierunkowaną na zagadnienia inżynierii mechanicznej	P6U_W	P6S_WG	P6S_WG_inż.
KMBM _W10	Zna wielkości związane z opisem geometrii wyrobu, potrafi zdefiniować elementy procesu pomiarowego, rozróżnia i zna charakterystyki metrologiczne sprzętu do pomiaru wielkości geometrycznych.	P6U_W	P6S_WG	P6S_WG_inż.

KMBM _W11	Ma podstawową wiedzę niezbędną do zrozumienia prawnych uwarunkowań działalności inżynierskiej z zakresu własności przemysłowej i prawa autorskiego	P6U_W	P6S_WK	P6S_WK_inż.
KMBM _W12	Ma podstawową wiedzę o pojęciach stosowanych w elektrotechnice, elektronice, automatyce oraz elementach i układach automatycznej regulacji.	P6U_W	P6S_WG	
KMBM _W13	Ma podstawową wiedzę dotyczącą procesu projektowo-konstrukcyjnego, budowy, działania, eksploatacji i niezawodności głównych elementów i zespołów maszynowych oraz zasad ich doboru i konstruowania, orientuje się w najnowszych trendach rozwoju maszyn i urządzeń.	P6U_W	P6S_WG, P6S_WK	P6S_WG_inż.
KMBM _W14	Ma wiedzę w zakresie układów napędowych maszyn z różnymi źródłami energii, w tym napędów hydrostatycznych, elektrycznych, hydrokinetycznych oraz zasad sterowania nimi	P6U_W	P6S_WG	
KMBM _W15	Ma uporządkowaną i podbudowaną teoretycznie wiedzę związaną z inżynierią mechaniczną w zakresie wytwarzania maszyn i urządzeń i układów mechanicznych.	P6U_W	P6S_WG	P6S_WG_inż.
KMBM _W16	Ma wiedzę z zakresu organizacji procesów produkcyjnych z uwzględnieniem specyfiki przepływu informacji technologicznej, jej struktury i powiązań w przedsiębiorstwie produkcyjnym oraz zarządzania i prowadzenia działaności gospodarczej.	P6U_W	P6S_WG, P6S_WK	P6S_WG_inż. P6S_WK_inż.
KMBM _W17	Ma podstawową wiedzę niezbędną do rozumienia pozatechnicznych uwarunkowań działalności inżynierskiej. Zna podstawowe zasady bezpieczeństwa i higieny pracy.	P6U_W	P6S_WG, P6S_WK	P6S_WG_inż. P6S_WK_inż.
KMBM _W18	Ma podstawową wiedzę niezbędną do zrozumienia prawnych, etyczno-społecznych, filozoficznych uwarunkowań działalności inżynierskiej.	P6U_W	P6S_WK	P6S_WK_inż.
KMBM _W19	Ma podstawową wiedzę w zakresie termodynamiki technicznej w zakresie inżynierii mechanicznej	P6U_W	P6S_WG	
KMBM _W20	Ma szczegółową wiedzę w zakresie projektowania, wytwarzania i eksploatacją maszyn i urządzeń mechanicznych.	P6U_W	P6S_WG, P6S_WK	P6S_WG_inż P6S_WK_inż.
KMBM _W21	Ma podstawową wiedzę w zakresie cyklu życia urządzeń, obiektów i systemów technicznych związanych z inżynierią mechaniczną.	P6U_W	P6S_WG	P6S_WG_inż

UMIEJĘTNOŚCI (U)				
KMBM _U01	Potrafi formułować i rozwiązywać złożone problemy matematyczne bazując na zdobytej wiedzy.	P6U_U	P6S_UW P6S_UK	
KMBM _U02	Potrafi rozwiązywać zadania i problemy w oparciu o zdobytą wiedzę oraz informacje pozyskane z literatury naukowo-technicznej w języku polskim i angielskim, baz danych i innych źródeł	P6U_U	P6S_UW P6S_UK	
KMBM _U03	Potrafi posłużyć się odpowiednimi metodami analitycznymi oraz eksperymentalnymi i urządzeniami umożliwiającymi pomiar wielkości.	P6U_U	P6S_UW P6S_UK	
KMBM _U04	Potrafi zastosować zasady rzutowania metodą Monge'a w celu odwzorowania elementów i tworów geometrycznych na płaszczyźnie rysunku. Potrafi zinterpretować rysunek wykonany wg metody rzutów Monge'a, przedstawiający położenie tworu geometrycznego w przestrzeni.	P6U_U	P6S_UW P6S_UK	P6S_UW_inż.
KMBM _U05	Posiada umiejętności zapisu konstrukcji i tworzenia dokumentacji technicznej konstrukcji mechanicznych oraz jej odczytywania. Potrafi odwzorować i wymiarować elementy maszyn, projektować i wykonywać obliczenia wytrzymałościowe układów mechanicznych z zastosowaniem komputerowego wspomagania projektowania maszyn.	P6U_U	P6S_UW P6S_UK	P6S_UW_inż.
KMBM _U06	Potrafi interpretować informacje o próbkach materiałowych w zakresie makro i mikrostruktury.	P6U_U	P6S_UW P6S_UK	P6S_UW_inż.
KMBM _U07	Potrafi rozwiązywać zadania i problemy w oparciu o wiedzę w zakresie mechaniki technicznej ukierunkowaną na inżynierię mechaniczną.	P6U_U	P6S_UW P6S_UK	P6S_UW_inż.
KMBM _U08	Potrafi rozwiązywać zadania i problemy w oparciu o wiedzę w zakresie wytrzymałości materiałów ukierunkowaną na inżynierię mechaniczną.	P6U_U	P6S_UW P6S_UK	P6S_UW_inż.
KMBM _U09	Potrafi interpretować wymagania wymiarowe, umie dokonać doboru i potrafi korzystać z odpowiedniego sprzętu pomiarowego, potrafi obliczać niepewność pomiarową oraz dokonać orzeczenia o zgodności lub niezgodności mierzonej wielkości ze specyfikacją.	P6U_U	P6S_UW P6S_UK	
KMBM _U10	Potrafi stosować zasady termodynamiki do opisu zjawisk fizycznych i modelowania wymiany ciepła w maszynach i procesach technologicznych.	P6U_U	P6S_UW	P6S_UW_inż.
KMBM _U11	Potrafi pozyskiwać informacje z literatury, baz danych i innych źródeł, potrafi opracować dokumentację lub prezentację dotyczącą realizacji zadania inżynierskiego; zadania te potrafi przygotować w języku polskim i angielskim.	P6U_U	P6S_UW P6S_UK P6S_UO	
KMBM _U12	Ma umiejętność samokształcenia się, m.in. w celu podnoszenia kompetencji zawodowych.	P6U_U	P6S_UU	
KMBM _U13	Potrafi wykonać pomiary, wyznaczać wartości oraz oceniać wiarygodność podstawowych wielkości fizycznych; potrafi wnioskować o własnościach całej populacji na podstawie wyodrębnionej części.	P6U_U	P6S_UW	P6S_UW_inż.
KMBM _U14	Potrafi analizować układy mechanicznych proste i złożone,a także powiązane z nimi układy hydrauliczne.	P6U_U	P6S_UW	P6S_UW_inż.

KMBM _U15	Potrafi stosować zasady mechaniki ośrodków ciągłych, mechanikę płynów, a także wspomagające metody komputerowe w zastosowaniu do układów mechanicznych.	P6U_U	P6S_UW	P6S_UW_inż.
KMBM _U16	Potrafi analizować obwody elektryczne, dobierać przyrządy pomiarowe i wyznaczać charakterystyki maszyn i urządzeń elektrycznych; potrafi dokonywać analizy i syntezy układów sterowania.	P6U_U	P6S_UW	P6S_UW_inż.
KMBM _U17	Potrafi wykorzystywać narzędzia informatyczne CAE oraz inne oprogramowanie inżynierskie.	P6U_U	P6S_UW	P6S_UW_inż.
KMBM _U18	Ma umiejętność dokonywania syntezy elementów i zespołów w układach maszynowych. Potrafi prowadzić prace projektowo-konstrukcyjne prostych zespołów maszynowych. Zna narzędzia metodologiczne oraz algorytmiczne wykorzystywane w projektowaniu.	P6U_U	P6S_UW	P6S_UW_inż.
KMBM _U19	Potrafi dokonać pomiarów i analizować charakterystyki układów napędowych, budować i testować układy regulacji i sterowania.	P6U_U	P6S_UW	P6S_UW_inż.
KMBM _U20	Potrafi dobrać i zaprojektować technologie wytwarzania dla określonych grup wyrobów.	P6U_U	P6S_UW	P6S_UW_inż.
KMBM _U21	Potrafi planować i nadzorować proces eksploatacji i remontów maszyn.	P6U_U	P6S_UW	P6S_UW_inż.
KMBM _U22	Potrafi przygotować prezentację zawierającą częściowe i kompletne wyniki pracy dyplomowej, uzasadnić w dyskusji sposób realizacji, stosowane metody i osiągnięte efekty.	P6U_U	P6S_UW P6S_UK P6S_UO	
KMBM _U23	Potrafi - przy formułowaniu i rozwiązywaniu zadań obejmujących konstruowanie i wytwarzanie elementów, układów i systemów mechanicznych - dostrzegać aspekty pozatechniczne, w tym środowiskowe, ekonomiczne, prawne oraz związaniem z bezpieczeństwem i higieną pracy.	P6U_U	P6S_UO, P6S_UW	P6S_UW_inż.
KMBM _U24	zależnie od wybranego poziomu studiowanego języka: ma wiedzę, umiejętności i kompetencje zgodne z wymaganiami określonymi dla poziomu B2 ESOKJ; pozyskuje, rozumie i interpretuje teksty specjalistyczne; stosuje w mowie i piśmie środki językowe typowe dla języka akademickiego oraz środowiska pracy inżyniera lub ma wiedzę, umiejętności i kompetencje zgodne z wymaganiami określonymi dla poziomu C1 ESOKJ; śledzi ze zrozumieniem i formułuje wypowiedzi na tematy związane ze studiowaną dyscypliną oraz pracą zawodową, stosując środki adekwatne do sytuacji; czyta, interpretuje, ocenia i tworzy teksty o tematyce specjalistycznej; wykorzystuje sprawności językowe w kontaktach interpersonalnych i w komunikacji w międzynarodowym środowisku akademickim i zawodowym	P6U_U	P6S_UW P6S_UK	
KMBM _U25	Potrafi pozyskiwać informację z literatury, integrować oraz interpretować naukowe teksty z dziedziny etyki inżynierskiej.	P6U_U	P6S_UW	P6S_UW_inż.
KMBM _U26	Potrafi korzystać z kodeksów prawa oraz aplikować przepisy prawa do typowych sytuacji w praktyce zawodowej.	P6U_U	P6S_UW	P6S_UW_inż.

KMBM _U27	Posiada umiejętność analizy wybranych maszyn lub urządzeń (roboczej, technologicznej, pojazdu, silnika lub generatora).	P6U_U	P6S_UW	P6S_UW_inż.
KMBM _U28	Potrafi samodzielnie korzystać z różnorodnych obcojęzycznych źródeł informacji oraz umiejętnie posługuje się językiem obcym w międzynarodowym środowisku zawodowym.	P6U_U	P6S_UK	
KMBM _U29	Rozumie obcojęzyczne teksty słuchane i czytane o tematyce ogólnej i naukowo-technicznej związanej z dziedziną nauki i dyscyplinami naukowymi właściwymi dla studiowanego kierunku studiów.	P6U_U	P6S_UK P6S_UU	
KMBM _U30	Dysponuje wystarczającym zakresem środowiskowym języków, aby stosunkowo bezbłędnie wypowiadać się (ustnie i pisemnie), formułować i uzasadniać opinie, wyjaśniać swoje stanowisko, przedstawiać wady i zalety różnych rozwiązań, uczestniczyć w dyskusji i prezentować tematykę ogólną i naukowo-techniczną (np. przygotować i wygłosić prezentację o realizacji zadania projektowego lub badawczego).	P6U_U	P6S_UK, P6S_UW	P6S_UW_inż.
KMBM _U31	potrafi samodzielnie zrealizować pracę dyplomową inżynierską, w tym: pozyskać informację z literatury, baz danych oraz innych źródeł, potrafi integrować pozyskane informacje, dokonywać ich interpretacji a także wyciągać wnioski oraz formułować i uzasadniać opinie, potrafi wykorzystać do formułowania i rozwiązywania problemów metody analityczne, symulacyjne i eksperymentalne	P6U_U	P6S_UW P6S_UK P6S_UO P6S_UU	P6S_UW_inż.
KOMPETENCJE SPOŁECZNE (K)				
KMBM _K01	rozumie potrzebę i zna możliwości ciągłego dokształcania się (studia II i III stopnia, studia podyplomowe, kursy) - podnoszenia kompetencji zawodowych, osobistych i społecznych	P6U_K	P6S_KK	
KMBM _K02	ma świadomość ważności i zrozumienie pozatechnicznych aspektów i skutków działalności inżyniera mechanika, w tym jej wpływu na środowisko i związanej z tym odpowiedzialności za podejmowane decyzje	P6U_K	P6S_KR	
KMBM _K03	ma świadomość ważności zachowania w sposób profesjonalny, prawidłowo definiuje i rozstrzyga dylematy, przestrzega zasady etyki zawodowej i poszanowania różnorodności poglądów i kultur	P6U_K	P6S_KR	
KMBM _K04	ma świadomość odpowiedzialności za pracę własną oraz gotowość podporządkowania się zasadom pracy w zespole i ponoszenia odpowiedzialności za wspólnie realizowane zadania, prawidłowo ocenia priorytety zadań własnych i grupowych	P6U_K	P6S_KO	
KMBM _K05	potrafi myśleć i działać w sposób przedsiębiorczy	P6U_K	P6S_KO	
KMBM _K06	ma świadomość roli społecznej absolwenta uczelni technicznej, rozumie potrzebę przekazywania społeczeństwu informacji i opinii dotyczących rozwoju segmentu budowy maszyn i innych aspektów działalności inżyniera; podejmuje starania, aby przekazać takie informacje i opnie w sposób powszechnie zrozumiały	P6U_K	P6S_KR	

KMBM _K07	ma przekonanie, że świadome i systematyczne uprawianie różnych form aktywności ruchowych, w czasie studiów oraz po ich zakończeniu, prowadzi do poprawy jakości życia	P6U_K	P6S_KO	
KMBM _K08	ma świadomość ważności i zrozumienie humanistycznych aspektów i skutków działalności inżynierskiej; poznaje skutki wpływu działalności technicznej na środowisko, i związaną z tym odpowiedzialnością społeczną nauki i techniki	P6U_K	P6S_KO	
KMBM _K09	prawidłowo identyfikuje i rozstrzyga dylematy związane z wykonywaniem zawodu; ma świadomość roli społecznej absolwenta uczelni technicznej; rozumie potrzebę formułowania i przekazywania społeczeństwu informacji i opinii dotyczących osiągnięć techniki i innych aspektów działalności inżyniera; potrafi przekazać taką informację i opinie w sposób zrozumiały, z uzasadnieniem różnych punktów widzenia	P6U_K	P6S_KR	
KMBM _K10	rozumie prawne aspekty i skutki działalności inżynierskiej	P6U_K	P6S_KO	
KMBM _K11	rozumie idee normalizacji, certyfikacji i integracji systemów zarządzania jakością, ochroną środowiska, bezpieczeństwem pracy i bezpieczeństwem informacji; rozumie koncepcję zarządzania przez jakość; identyfikuje podstawowe problemy zarządzania jakością, w tym kosztów jakości oraz zasady ich rozwiązywania; zna ogólne zasady tworzenia i rozwoju form indywidualnej przedsiębiorczości	P6U_K	P6S_KO	
KMBM _K12	rozumie znaczenie wykorzystywania metod matematycznych w reprezentowanej dyscyplinie inżynierskiej	P6U_K	P6S_KR	
KMBM _K13	potrafi krytycznie oceniać własną wiedzę oraz prawidłowo weryfikuje docierające informacji	P6U_K	P6S_KK	

Zal. nr 4 do ZW 121/2020 Zal. nr 2 do Programu studiów

OPIS PROGRAMU STUDIÓW

Kierunek studiów: MECHANIKA i BUDOWA MASZYN
specjalność: konstrukcja maszyn, urządzeń i pojazdów
Poziom studiów: studia I stopnia

Profil: ogólnoakademicki
Forma studiów: stacjonarna

1. Opis ogólny

1.1 Liczba semestrów: **7**	1.2 Całkowita liczba punktów ECTS konieczna do ukończenia studiów na danym poziomie: **210**
1.3 Łączna liczba godzin zajęć: **2550**	1.4 Wymagania wstępne (w szczególności w przypadku studiów drugiego stopnia): Podstawą decyzji o przyjęciu na studia jest WSKAŹNIK REKRUTACYJNY. O jego wartości decydują wybrane wyniki egzaminu dojrzałości. WSKAŹNIK REKRUTACYJNY jest sumą punktów z przedmiotów kwalifikacyjnych (matematyka, fizyka, język polski, język obcy nowożytny), obliczanym zgodnie z uchwalonymi przez Senat zasadami przyjęć kandydatów. Wartość progowa wskaźnika rekrutacyjnego ustalana jest w zależności od liczby kandydatów.
1.5 Tytuł zawodowy nadawany po zakończeniu studiów: **inżynier**	1.6 Sylwetka absolwenta, możliwości zatrudnienia: Sylwetka absolwenta, możliwości zatrudnienia: Absolwenci studiów pierwszego stopnia posiadają podstawową wiedzę i umiejętności konieczne do zrozumienia zagadnień z zakresu budowy, wytwarzania i eksploatacji maszyn. Posiadają gruntowną znajomość zasad mechaniki oraz projektowania z wykorzystaniem nowoczesnych narzędzi obliczeniowych. Absolwenci są przygotowani do: (1) realizacji procesów wytwarzania, montażu i eksploatacji maszyn, (2) prac wspomagających projektowanie maszyn, dobór materiałów inżynierskich stosowanych jako elementy maszyn oraz nadzór nad ich eksploatacją, (3) pracy w zespole, (4) koordynacji prac i oceny ich wyników, (5) sprawnego posługiwania się nowoczesnymi technikami komputerowymi. Absolwenci studiów powinni znać język obcy na poziomie biegłości B2 Europejskiego Systemu Opisu Kształcenia Językowego Rady Europy oraz posiadać umiejętności posługiwania się językiem specjalistycznym z zakresu kierunku kształcenia. Absolwenci powinni być przygotowani do podjęcia studiów drugiego stopnia. Absolwenci są przygotowani do pracy w: (1) przedsiębiorstwach przemysłu maszynowego oraz w innych zajmujących się wytwarzaniem i eksploatacją maszyn, (2) jednostkach projektowych, konstrukcyjnych i technologicznych oraz związanych z organizacją produkcji i automatyzacją procesów technologicznych, (3) jednostkach odbioru technicznego produktów i materiałów, jednostkach akredytacyjnych i atestacyjnych, (4) jednostkach naukowo-badawczych i konsultingowych oraz (5) innych jednostkach gospodarczych, administracyjnych i edukacyjnych wymagających wiedzy technicznej i informatycznej.
1.7 Możliwość kontynuacji studiów: **możliwość ubiegania się o przyjęcie na studia drugiego stopnia i studia podyplomowe**	1.8 Wskazanie związku z misją Uczelni i strategia jej rozwoju: Wydział Mechaniczny Politechniki Wrocławskiej posiada misję, która zawarta jest na stronie Wydziału Mechanicznego (https://wm.pwr.edu.pl/o-wydziale/misja-wydzialu). Jest ona zgodna z misją i strategia Politechniki Wrocławskiej. Misja Wydziału wyraźnie odnosi się dydaktyki oferowanej na Wydziale: „Przewodzenie w rozwoju cywilizacji technicznej, odkrywanie i przekazywanie wiedzy w obszarze inżynierii mechanicznej, poprzez kształcenie uniwersyteckie oparte na zaawansowanych badaniach naukowych, rozwoju wiedzy oraz transferze nowych technologii i wdrożeniach przemysłowych”. Plany i programy studiów dyskutowane są z Radą Społeczną Wydziału Mechanicznego (https://wm.pwr.edu.pl/o-wydziale/wladze/rada-spoleczna) jako głosu otoczenia społeczno-gospodarczego. Ma to na celu powiązanie misji i strategii Uczelni i Wydziału z potrzebami otoczenia społeczno-gospodarczego, by sprostać wymaganiom stawianym specjalistom w zakresie Mechaniki i Budowy Maszyn. Wyraźnym przesłaniem zgodnym z misją i strategią uczelni jest, by nasz student zdobył wiedzę, która będzie mogła zaowocować nie tylko sukcesami w przyszłym życiu zawodowym, ale również ma na celu ukształtować człowieka ze zmysłem przedsiębiorcy, twórczego i otwartego na nowe wyzwania.

2. Opis szczegółowy

2.1 Całkowita liczba efektów uczenia się w programie studiów: W (wiedza)= 21, U (umiejętności)= 31, K (kompetencje)= 13, W+U+K= 65

2.2 Dla kierunku studiów przyporządkowanego do więcej niż jednej dyscypliny - liczba efektów uczenia się przypisana do dyscypliny:
D1 (wiodąca)…., D2….., D3….., D4…..

2.3 Dla kierunku studiów przyporządkowanego do więcej niż jednej dyscypliny - procentowy udział liczby punktów ECTS dla każdej z dyscyplin:
D1…..% punktów ECTS, D2…..% punktów ECTS, D3…..% punktów ECTS, D4…..% punktów ECTS

2.4a. Dla kierunku studiów o profilu ogólnoakademickim - liczba punktów ECTS przypisana zajęciom związanym z prowadzoną w Uczelni działalnością naukową w dyscyplinie lub dyscyplinach, do których przyporządkowany jest kierunek studiów (*musi być większa niż 50% całkowitej liczby punktów ECTS z p.1.2*).....

162

2.4b. Dla kierunku studiów o profilu praktycznym - liczba punktów ECTS przypisana zajęciom kształtującym umiejętności praktyczne (*musi być większa niż 50% całkowitej liczby punktów ECTS z p.1.2*).....

2.5 Zwięzła analiza zgodności zakładanych efektów uczenia się z potrzebami rynku pracy

Efekty uczenia odnoszą się nie tylko do mechaniki i budowy maszyn ale również ze względu na wymagania nowoczesnego przemysłu do mechaniki, automatyki i robotyki, mechatroniki oraz informatyki i technologii informatycznych. Uzyskanie zakładanych efektów uczenia się pozwoli absolwentowi na znalezienie atrakcyjnej i ciekawej pracy we wszystkich gałęziach przemysłu, jak również na uruchomienie własnej działalności gospodarczej. Prace nad efektami uczenia się były referowane i dyskutowane na zebraniach Konwentu Wydziału Mechanicznego, w skład którego wchodzą między innymi przedstawiciele zakładów przemysłowych z Polski, ze szczególnym uwzględnieniem Dolnego Śląska i województw sąsiednich.

2.6 Łączna liczba punktów ECTS, którą student musi uzyskać na zajęciach wymagających bezpośredniego udziału nauczycieli akademickich lub innych osób prowadzących zajęcia (wpisać sumę punktów ECTS dla kursów/ grup kursów oznaczonych kodem BU[1], przy czym dla studiów stacjonarnych liczba ta musi być większa niż 50 % całkowitej liczby punktów ECTS z p. 1.2)

134,8 ECTS

2.7 Łączna liczba punktów ECTS, którą student musi uzyskać w ramach zajęć z zakresu nauk podstawowych

Liczba punktów ECTS z przedmiotów obowiązkowych	**65**
Liczba punktów ECTS z przedmiotów wybieralnych	**0**
Łączna liczba punktów ECTS	**65**

2.8 Łączna liczba punktów ECTS, którą student musi uzyskać w ramach zajęć o charakterze praktycznym, w tym zajęć laboratoryjnych i projektowych (wpisać sumę punktów ECTS kursów/grup kursów oznaczonych kodem P)

Liczba punktów ECTS z przedmiotów obowiązkowych	**66**
Liczba punktów ECTS z przedmiotów wybieralnych	**43**
Łączna liczba punktów ECTS	**109**

2.9 Minimalna liczba punktów ECTS, którą student musi uzyskać, realizując bloki kształcenia oferowane na zajęciach ogólnouczelnianych lub na innym kierunku studiów (wpisać sumę punktów ECTS kursów/grup kursów oznaczonych kodem O)

31 ECTS

2.10 Łączna liczba punktów ECTS, którą student może uzyskać, realizując bloki wybieralne (min. 30 % całkowitej liczby punktów ECTS)

65 ECTS

3. Opis procesu prowadzącego do uzyskania efektów uczenia się:

* Student rozpoczynający zajęcia posiada odpowiedni poziom wiedzy i umiejętności stanowiący wymagania wstępne.
* Student uczestniczy w zajęciach zorganizowanych na uczelni
* Student realizuje prace projektowe, laboratoryjne, obliczeniowe, analizy, prezentacje, studiuje literaturę i zalecane materiały.
* Student uczestniczy w sprawdzianach wiedzy i umiejętności, zapoznaje się z prawidłowymi odpowiedziami, ocenami i uwagami prowadzącego.
* Student w ramach wyszczególnionych przedmiotów uczy się pracy grupowej.
* Student jest zachęcany do angażowanie się w pracę kół naukowych.
* Student uczestniczy w spotkaniach z przedsiębiorcami, wycieczkach technicznych, targach pracy.

4. Lista bloków zajęć:

4.1. Lista bloków zajęć obowiązkowych:

4.1.1 Lista bloków kształcenia ogólnego

4.1.1.1 Blok Przedmioty humanistyczno-menedżerskie (min. 2 pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI0061W	Podstawy zarządzania	1					KMBM _W16, KMBM_K02, KMBM_K04, KMBM_K05, KMBM_K09, KMBM_K11	15	30	1		0,6	T	z				KO
2.	W10MBM-SI0102W	Zarządzanie w produkcji	1					KMBM _W16	15	30	1		0,6	T	z				KO
		Razem	**2**	**0**	**0**	**0**	**0**		**30**	**60**	**2**	**0**	**1,2**						

4.1.1.2 Blok Języki obce (min. ...... pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
		Razem	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**						

4.1.1.3 Blok Zajęcia sportowe (0 pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
		Razem	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**						

4.1.1.4 Technologie informacyjne (min. 2 pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI0064W	Technologie informacyjne	2					KMBM _W04	30	60	2		1,2	T	z				PD
		Razem	**2**	**0**	**0**	**0**	**0**		**30**	**60**	**2**	**0**	**1,2**						

Razem dla bloków kształcenia ogólnego

Łączna liczba godzin						Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN[5]	Liczba punktów ECTS zajęć BU[1]
w	ć	l	p	s						
4	**0**	**0**	**0**	**0**		**60**	**120**	**4**	**0**	**2,4**

4.1.2 Lista bloków z zakresu nauk podstawowych

4.1.2.1 Blok Matematyka

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W13MBM-SI0004W	Algebra liniowa z geometrią analityczną B	2					KMBM_W01	30	50	2		1,5	T	E	O			PD
2.	W13MBM-SI0004C	Algebra liniowa z geometrią analityczną B		1				KMBM_U01, KMBM_K12	15	50	2		0,7	T	z	O		P	PD
3.	W13MBM-SI0005W	Analiza matematyczna 1A	2					KMBM_W01	30	125	5		1,5	T	E	O			PD
4.	W13MBM-SI0005C	Analiza matematyczna 1A		2				KMBM_U01, KMBM_K12	30	75	3		1,5	T	z	O		P	PD
5.	W13MBM-SI0006W	Elementy analizy matematycznej 2	1					KMBM_W01	15	50	2		0,7	T	E	O			PD
6.	W13MBM-SI0006C	Elementy analizy matematycznej 2		1				KMBM_U01, KMBM_K12	15	50	2		0,7	T	z	O		P	PD
7.	W10MBM-SI0082W	Statystyka inżynierska	1					KMBM _W01	15	30	1		0,6	T	z				PD
8.	W10MBM-SI0082P	Statystyka inżynierska				1		KMBM _U01, KMBM _K04, KMBM_K12	15	30	1		0,7	T	z			P	PD
9.	W10MBM-SI0077W	Równania różniczkowe zwyczajne	1					KMBM _W01	15	30	1		0,6	T	z				PD
10.	W10MBM-SI0077C	Równania różniczkowe zwyczajne		1				KMBM _U01, KMBM_K03, KMBM_K04, KMBM_K12	15	30	1		0,7	T	z			P	PD
		Razem	**7**	**5**	**0**	**1**	**0**		**195**	**520**	**20**	**0**	**9,2**						

4.1.2.2 Blok Fizyka

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W11MBM-SI0002W	Fizyka 1A	2					KMBM_W02, KMBM_K13	30	75	3		1,5	T	E	O			PD
2.	W11MBM-SI0002C	Fizyka 1A		1				KMBM_U02, KMBM_K13	15	50	2		1,4	T	z	O		P	PD
3.	W11MBM-SI0003L	Laboratorium podstaw fizyki			1			KMBM_U03, KMBM_K13	15	50	2		1,4	T	z	O		P	PD
		Razem	**2**	**1**	**1**	**0**	**0**		**60**	**175**	**7**	**0**	**4,3**						

4.1.2.3 Blok Chemia

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI0066W	Chemia	2					KMBM _W03	30	60	2		1,2	T	z				PD
		Razem	**2**	**0**	**0**	**0**	**0**		**30**	**60**	**2**	**0**	**1,2**						

4.1.2.4 Blok przedmioty podstawowe

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI0065W	Grafika inżynierska - geometria wykreślna	1					KMBM _W05	15	30	1		0,6	T	z				PD
2.	W10MBM-SI0065C	Grafika inżynierska - geometria wykreślna		2				KMBM _U04	30	60	2		1,4	T	z			P	PD
3.	W10MBM-SI0069W	Termodynamika techniczna	2					KMBM _W19	30	60	2	2	1,2	T	z		DN		PD
4.	W10MBM-SI0069L	Termodynamika techniczna			1			KMBM _U10, KMBM _K01, KMBM _K02, KMBM _K06	15	60	2	2	1,4	T	z		DN	P	PD
5.	W10MBM-SI0071W	Grafika inżynierska - zapis konstrukcji	1					KMBM _W06	15	30	1	1	0,6	T	z		DN		PD
6.	W10MBM-SI0071P	Grafika inżynierska - zapis konstrukcji				2		KMBM _U05	30	60	2	2	1,4	T	z		DN	P	PD
7.	W10MBM-SI0072W	Podstawy materiałoznawstwa	2					KMBM _W07	30	60	2	2	1,2	T	z		DN		PD
8.	W10MBM-SI0072L	Podstawy materiałoznawstwa			1			KMBM _U06	15	30	1	1	0,7	T	z		DN	P	PD
9.	W10MBM-SI0073W	Mechanika I	2					KMBM _W08	30	60	2	2	1,2	T	z		DN		PD
10.	W10MBM-SI0073C	Mechanika I		2				KMBM _U07	30	60	2	2	1,4	T	z		DN	P	PD
11.	W10MBM-SI0076W	Materiałoznawstwo	2					KMBM _W07	30	90	3	3	1,8	T	E		DN		PD
12.	W10MBM-SI0076L	Materiałoznawstwo			1			KMBM _U06	15	60	2	2	1,4	T	z		DN	P	PD
13.	W10MBM-SI0083W	Mechanika II	2					KMBM _W08	30	60	2	2	1,2	T	E		DN		PD
14.	W10MBM-SI0083C	Mechanika II		2				KMBM _U07	30	60	2	2	1,4	T	z		DN	P	PD
15.	W10MBM-SI0091W	Metrologia wielkości geometrycznych	1					KMBM _W10	15	30	1	1	0,6	T	z		DN		PD
16.	W10MBM-SI0091L	Metrologia wielkości geometrycznych			1			KMBM _U09	15	30	1	1	0,7	T	z		DN	P	PD
17.	W10MBM-SI0081W	Podstawy wytrzymałości materiałów	2					KMBM _W09	30	60	2	2	1,2	T	z		DN		PD
18.	W10MBM-SI0081C	Podstawy wytrzymałości materiałów		1				KMBM _U08	15	30	1	1	0,7	T	z		DN	P	PD
19.	W10MBM-SI0089W	Wytrzymałość materiałów	2					KMBM _W09	30	60	2	2	1,2	T	E		DN		PD

20.	W10MBM-SI0089C	Wytrzymałość materiałów		1				KMBM _U08, KMBM_U07, KMBM _K01, KMBM _K03	15	60	2	2	1,4	T	z		DN	P	PD
21.	W10MBM-SI0105L	Podstawy wytrzymałości materiałów			1			KMBM _U08	15	30	1	1	0,7	T	z		DN	P	PD
		Razem	**17**	**8**	**5**	**2**	**0**		**480**	**1080**	**36**	**33**	**23,4**						

Razem dla bloków z zakresu nauk podstawowych

Łączna liczba godzin						Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN[5]	Liczba punktów ECTS zajęć BU[1]
w	ć	l	p	s						
28	**14**	**6**	**3**	**0**		**765**	**1835**	**65**	**33**	**38,1**

4.1.3 Lista bloków kierunkowych

4.1.3.1 Blok Przedmioty obowiązkowe kierunkowe

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI0063W	Podstawy metrologii	1					KMBM _W10, KMBM _K04	15	30	1		0,6	T	z				K
2.	W10MBM-SI0062W	Ergonomia i BHP	1					KMBM _W17, KMBM _K02, KMBM_K03	15	30	1		0,6	T	z				KO
3.	W10MBM-SI0070W	Ekologia	1					KMBM _W17, KMBM_W18, KMBM_K08, KMBM_K10, KMBM_K11	15	30	1		0,6	T	z				K
4.	W10MBM-SI0068W	Technologia materiałów inżynierskich	1					KMBM _W07	15	60	2	2	1,2	T	z		DN		K
5.	W10MBM-SI0068L	Technologia materiałów inżynierskich			1			KMBM _U06, KMBM _K04	15	60	2	2	1,4	T	z		DN	P	K
6.	W10MBM-SI0067W	Maszynoznawstwo	1					KMBM_W13	15	30	1	1	0,6	T	z		DN		K
7.	W05MBM-SI0003W	Elektrotechnika	2					KMBM _W12	30	60	2		1,2	T	z				K
8.	W12MBM-SI0002W	Elektronika	2					KMBM_W12, KMBM _K04	30	60	2		1,2	T	z				K
9.	W10MBM-SI0074P	Grafika inżynierska 3D				2		KMBM _U05, KMBM _K04	30	60	2	2	1,4	T	z		DN	P	K
10.	W05MBM-SI0004L	Elektrotechnika			1			KMBM _U16, KMBM _K04	15	30	1		0,7	T	z			P	K
11.	W10MBM-SI0075W	Mechanika płynów	2					KMBM _W08, KMBM _W02	30	60	2	2	1,2	T	z		DN		K
12.	W10MBM-SI0075C	Mechanika płynów		1				KMBM _U15, KMBM _U02	15	30	1	1	0,7	T	z		DN	P	K
13.	W10MBM-SI0078W	Tworzywa sztuczne	2					KMBM _W07, KMBM_W20	30	60	2	2	1,2	T	z		DN		K
14.	W10MBM-SI0078L	Tworzywa sztuczne			1			KMBM _U06, KMBM_U20, KMBM _K09	15	30	1	1	0,7	T	z		DN	P	K
15.	W10MBM-SI0080W	Techniki wytwarzania - odlewnictwo	1					KMBM _W20	15	60	2	2	1,2	T	z		DN		K
16.	W10MBM-SI0080L	Techniki wytwarzania - odlewnictwo			1			KMBM _U20, KMBM _K01, KMBM _K04, KMBM _K06	15	30	1	1	0,7	T	z		DN	P	K
17.	W10MBM-SI0079P	Informatyka podstawy programowania (Matlab)				2		KMBM _U17, KMBM _K04	30	60	2		1,4	T	z			P	K
18.	W10MBM-SI0085W	Podstawy konstrukcji maszyn I	2					KMBM _W13	30	90	3	3	1,8	T	E		DN		K
19.	W10MBM-SI0085L	Podstawy konstrukcji maszyn I			1			KMBM _U18, KMBM _U08, KMBM _U23, KMBM _K10	15	60	2	2	1,4	T	z		DN	P	K
20.	W10MBM-SI0085P	Podstawy konstrukcji maszyn I				2		KMBM _U18, KMBM _U08, KMBM _U23, KMBM _K10	30	60	2	2	1,4	T	z		DN	P	K
21.	W10MBM-SI0086W	Teoria mechanizmów i manipulatorów	2					KMBM _W15, KMBM_W08	30	60	2	2	1,2	T	E		DN		K
22.	W10MBM-SI0086P	Teoria mechanizmów i manipulatorów				2		KMBM _U07, KMBM_U14, KMBM _K04	30	90	3	3	2,1	T	z		DN	P	K
23.	W10MBM-SI0088W	Techniki wytwarzania - przeróbka plastyczna	1					KMBM _W20	15	60	2	2	1,2	T	z		DN		K
24.	W10MBM-SI0088L	Techniki wytwarzania - przeróbka plastyczna			1			KMBM _U20, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
25.	W10MBM-SI0087W	Techniki wytwarzania - spawalnictwo	1					KMBM _W20	15	60	2	2	1,2	T	z		DN		K
26.	W10MBM-SI0087L	Techniki wytwarzania - spawalnictwo			1			KMBM _U20, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
27.	W10MBM-SI0090W	Układy napędowe pojazdów	1					KMBM _W14	15	30	1	1	0,6	T	z		DN		K
28.	W10MBM-SI0090L	Układy napędowe pojazdów			1			KMBM _U27, KMBM _U19, KMBM _K02, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
29.	W10MBM-SI0084W	Metrologia przemysłowa			1			KMBM _U09, KMBM_U13, KMBM _K01, KMBM _K03	15	30	1	1	0,7	T	z		DN	P	K
30.	W10MBM-SI0092W	Hydrostatyczne układy napędowe	1					KMBM _W13	15	30	1	1	0,6	T	z		DN		K
31.	W10MBM-SI0092L	Hydrostatyczne układy napędowe			1			KMBM _U14, KMBM_K09	15	30	1	1	0,7	T	z		DN	P	K
32.	W10MBM-SI0093W	Metoda elementów skończonych	1					KMBM _W20, KMBM _W13, KMBM_W09	15	30	1	1	0,6	T	z		DN		K
33.	W10MBM-SI0093P	Metoda elementów skończonych				2		KMBM _U17, KMBM _U08, KMBM_K02	30	60	2	2	1,4	T	z		DN	P	K
34.	W10MBM-SI0094W	Podstawy konstrukcji maszyn II	2					KMBM _W13	30	60	2	2	1,2	T	E		DN		K
35.	W10MBM-SI0094P	Podstawy konstrukcji maszyn II				2		KMBM _U18, KMBM _U08, KMBM _K02, KMBM _K03, KMBM _K05, KMBM _K11	30	90	3	3	2,1	T	z		DN	P	K
36.	W10MBM-SI0095W	Podstawy automatyki	2					KMBM _W01, KMBM _W12	30	60	2	2	1,2	T	E		DN		K
37.	W10MBM-SI0095L	Podstawy automatyki			2			KMBM _U19, KMBM_K05	30	60	2	2	1,4	T	z		DN	P	K
38.	W10MBM-SI0096W	Techniki wytwarzania - obróbka ubytkowa	3					KMBM _W20, KMBM _W13, KMBM_W09	45	60	2	2	1,2	T	E		DN		K
39.	W10MBM-SI0096L	Techniki wytwarzania - obróbka ubytkowa			2			KMBM _U20, KMBM _U17, KMBM _K04	30	60	2	2	1,4	T	z		DN	P	K
40.	W10MBM-SI0097W	Bezpieczeństwo maszyn i procesów technologicznych	1					KMBM _W21	15	60	2	2	1,2	T	E		DN		K
41.	W10MBM-SI0097S	Bezpieczeństwo maszyn i procesów technologicznych					1	KMBM _U21, KMBM_U26	15	30	1	1	0,7	T	z		DN	P	K
42.	W10MBM-SI0098W	Maszyny technologiczne CNC i roboty	1					KMBM _W20	15	30	1	1	0,6	T	z		DN		K
43.	W10MBM-SI0098L	Maszyny technologiczne CNC i roboty			1			KMBM _U20, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
44.	W10MBM-SI0098P	Maszyny technologiczne CNC i roboty				1		KMBM _U20, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
45.	W10MBM-SI0101W	Podstawy eksploatacji i remontów maszyn	2					KMBM _W20, KMBM _W21	30	60	2	2	1,2	T	z		DN		K
46.	W10MBM-SI0101L	Podstawy eksploatacji i remontów maszyn			1			KMBM _U21, KMBM_U27, KMBM _K02, KMBM _K05, KMBM _K10, KMBM _K11	15	30	1	1	0,7	T	z		DN	P	K
47.	W10MBM-SI0100W	Podstawy organizacji produkcji	2					KMBM _W16	30	60	2		1,2	T	z				K
		Razem	**36**	**1**	**16**	**13**	**1**		**1005**	**2280**	**76**	**64**	**49,1**						

Razem dla bloków kierunkowych

Łączna liczba godzin				
w	ć	l	p	s
36	**1**	**16**	**13**	**1**

Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN[5]	Liczba punktów ECTS zajęć BU[1]
1005	**2280**	**76**	**64**	**49,1**

4.2. Lista bloków wybieralnych:

4.2.1 Lista bloków kształcenia ogólnego

4.2.1.1 Blok Przedmioty humanistyczno-menedżerskie (min. 3 pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2]kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	MBM-SI1W-0001	**BLOK HUMANISTYCZNY**	2					KMBM_W18, KMBM_K08, KMBM_K09	30	60	2		1,2	T	z	O			KO
	W08MBM-SI0002W	Wstęp do filozofii	2																
	W10MBM-SI0103W	Technika wojskowa w konfliktach zbrojnych	2																
2.	MBM-SI2W-0001	**BLOK HUMANISTYCZNY:**	1					KMBM _W11, KMBM_K10	15	30	1		0,6	T	z	O			KO
	W10MBM-SI0104W	Ochrona własności intelektualnej	1																
	W08MBM-SI0003W	Prawo wynalazcze i autorskie	1																
		Razem	**3**	**0**	**0**	**0**	**0**		**45**	**90**	**3**	**0**	**1,8**						

4.2.1.2 Blok Języki obce (min. 5 pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2]kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	SJO-SI0001	Języki obce A1/A2/B1/B2.1/C1.1		4				KMBM_U11, KMBM_U24,KMBM_U28, KMBM_U29, KMBM_K06	60	60	2		2	T	z	O		P	KO
2.	SJO-SI0002	Języki obce B2.2/C1.2		4				KMBM_U11, KMBM_U24,KMBM_U28, KMBM_U29, KMBM_K06, KMBM_K07	60	90	3		2,5	T	z	O		P	KO
		Razem	**0**	**8**	**0**	**0**	**0**		**120**	**150**	**5**	**0**	**4,5**						

4.2.1.3 Blok Zajęcia sportowe (min. 0 pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2]kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	SWF-S00001	Zajęcia sportowe		2				KMBM _K07	30	0	0		0	T	z	O		P	KO
2.	SWF-S00001	Zajęcia sportowe		2				KMBM _K07	30	0	0		0	T	z	O		P	KO
		Razem	**0**	**4**	**0**	**0**	**0**		**60**	**0**	**0**		**0**						

4.2.1.4 Technologie informacyjne (min. ...... pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2]kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
		Razem	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**						

Razem dla bloków kształcenia ogólnego

Łączna liczba godzin					Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN[5]	Liczba punktów ECTS zajęć BU[1]
w	ć	l	p	s					
3	**12**	**0**	**0**	**0**	**225**	**240**	**8**	**0**	**6,3**

4.2.2 Lista bloków z zakresu nauk podstawowych

4.2.2.1 Blok Matematyka (min. ...... pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
		Razem	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**						

4.2.2.2 Blok Fizyka (min. ...... pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
		Razem	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**						

4.2.2.3 Blok Chemia (min. ...... pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
		Razem	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**						

Razem dla bloków z zakresu nauk podstawowych

Łączna liczba godzin						Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN[5]	Liczba punktów ECTS zajęć BU[1]
w	ć	l	p	s						
0	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**

4.2.3 Lista bloków kierunkowych

4.2.3.1 Blok Programowanie, modelowanie numeryczne

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	**MBM-SI5W-0001**	**BLOK WYBIERALNY:**				1		KMBM_U17, KMBM_K04	15	30	1	1	0,7	T	z		DN	P	S
	W10MBM-SI106P	Analiza MES w zastosowaniach silnie nieliniowych w pakiecie MSC.MARC				1													
	W10MBM-SI107P	Grafika inżynierska 3D-SolidWorks				1													
	W10MBM-SI108P	Inspekcja wymiarowo-kształtowa 3D z wykorzystaniem programów GOM Inspect i Solidworks				1													
	W10MBM-SI109P	Komputerowo wspomagane wytwarzanie w systemie CAD-CAM				1													
	W10MBM-SI110P	Modelowanie bryłowe i powierzchniowe w systemie CATIA				1													
	W10MBM-SI111P	Modelowanie numeryczne				1													
	W10MBM-SI112P	Obliczenia inżynierskie z użyciem arkusza kalkulacyjnego				1													
	W10MBM-SI113P	Podstawy modelowania geometrii i generowanie dokumentacji z wykorzystaniem oprogramowanie PTC Creo Parametric				1													
	W10MBM-SI114P	Programowanie obróbki szybkościowej w programie Inventor HSM				1													
	W10MBM-SI115P	Projektowanie form wtryskowych i odlewniczych w programie Solidworks				1													
	W10MBM-SI116P	Projektowanie zespołów maszyn roboczych w systemach CAD (Inventor, AutoCAD)				1													
	W10MBM-SI117P	Rozwiązywanie zagadanień mechaniki w systemie ABAQUS				1													
	W10MBM-SI118P	Techniki projektowania - SolidWorks				1													
	W10MBM-SI119P	Tworzenie dokumentacji technicznej w programie Solidworks				1													
	W10MBM-SI120P	Zaawansowane funkcje i programowanie w Microsoft Excel				1													
	W10MBM-SI121P	Zaawansowane metody modelowania i analizy w systemach CAD/FEM				1													
	W10MBM-SI122P	Zarządzanie konfiguracjami i budowanie sparametryzowanych bibliotej danych CAD z wykorzystaniem programów Solidworks i Microsoft Excel				1													
	W10MBM-SI123P	Zaawansowane wspomaganie wytwarzania w systemie CATIA				1													
	W10MBM-SI124P	Komputerowa analiza danych pomiarowych				1													
		Razem	**0**	**0**	**0**	**1**	**0**		**15**	**30**	**1**	**1**	**0,7**						

Razem dla bloków kierunkowych

Łączna liczba godzin				
w	ć	l	p	s
0	**0**	**0**	**1**	**0**

Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN[5]	Liczba punktów ECTS zajęć BU[1]
15	**30**	**1**	**1**	**0,7**

4.2.4 Lista bloków specjalnościowych

4.2.4.1 Blok Przedmioty specjalnościowe (min. 41 pkt ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI1012W	Budowa pojazdów samochodowych	2					KMBM _W13	30	90	3	3	1,8	T	z		DN		S
2.	W10MBM-SI1013W	Podstawy tribologii	1					KMBM _W07, KMBM_W20	15	60	2	2	1,2	T	z		DN		S
3.	W10MBM-SI1013L	Podstawy tribologii			1			KMBM _U01, KMBM _U03, KMBM _K02, KMBM _K03, KMBM _K04	15	60	2	2	1,4	T	z		DN	P	S
4.	W10MBM-SI1011P	Modelowanie komputerowe w projektowaniu I				1		KMBM_U08, KMBM _U14, KMBM _U17, KMBM_U18, KMBM_U27, KMBM _K04, KMBM _K05	15	30	1	1	0,7	T	z		DN	P	S
5.	W10MBM-SI1019P	Wstęp do pracy dyplomowej				1		KMBM _U01, KMBM _U02, KMBM _U22, KMBM _U25, KMBM _U28, KMBM _U31, KMBM _K03, KMBM _K04, KMBM _K05	15	90	3		2,1	T	z			P	S
6.	W10MBM-SI1016W	Inżynieria pojazdów przemysłowych	2					KMBM _W01, KMBM _W14	30	60	2	2	1,2	T	z		DN		S
7.	W10MBM-SI1016L	Inżynieria pojazdów przemysłowych			2			KMBM _U01, KMBM_U27	30	60	2	2	1,4	T	z		DN	P	S
8.	W10MBM-SI1016P	Inżynieria pojazdów przemysłowych				1		KMBM _U01, KMBM_U27, KMBM _K01, KMBM _K04, KMBM _K10	15	30	1	1	0,7	T	z		DN	P	S
9.	W10MBM-SI1017W	Napęd hydrauliczny	2					KMBM_W14	30	60	2	2	1,2	T	E		DN		S
10.	W10MBM-SI1017L	Napęd hydrauliczny			2			KMBM_U14, KMBM _K04, KMBM _K09	30	60	2	2	1,4	T	z		DN	P	S
11.	W10MBM-SI1017P	Napęd hydrauliczny				1		KMBM_U14, KMBM _K04, KMBM _K09	15	30	1	1	0,7	T	z		DN	P	S
12.	W10MBM-SI1018W	Silniki spalinowe	1					KMBM _W13, KMBM _W14	15	30	1	1	0,6	T	z		DN		S
13.	W10MBM-SI1018L	Silniki spalinowe			1			KMBM _U27, KMBM _K01, KMBM _K02	15	30	1	1	0,7	T	z		DN	P	S
14.	W10MBM-SI1015W	Ustroje nośne	1					KMBM _W13, KMBM _W14	15	30	1	1	0,6	T	z		DN		S
15.	W10MBM-SI1015P	Ustroje nośne				2		KMBM_U18, KMBM_U14, KMBM _K04, KMBM _K05	30	60	2	2	1,4	T	z		DN	P	S
16.	W10MBM-SI1014P	Modelowanie komputerowe w projektowaniu II				2		KMBM_U08, KMBM _U14, KMBM _U17, KMBM_U18, KMBM_U27, KMBM _K04, KMBM _K05	30	90	3	3	2,1	T	z		DN	P	S
17.	W10MBM-SI1023S	Seminarium dyplomowe					1	KMBM _U22, KMBM _U28, KMBM_K01, KMBM _K02, KMBM _K05	15	30	1		0,7	T	z			P	S
18.	W10MBM-SI1022W	Projektowanie elementów z tworzyw sztucznych	2					KMBM _W20	30	90	3	3	1,8	T	z		DN		S
19.	W10MBM-SI1020W	Modelowanie obciążeń pojazdów samochodowych	1					KMBM _W20, KMBM_W21	15	60	2	2	1,2	T	z		DN		S
20.	W10MBM-SI1020P	Modelowanie obciążeń pojazdów samochodowych				1		KMBM _U18, KMBM _K01, KMBM _K05, KMBM _K09	15	60	2	2	1,4	T	z		DN	P	S
21.	W10MBM-SI1021W	Uwarunkowania prawne działalności inżyniera	1					KMBM _W18, KMBM _K01, KMBM _K05, KMBM _K09	15	30	1	1	0,6	T	z		DN		S
22.	W10MBM-SI1021P	Uwarunkowania prawne działalności inżyniera				1		KMBM _U25, KMBM _U26, KMBM _K01, KMBM _K05, KMBM _K09	15	30	1	1	0,7	T	z		DN	P	S
23.	**MBM-SI7W-KMP2**	**BLOK WYBIERALNY:**	**1**						15	60	2	2	1,2	T	z		DN		S
	W10MBM-SI1025W	Biomechanika inżynierska	1					KMBM _W09, KMBM _W08											
	W10MBM-SI1026W	Technika w medycynie	1					KMBM _W09, KMBM _W08, KMBM _K01, KMBM _K02, KMBM _K06, KMBM _K08											
		Razem	**14**	**0**	**6**	**10**	**1**		**465**	**1230**	**41**	**37**	**26,8**						

4.2.4.2 Blok Profil dyplomowania (min. …pkt ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
		Razem	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**						

Razem dla bloków specjalnościowych

Łączna liczba godzin				
w	ć	l	p	s
14	**0**	**6**	**10**	**1**

Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN[5]	Liczba punktów ECTS zajęć BU[1]
465	**1230**	**41**	**37**	**26,8**

4.3 Blok praktyk Uchwała RW 174/16/RW10/2021-2024 nt. zasad zaliczania praktyki – zał. nr 2.1 do opisu programu studiów

Nazwa praktyki				
Liczba punktów ECTS	**Liczba punktów ECTS zajęć DN[5]**	**Liczba punktów ECTS zajęć BU[1]**	**Tryb zaliczenia praktyki**	**Kod**
3	3	3	raport	W10MBM-SI0099
Czas trwania praktyki	**Cel praktyki**			
4 tygodnie	Celem praktyki jest zdobycie doświadczenia przemysłowego, zapoznanie się z podstawowym wyposażeniem technicznym i technologicznym zakładów, zapoznanie się z pracą wyższego dozoru technicznego zakładu, a w szczególności: • poszerzenie wiedzy zdobytej na studiach i rozwijanie umiejętności jej wykorzystania, • zapoznanie się ze specyfiką środowiska zawodowego, • kształtowanie konkretnych umiejętności zawodowych związanych bezpośrednio z miejscem odbywania praktyki, • kształtowanie umiejętności skutecznego komunikowania się, • poznanie zasad organizacji pracy i podziału kompetencji, procedur, procesu planowania pracy, kontroli, • doskonalenie umiejętności organizacji pracy własnej, pracy zespołowej, efektywnego zarządzania czasem, sumienności, odpowiedzialności za powierzone zadania, • doskonalenie umiejętności posługiwania się językiem obcym w sytuacjach zawodowych. Poprzez swobodny wybór miejsca odbywania praktyki, m. in. przez własny wybór „firmy", student może realizować swoje zainteresowania zawodowe. Wynikiem tego może być sformułowanie indywidualnego tematu pracy dyplomowej inżynierskiej. Pierwsza praca zawodowa odbywa się często w miejscu praktyki.			

4.4 Blok "praca dyplomowa"

Typ pracy dyplomowej	**~~licencjacka~~ / inżynierska / ~~magisterska~~**	
Liczba semestrów pracy dyplomowej	**Liczba punktów ECTS**	**Kod**
1	**12**	**W10MBM-SI1024D**
Charakter pracy dyplomowej		
Praca dyplomowa inżynierska ma charakter użyteczny dla praktyki inżynierskiej. Jej przedmiotem jest w szczególności rozwiązanie zadania z zakresu: projektowania, eksperymentu pomiarowego, opracowania programu komputerowego oraz analizy części lub całości procesów o charakterze technicznym, organizacyjno-technicznym, ekonomiczno-technicznym. Nie ma ona wyłącznie charakteru opisowego, a jest w niej widoczna część będąca wkładem własnym studenta.		
Liczba punktów ECTS BU[1]	**8,4**	
Liczba punktów ECTS DN[5]	**12**	

5. Sposoby weryfikacji zakładanych efektów uczenia się

Typ zajęć	**Sposoby weryfikacji zakładanych efektów uczenia się**
wykład	*egzamin, kolokwium, kartkówka, odpowiedź ustna, udział w dyskusji*
ćwiczenia	*test, kolokwium, ocena przygotowania projektu, kartkówka, odpowiedź ustna, sprawdzian*
laboratorium	*wejściówka, sprawozdanie z laboratorium, kartkówka, odpowiedź ustna, sprawdzian, aktywność, referat, dyskusja*
projekt	*obrona projektu, kolokwium, kartkówka, test, dyskusja problemowa, prezentacja projektu, raport, odpowiedź ustna*
seminarium	*udział w dyskusji, prezentacja tematu, aktywność, raport*
praktyka	*raport z praktyki*
praca dyplomowa	*przygotowana praca dyplomowa*

6. Zakres egzaminu dyplomowego

Egzamin dyplomowy jest egzaminem ustnym sprawdzającym wiedzę nabytą przez studenta w czasie jego studiów, w zakresie danego planu i programu studiów a szczególności kartach przedmiotów. W czasie egzaminu studentowi zadawane są 3 pytania po jednym z poszczególnych grup.
•Grupa A skupia się na przedmiotach podstawowych w obszarze tematycznym ogólnie pojętej Mechaniki, Wytrzymałości Materiałów i Materiałoznawstwa.
•Grupa B – zakresem obejmuje zagadnienia związane z konstruowaniem, czyli obszar Podstaw Konstrukcji Maszyn, Teorii Maszyn i Mechanizmów oraz Podstaw Metody Elementów Skończonych.
•Grupa C swoim zakresem obejmuje metody pomiarowe oraz procesy technologii wytwarzania, związane Mechaniką i Budową Maszyn.
Lista obowiązujących pytań (zagadnień) egzaminacyjnych jest zatwierdzana i aktualizowana przez Komisję Programową i publikowana na stronie Wydziału. Pytania zadawane na egzaminie nie mogą wykraczać poza materiał kursów realizowanych przez studenta w toku kształcenia.

7. Wymagania dotyczące terminu zaliczenia określonych kursów/grup kursów lub wszystkich kursów w poszczególnych blokach

Lp.	Kod kursu	Nazwa kursu	Termin zaliczenia do... (numer semestru)

8. Plan studiów (załącznik nr 3 do programu studiów)

Zał. nr 4 do ZW 121/2020 Zał. nr 2 do Programu studiów

OPIS PROGRAMU STUDIÓW

Kierunek studiów: MECHANIKA i BUDOWA MASZYN
specjalność: technologie i systemy wytwórcze
Poziom studiów: studia I stopnia

Profil: ogólnoakademicki
Forma studiów: stacjonarna

1. Opis ogólny

1.1 Liczba semestrów: **7**	1.2 Całkowita liczba punktów ECTS konieczna do ukończenia studiów na danym poziomie: **210**
1.3 Łączna liczba godzin zajęć: **2550**	1.4 Wymagania wstępne (w szczególności w przypadku studiów drugiego stopnia): Podstawą decyzji o przyjęciu na studia jest WSKAŹNIK REKRUTACYJNY. O jego wartości decydują wybrane wyniki egzaminu dojrzałości. WSKAŹNIK REKRUTACYJNY jest sumą punktów z przedmiotów kwalifikacyjnych (matematyka, fizyka, język polski, język obcy nowożytny), obliczanym zgodnie z uchwalonymi przez Senat zasadami przyjęć kandydatów. Wartość progowa wskaźnika rekrutacyjnego ustalana jest w zależności od liczby kandydatów.
1.5 Tytuł zawodowy nadawany po zakończeniu studiów: **inżynier**	1.6 Sylwetka absolwenta, możliwości zatrudnienia: Sylwetka absolwenta, możliwości zatrudnienia: Absolwenci studiów pierwszego stopnia posiadają podstawową wiedzę i umiejętności konieczne do zrozumienia zagadnień z zakresu budowy, wytwarzania i eksploatacji maszyn. Posiadają gruntowną znajomość zasad mechaniki oraz projektowania z wykorzystaniem nowoczesnych narzędzi obliczeniowych. Absolwenci są przygotowani do: (1) realizacji procesów wytwarzania, montażu i eksploatacji maszyn, (2) prac wspomagających projektowanie maszyn, dobór materiałów inżynierskich stosowanych jako elementy maszyn oraz nadzór nad ich eksploatacją, (3) pracy w zespole, (4) koordynacji prac i oceny ich wyników, (5) sprawnego posługiwania się nowoczesnymi technikami komputerowymi. Absolwenci studiów powinni znać język obcy na poziomie biegłości B2 Europejskiego Systemu Opisu Kształcenia Językowego Rady Europy oraz posiadać umiejętności posługiwania się językiem specjalistycznym z zakresu kierunku kształcenia. Absolwenci powinni być przygotowani do podjęcia studiów drugiego stopnia. Absolwenci są przygotowani do pracy w: (1) przedsiębiorstwach przemysłu maszynowego oraz w innych zajmujących się wytwarzaniem i eksploatacją maszyn, (2) jednostkach projektowych, konstrukcyjnych i technologicznych oraz związanych z organizacją produkcji i automatyzacją procesów technologicznych, (3) jednostkach odbioru technicznego produktów i materiałów, jednostkach akredytacyjnych i atestacyjnych, (4) jednostkach naukowo-badawczych i konsultingowych oraz (5) innych jednostkach gospodarczych, administracyjnych i edukacyjnych wymagających wiedzy technicznej i informatycznej.
1.7 Możliwość kontynuacji studiów: **możliwość ubiegania się o przyjęcie na studia drugiego stopnia i studia podyplomowe**	1.8 Wskazanie związku z misją Uczelni i strategia jej rozwoju: Wydział Mechaniczny Politechniki Wrocławskiej posiada misję, która zawarta jest na stronie Wydziału Mechanicznego (https://wm.pwr.edu.pl/o-wydziale/misja-wydzialu). Jest ona zgodna z misją i strategia Politechniki Wrocławskiej. Misja Wydziału wyraźnie odnosi się dydaktyki oferowanej na Wydziale: „Przewodzenie w rozwoju cywilizacji technicznej, odkrywanie i przekazywanie wiedzy w obszarze inżynierii mechanicznej, poprzez kształcenie uniwersyteckie oparte na zaawansowanych badaniach naukowych, rozwoju wiedzy oraz transferze nowych technologii i wdrożeniach przemysłowych". Plany i programy studiów dyskutowane są z Radą Społeczną Wydziału Mechanicznego (https://wm.pwr.edu.pl/o-wydziale/wladze/rada-spoleczna) jako głosu otoczenia społeczno-gospodarczego. Ma to na celu powiązanie misji i strategii Uczelni i Wydziału z potrzebami otoczenia społeczno-gospodarczego, by sprostać wymaganiom stawianym specjalistom w zakresie Mechaniki i Budowy Maszyn. Wyraźnym przesłaniem zgodnym z misją i strategią uczelni jest, by nasz student zdobył wiedzę, która będzie mogła zaowocować nie tylko sukcesami w przyszłym życiu zawodowym, ale również ma na celu ukształtować człowieka ze zmysłem przedsiębiorcy, twórczego i otwartego na nowe wyzwania.

2. Opis szczegółowy

2.1 Całkowita liczba efektów uczenia się w programie studiów: W (wiedza)= 21, U (umiejętności)= 31, K (kompetencje)= 13, W+U+K= 65

2.2 Dla kierunku studiów przyporządkowanego do więcej niż jednej dyscypliny - liczba efektów uczenia się przypisana do dyscypliny:
D1 (wiodąca)…., D2….., D3….., D4…..

2.3 Dla kierunku studiów przyporządkowanego do więcej niż jednej dyscypliny - procentowy udział liczby punktów ECTS dla każdej z dyscyplin:
D1…..% punktów ECTS, D2…..% punktów ECTS, D3…..% punktów ECTS, D4…..% punktów ECTS

2.4a. Dla kierunku studiów o profilu ogólnoakademickim - liczba punktów ECTS przypisana zajęciom związanym z prowadzoną w Uczelni działalnością naukową w dyscyplinie lub dyscyplinach, do których przyporządkowany jest kierunek studiów (*musi być większa niż 50% całkowitej liczby punktów ECTS z p.1.2*).....

162

2.4b. Dla kierunku studiów o profilu praktycznym - liczba punktów ECTS przypisana zajęciom kształtującym umiejętności praktyczne (*musi być większa niż 50% całkowitej liczby punktów ECTS z p.1.2*).....

2.5 Zwięzła analiza zgodności zakładanych efektów uczenia się z potrzebami rynku pracy

Efekty uczenia odnoszą się nie tylko do mechaniki i budowy maszyn ale również ze względu na wymagania nowoczesnego przemysłu do mechaniki, automatyki i robotyki, mechatroniki oraz informatyki i technologii informatycznych. Uzyskanie zakładanych efektów uczenia się pozwoli absolwentowi na znalezienie atrakcyjnej i ciekawej pracy we wszystkich gałęziach przemysłu, jak również na uruchomienie własnej działalności gospodarczej. Prace nad efektami uczenia się były referowane i dyskutowane na zebraniach Konwentu Wydziału Mechanicznego, w skład którego wchodzą między innymi przedstawiciele zakładów przemysłowych z Polski, ze szczególnym uwzględnieniem Dolnego Śląska i województw sąsiednich.

2.6 Łączna liczba punktów ECTS, którą student musi uzyskać na zajęciach wymagających bezpośredniego udziału nauczycieli akademickich lub innych osób prowadzących zajęcia (wpisać sumę punktów ECTS dla kursów/ grup kursów oznaczonych kodem BU[1], przy czym dla studiów stacjonarnych liczba ta musi być większa niż 50 % całkowitej liczby punktów ECTS z p. 1.2)

134,9 ECTS

2.7 Łączna liczba punktów ECTS, którą student musi uzyskać w ramach zajęć z zakresu nauk podstawowych

Liczba punktów ECTS z przedmiotów obowiązkowych	**65**
Liczba punktów ECTS z przedmiotów wybieralnych	**0**
Łączna liczba punktów ECTS	**65**

2.8 Łączna liczba punktów ECTS, którą student musi uzyskać w ramach zajęć o charakterze praktycznym, w tym zajęć laboratoryjnych i projektowych (wpisać sumę punktów ECTS kursów/grup kursów oznaczonych kodem P)

Liczba punktów ECTS z przedmiotów obowiązkowych	**66**
Liczba punktów ECTS z przedmiotów wybieralnych	**44**
Łączna liczba punktów ECTS	**110**

2.9 Minimalna liczba punktów ECTS, którą student musi uzyskać, realizując bloki kształcenia oferowane na zajęciach ogólnouczelnianych lub na innym kierunku studiów (wpisać sumę punktów ECTS kursów/grup kursów oznaczonych kodem O)

31 ECTS

2.10 Łączna liczba punktów ECTS, którą student może uzyskać, realizując bloki wybieralne (min. 30 % całkowitej liczby punktów ECTS)

65 ECTS

3. Opis procesu prowadzącego do uzyskania efektów uczenia się:

* Student rozpoczynający zajęcia posiada odpowiedni poziom wiedzy i umiejętności stanowiący wymagania wstępne.
* Student uczestniczy w zajęciach zorganizowanych na uczelni
* Student realizuje prace projektowe, laboratoryjne, obliczeniowe, analizy, prezentacje, studiuje literaturę i zalecane materiały.
* Student uczestniczy w sprawdzianach wiedzy i umiejętności, zapoznaje się z prawidłowymi odpowiedziami, ocenami i uwagami prowadzącego.
* Student w ramach wyszczególnionych przedmiotów uczy się pracy grupowej.
* Student jest zachęcany do angażowanie się w pracę kół naukowych.
* Student uczestniczy w spotkaniach z przedsiębiorcami, wycieczkach technicznych, targach pracy.

4. Lista bloków zajęć:

4.1. Lista bloków zajęć obowiązkowych:

4.1.1 Lista bloków kształcenia ogólnego

4.1.1.1 Blok Przedmioty humanistyczno-menedżerskie (min.2 pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2]kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI0061W	Podstawy zarządzania	1					KMBM _W16, KMBM_K02, KMBM_K04, KMBM_K05, KMBM_K09, KMBM_K11	15	30	1		0,6	T	z				KO
2.	W10MBM-SI0102W	Zarządzanie w produkcji	1					KMBM _W16	15	30	1		0,6	T	z				KO
		Razem	**2**	**0**	**0**	**0**	**0**		**30**	**60**	**2**	**0**	**1,2**						

4.1.1.2 Blok Języki obce (min. ...... pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2]kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
		Razem	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**						

4.1.1.3 Blok Zajęcia sportowe (0 pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2]kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
		Razem	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**						

4.1.1.4 Technologie informacyjne (min. 2 pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2]kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI0064W	Technologie informacyjne	2					KMBM _W04	30	60	2		1,2	T	z				PD
		Razem	**2**	**0**	**0**	**0**	**0**		**30**	**60**	**2**	**0**	**1,2**						

Razem dla bloków kształcenia ogólnego

Łączna liczba godzin					Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN[5]	Liczba punktów ECTS zajęć BU[1]
w	ć	l	p	s					
4	**0**	**0**	**0**	**0**	**60**	**120**	**4**	**0**	**2,4**

4.1.2 Lista bloków z zakresu nauk podstawowych

4.1.2.1 Blok Matematyka

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2]kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W13MBM-SI0004W	Algebra liniowa z geometrią analityczną B	2					KMBM_W01	30	50	2		1,5	T	E	O			PD
2.	W13MBM-SI0004C	Algebra liniowa z geometrią analityczną B		1				KMBM_U01, KMBM_K12	15	50	2		0,7	T	z	O		P	PD
3.	W13MBM-SI0005W	Analiza matematyczna 1A	2					KMBM_W01	30	125	5		1,5	T	E	O			PD
4.	W13MBM-SI0005C	Analiza matematyczna 1A		2				KMBM_U01, KMBM_K12	30	75	3		1,5	T	z	O		P	PD
5.	W13MBM-SI0006W	Elementy analizy matematycznej 2	1					KMBM_W01	15	50	2		0,7	T	E	O			PD
6.	W13MBM-SI0006C	Elementy analizy matematycznej 2		1				KMBM_U01, KMBM_K12	15	50	2		0,7	T	z	O		P	PD
7.	W10MBM-SI0082W	Statystyka inżynierska	1					KMBM _W01	15	30	1		0,6	T	z				PD
8.	W10MBM-SI0082P	Statystyka inżynierska				1		KMBM _U01, KMBM _K04, KMBM_K12	15	30	1		0,7	T	z			P	PD
9.	W10MBM-SI0077W	Równania różniczkowe zwyczajne	1					KMBM _W01	15	30	1		0,6	T	z				PD
10.	W10MBM-SI0077C	Równania różniczkowe zwyczajne		1				KMBM _U01, KMBM_K03, KMBM_K04, KMBM_K12	15	30	1		0,7	T	z			P	PD
		Razem	**7**	**5**	**0**	**1**	**0**		**195**	**520**	**20**	**0**	**9,2**						

4.1.2.2 Blok Fizyka

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2]kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W11MBM-SI0002W	Fizyka 1A	2					KMBM_W02, KMBM_K13	30	75	3		1,5	T	E	O			PD
2.	W11MBM-SI0002C	Fizyka 1A		1				KMBM_U02, KMBM_K13	15	50	2		1,4	T	z	O		P	PD
3.	W11MBM-SI0003L	Laboratorium podstaw fizyki			1			KMBM_U03, KMBM_K13	15	50	2		1,4	T	z	O		P	PD
		Razem	**2**	**1**	**1**	**0**	**0**		**60**	**175**	**7**	**0**	**4,3**						

4.1.2.3 Blok Chemia

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2]kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI0066W	Chemia	2					KMBM _W03	30	60	2		1,2	T	z				PD
		Razem	**2**	**0**	**0**	**0**	**0**		**30**	**60**	**2**	**0**	**1,2**						

4.1.2.4 Blok przedmioty podstawowe

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI0065W	Grafika inżynierska - geometria wykreślna	1					KMBM _W05	15	30	1		0,6	T	z				PD
2.	W10MBM-SI0065C	Grafika inżynierska - geometria wykreślna		2				KMBM _U04	30	60	2		1,4	T	z			P	PD
3.	W10MBM-SI0069W	Termodynamika techniczna	2					KMBM _W19	30	60	2	2	1,2	T	z		DN		PD
4.	W10MBM-SI0069L	Termodynamika techniczna			1			KMBM _U10, KMBM _K01, KMBM _K02, KMBM _K06	15	60	2	2	1,4	T	z		DN	P	PD
5.	W10MBM-SI0071W	Grafika inżynierska - zapis konstrukcji	1					KMBM _W06	15	30	1	1	0,6	T	z		DN		PD
6.	W10MBM-SI0071P	Grafika inżynierska - zapis konstrukcji				2		KMBM _U05	30	60	2	2	1,4	T	z		DN	P	PD
7.	W10MBM-SI0072W	Podstawy materiałoznawstwa	2					KMBM _W07	30	60	2	2	1,2	T	z		DN		PD
8.	W10MBM-SI0072L	Podstawy materiałoznawstwa			1			KMBM _U06	15	30	1	1	0,7	T	z		DN	P	PD
9.	W10MBM-SI0073W	Mechanika I	2					KMBM _W08	30	60	2	2	1,2	T	z		DN		PD
10.	W10MBM-SI0073C	Mechanika I		2				KMBM _U07	30	60	2	2	1,4	T	z		DN	P	PD
11.	W10MBM-SI0076W	Materiałoznawstwo	2					KMBM _W07	30	90	3	3	1,8	T	E		DN		PD
12.	W10MBM-SI0076L	Materiałoznawstwo			1			KMBM _U06	15	60	2	2	1,4	T	z		DN	P	PD
13.	W10MBM-SI0083W	Mechanika II	2					KMBM _W08	30	60	2	2	1,2	T	E		DN		PD
14.	W10MBM-SI0083C	Mechanika II		2				KMBM _U07	30	60	2	2	1,4	T	z		DN	P	PD
15.	W10MBM-SI0091W	Metrologia wielkości geometrycznych	1					KMBM _W10	15	30	1	1	0,6	T	z		DN		PD
16.	W10MBM-SI0091L	Metrologia wielkości geometrycznych			1			KMBM _U09	15	30	1	1	0,7	T	z		DN	P	PD
17.	W10MBM-SI0081W	Podstawy wytrzymałości materiałów	2					KMBM _W09	30	60	2	2	1,2	T	z		DN		PD
18.	W10MBM-SI0081C	Podstawy wytrzymałości materiałów		1				KMBM _U08	15	30	1	1	0,7	T	z		DN	P	PD
19.	W10MBM-SI0089W	Wytrzymałość materiałów	2					KMBM _W09	30	60	2	2	1,2	T	E		DN		PD
20.	W10MBM-SI0089C	Wytrzymałość materiałów		1				KMBM _U08, KMBM_U07, KMBM _K01, KMBM _K03	15	60	2	2	1,4	T	z		DN	P	PD
21.	W10MBM-SI0105L	Podstawy wytrzymałości materiałów			1			KMBM _U08	15	30	1	1	0,7	T	z		DN	P	PD
		Razem	**17**	**8**	**5**	**2**	**0**		**480**	**1080**	**36**	**33**	**23,4**						

Razem dla bloków z zakresu nauk podstawowych

Łączna liczba godzin					Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN[5]	Liczba punktów ECTS zajęć BU[1]
w	ć	l	p	s					
28	**14**	**6**	**3**	**0**	**765**	**1835**	**65**	**33**	**38,1**

4.1.3 Lista bloków kierunkowych

4.1.3.1 Blok Przedmioty obowiązkowe kierunkowe

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI0063W	Podstawy metrologii	1					KMBM _W10, KMBM _K04	15	30	1		0,6	T	z				K
2.	W10MBM-SI0062W	Ergonomia i BHP	1					KMBM _W17, KMBM _K02, KMBM_K03	15	30	1		0,6	T	z				KO
3.	W10MBM-SI0070W	Ekologia	1					KMBM _W17, KMBM_W18, KMBM_K08, KMBM_K10, KMBM_K11	15	30	1		0,6	T	z				K
4.	W10MBM-SI0068W	Technologia materiałów inżynierskich	1					KMBM _W07	15	60	2	2	1,2	T	z		DN		K
5.	W10MBM-SI0068L	Technologia materiałów inżynierskich			1			KMBM _U06, KMBM _K04	15	60	2	2	1,4	T	z		DN	P	K
6.	W10MBM-SI0067W	Maszynoznawstwo	1					KMBM_W13	15	30	1	1	0,6	T	z		DN		K
7.	W05MBM-SI0003W	Elektrotechnika	2					KMBM _W12	30	60	2		1,2	T	z				K
8.	W12MBM-SI0002W	Elektronika	2					KMBM_W12, KMBM _K04	30	60	2		1,2	T	z				K
9.	W10MBM-SI0074P	Grafika inżynierska 3D				2		KMBM _U05, KMBM _K04	30	60	2	2	1,4	T	z		DN	P	K
10.	W05MBM-SI0004L	Elektrotechnika			1			KMBM _U16, KMBM _K04	15	30	1		0,7	T	z			P	K
11.	W10MBM-SI0075W	Mechanika płynów	2					KMBM _W08, KMBM _W02	30	60	2	2	1,2	T	z		DN		K
12.	W10MBM-SI0075C	Mechanika płynów		1				KMBM _U15, KMBM _U02	15	30	1	1	0,7	T	z		DN	P	K
13.	W10MBM-SI0078W	Tworzywa sztuczne	2					KMBM _W07, KMBM_W20	30	60	2	2	1,2	T	z		DN		K
14.	W10MBM-SI0078L	Tworzywa sztuczne			1			KMBM _U06, KMBM_U20, KMBM _K09	15	30	1	1	0,7	T	z		DN	P	K
15.	W10MBM-SI0080W	Techniki wytwarzania - odlewnictwo	1					KMBM _W20	15	60	2	2	1,2	T	z		DN		K
16.	W10MBM-SI0080L	Techniki wytwarzania - odlewnictwo			1			KMBM _U20, KMBM _K01, KMBM _K04, KMBM _K06	15	30	1	1	0,7	T	z		DN	P	K
17.	W10MBM-SI0079P	Informatyka podstawy programowania (Matlab)				2		KMBM _U17, KMBM _K04	30	60	2		1,4	T	z			P	K
18.	W10MBM-SI0085W	Podstawy konstrukcji maszyn I	2					KMBM _W13	30	90	3	3	1,8	T	E		DN		K
19.	W10MBM-SI0085L	Podstawy konstrukcji maszyn I			1			KMBM _U18, KMBM _U08, KMBM _U23, KMBM _K10	15	60	2	2	1,4	T	z		DN	P	K
20.	W10MBM-SI0085P	Podstawy konstrukcji maszyn I				2		KMBM _U18, KMBM _U08, KMBM _U23, KMBM _K10	30	60	2	2	1,4	T	z		DN	P	K
21.	W10MBM-SI0086W	Teoria mechanizmów i manipulatorów	2					KMBM _W15, KMBM_W08	30	60	2	2	1,2	T	E		DN		K
22.	W10MBM-SI0086P	Teoria mechanizmów i manipulatorów				2		KMBM _U07, KMBM_U14, KMBM _K04	30	90	3	3	2,1	T	z		DN	P	K
23.	W10MBM-SI0088W	Techniki wytwarzania - przeróbka plastyczna	1					KMBM _W20	15	60	2	2	1,2	T	z		DN		K
24.	W10MBM-SI0088L	Techniki wytwarzania - przeróbka plastyczna			1			KMBM _U20, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
25.	W10MBM-SI0087W	Techniki wytwarzania - spawalnictwo	1					KMBM _W20	15	60	2	2	1,2	T	z		DN		K
26.	W10MBM-SI0087L	Techniki wytwarzania - spawalnictwo			1			KMBM _U20, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
27.	W10MBM-SI0090W	Układy napędowe pojazdów	1					KMBM _W14	15	30	1	1	0,6	T	z		DN		K
28.	W10MBM-SI0090L	Układy napędowe pojazdów			1			KMBM _U27, KMBM _U19, KMBM _K02, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
29.	W10MBM-SI0084W	Metrologia przemysłowa			1			KMBM _U09, KMBM_U13, KMBM _K01, KMBM _K03	15	30	1	1	0,7	T	z		DN	P	K
30.	W10MBM-SI0092W	Hydrostatyczne układy napędowe	1					KMBM _W13	15	30	1	1	0,6	T	z		DN		K
31.	W10MBM-SI0092L	Hydrostatyczne układy napędowe			1			KMBM _U14, KMBM_K09	15	30	1	1	0,7	T	z		DN	P	K
32.	W10MBM-SI0093W	Metoda elementów skończonych	1					KMBM _W20, KMBM _W13, KMBM_W09	15	30	1	1	0,6	T	z		DN		K
33.	W10MBM-SI0093P	Metoda elementów skończonych				2		KMBM _U17, KMBM _U08, KMBM_K02	30	60	2	2	1,4	T	z		DN	P	K
34.	W10MBM-SI0094W	Podstawy konstrukcji maszyn II	2					KMBM _W13	30	60	2	2	1,2	T	E		DN		K
35.	W10MBM-SI0094P	Podstawy konstrukcji maszyn II				2		KMBM _U18, KMBM _U08, KMBM _K02, KMBM _K03, KMBM _K05, KMBM _K11	30	90	3	3	2,1	T	z		DN	P	K
36.	W10MBM-SI0095W	Podstawy automatyki	2					KMBM _W01, KMBM _W12	30	60	2	2	1,2	T	E		DN		K
37.	W10MBM-SI0095L	Podstawy automatyki			2			KMBM _U19, KMBM_K05	30	60	2	2	1,4	T	z		DN	P	K
38.	W10MBM-SI0096W	Techniki wytwarzania - obróbka ubytkowa	3					KMBM _W20, KMBM _W13, KMBM_W09	45	60	2	2	1,2	T	E		DN		K
39.	W10MBM-SI0096L	Techniki wytwarzania - obróbka ubytkowa			2			KMBM _U20, KMBM _U17, KMBM _K04	30	60	2	2	1,4	T	z		DN	P	K
40.	W10MBM-SI0097W	Bezpieczeństwo maszyn i procesów technologicznych	1					KMBM _W21	15	60	2	2	1,2	T	E		DN		K
41.	W10MBM-SI0097S	Bezpieczeństwo maszyn i procesów technologicznych					1	KMBM _U21, KMBM_U26	15	30	1	1	0,7	T	z		DN	P	K
42.	W10MBM-SI0098W	Maszyny technologiczne CNC i roboty	1					KMBM _W20	15	30	1	1	0,6	T	z		DN		K
43.	W10MBM-SI0098L	Maszyny technologiczne CNC i roboty			1			KMBM _U20, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
44.	W10MBM-SI0098P	Maszyny technologiczne CNC i roboty				1		KMBM _U20, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
45.	W10MBM-SI0101W	Podstawy eksploatacji i remontów maszyn	2					KMBM _W20, KMBM _W21	30	60	2	2	1,2	T	z		DN		K
46.	W10MBM-SI0101L	Podstawy eksploatacji i remontów maszyn			1			KMBM _U21, KMBM_U27, KMBM _K02, KMBM _K05, KMBM _K10, KMBM _K11	15	30	1	1	0,7	T	z		DN	P	K
47.	W10MBM-SI0100W	Podstawy organizacji produkcji	2					KMBM _W16	30	60	2		1,2	T	z				K
		Razem	**36**	**1**	**16**	**13**	**1**		**1005**	**2280**	**76**	**64**	**49,1**						

Razem dla bloków kierunkowych

Łączna liczba godzin					Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN[5]	Liczba punktów ECTS zajęć BU[1]
w	ć	l	p	s					
36	**1**	**16**	**13**	**1**	**1005**	**2280**	**76**	**64**	**49,1**

4.2. Lista bloków wybieralnych:

4.2.1 Lista bloków kształcenia ogólnego

4.2.1.1 Blok Przedmioty humanistyczno-menedżerskie (min. 3 pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2]kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	MBM-SI1W-0001	**BLOK HUMANISTYCZNY**	2					KMBM_W18, KMBM_K08, KMBM_K09	30	60	2		1,2	T	z	O			KO
	W08MBM-SI0002W	Wstęp do filozofii	2																
	W10MBM-SI0103W	Technika wojskowa w konfliktach zbrojnych	2																
2.	MBM-SI2W-0001	**BLOK HUMANISTYCZNY:**	1					KMBM _W11, KMBM_K10	15	30	1		0,6	T	z	O			KO
	W10MBM-SI0104W	Ochrona własności intelektualnej	1																
	W08MBM-SI0003W	Prawo wynalazcze i autorskie	1																
		Razem	**3**	**0**	**0**	**0**	**0**		**45**	**90**	**3**	**0**	**1,8**						

4.2.1.2 Blok Języki obce (min. 5 pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2]kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	SJO-SI0001	Języki obce A1/A2/B1/B2.1/C1.1		4				KMBM_U11, KMBM_U24,KMBM_U28, KMBM_U29, KMBM_K06	60	60	2		2	T	z	O		P	KO
2.	SJO-SI0002	Języki obce B2.2/C1.2		4				KMBM_U11, KMBM_U24,KMBM_U28, KMBM_U29, KMBM_K06	60	90	3		2,5	T	z	O		P	KO
		Razem	**0**	**8**	**0**	**0**	**0**		**120**	**150**	**5**	**0**	**4,5**						

4.2.1.3 Blok Zajęcia sportowe (min. 0 pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2]kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	SWF-S00001	Zajęcia sportowe		2				KMBM _K07	30	0	0		0	T	z	O		P	KO
2.	SWF-S00001	Zajęcia sportowe		2				KMBM _K07	30	0	0		0	T	z	O		P	KO
		Razem	**0**	**4**	**0**	**0**	**0**		**60**	**0**	**0**		**0**						

4.2.1.4 Technologie informacyjne (min. ...... pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2]kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
		Razem	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**						

Razem dla bloków kształcenia ogólnego

Łączna liczba godzin						Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN[5]	Liczba punktów ECTS zajęć BU[1]
w	ć	l	p	s						
3	**12**	**0**	**0**	**0**		**225**	**240**	**8**	**0**	**6,3**

4.2.2 Lista bloków z zakresu nauk podstawowych

4.2.2.1 Blok Matematyka (min. ...... pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
		Razem	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**						

4.2.2.2 Blok Fizyka (min. ...... pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
		Razem	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**						

4.2.2.3 Blok Chemia (min. ...... pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
		Razem	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**						

Razem dla bloków z zakresu nauk podstawowych

Łączna liczba godzin				
w	ć	l	p	s
0	**0**	**0**	**0**	**0**

Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN[5]	Liczba punktów ECTS zajęć BU[1]
0	**0**	**0**	**0**	**0**

4.2.3 Lista bloków kierunkowych

4.2.3.1 Blok Programowanie, modelowanie numeryczne

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	**MBM-SI5W-0001**	**BLOK WYBIERALNY:**				**1**		KMBM_U17, KMBM_K04	15	30	1	1	0,7	T	z		DN	P	S
	W10MBM-SI106P	Analiza MES w zastosowaniach silnie nieliniowych w pakiecie MSC.MARC				1													
	W10MBM-SI107P	Grafika inżynierska 3D-SolidWorks				1													
	W10MBM-SI108P	Inspekcja wymiarowo-kształtowa 3D z wykorzystaniem programów GOM Inspect i Solidworks				1													
	W10MBM-SI109P	Komputerowo wspomagane wytwarzanie w systemie CAD-CAM				1													
	W10MBM-SI110P	Modelowanie bryłowe i powierzchniowe w systemie CATIA				1													
	W10MBM-SI111P	Modelowanie numeryczne				1													
	W10MBM-SI112P	Obliczenia inżynierskie z użyciem arkusza kalkulacyjnego				1													
	W10MBM-SI113P	Podstawy modelowania geometrii i generowanie dokumentacji z wykorzystaniem oprogramowanie PTC Creo Parametric				1													
	W10MBM-SI114P	Programowanie obróbki szybkościowej w programie Inventor HSM				1													
	W10MBM-SI115P	Projektowanie form wtryskowych i odlewniczych w programie Solidworks				1													
	W10MBM-SI116P	Projektowanie zespołów maszyn roboczych w systemach CAD (Inventor, AutoCAD)				1													
	W10MBM-SI117P	Rozwiązywanie zagadanień mechaniki w systemie ABAQUS				1													
	W10MBM-SI118P	Techniki projektowania - SolidWorks				1													
	W10MBM-SI119P	Tworzenie dokumentacji technicznej w programie Solidworks				1													
	W10MBM-SI120P	Zaawansowane funkcje i programowanie w Microsoft Excel				1													
	W10MBM-SI121P	Zaawansowane metody modelowania i analizy w systemach CAD/FEM				1													
	W10MBM-SI122P	Zarządzanie konfiguracjami i budowanie sparametryzowanych bibliotej danych CAD z wykorzystaniem programów Solidworks i Microsoft Excel				1													
	W10MBM-SI123P	Zaawansowane wspomaganie wytwarzania w systemie CATIA				1													
	W10MBM-SI124P	Komputerowa analiza danych pomiarowych				1													
		Razem	**0**	**0**	**0**	**1**	**0**		**15**	**30**	**1**	**1**	**0,7**						

Razem dla bloków kierunkowych

Łączna liczba godzin					Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN[5]	Liczba punktów ECTS zajęć BU[1]
w	ć	l	p	s					
0	**0**	**0**	**1**	**0**	**15**	**30**	**1**	**1**	**0,7**

4.2.4 Lista bloków specjalnościowych

4.2.4.1 Blok Przedmioty specjalnościowe (min. 41 pkt ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin w	ć	l	p	s	Symbol efektu uczenia się	Liczba godzin ZZU	CNPS	Liczba pkt. ECTS łączna	zajęć DN[5]	zajęć BU[1]	Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI2013P	Projektowanie procesów wytwarzania – obróbka bezubytkowa I				1		KMBM_U17, KMBM _U20, KMBM _K02	15	30	1	1	0,7	T	z		DN	P	S
2.	W10MBM-SI2014W	Komputerowa symulacja procesów odlewania	1					KMBM _W20, KMBM _K01	15	60	2	2	1,2	T	z		DN		S
3.	W10MBM-SI2014P	Komputerowa symulacja procesów odlewania				1		KMBM _U17, KMBM _K01	15	30	1	1	0,7	T	z		DN	P	S
4.	W10MBM-SI2015W	Technologie spajania	2					KMBM _W20, KMBM _K02	30	60	2	2	1,2	T	z		DN		S
5.	W10MBM-SI2015L	Technologie spajania			1			KMBM _U20, KMBM _K02	15	60	2	2	1,4	T	z		DN	P	S
6.	W10MBM-SI2022P	Wstęp do pracy dyplomowej				1		KMBM _U01, KMBM _U02, KMBM _U22, KMBM _U25, KMBM _U28, KMBM _U31, KMBM _K03, KMBM _K04, KMBM _K05	15	90	3		2,1	T	z			P	S
7.	W10MBM-SI2017W	Komputerowa symulacja procesów kształtowania plastycznego	1					KMBM _W20	15	60	2	2	1,2	T	z		DN		S
8.	W10MBM-SI2017P	Komputerowa symulacja procesów kształtowania plastycznego				1		KMBM_U17, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	S
9.	W10MBM-SI2018W	Narzędzia skrawające	1					KMBM _W20	15	30	1	1	0,6	T	z		DN		S
10.	W10MBM-SI2018L	Narzędzia skrawające			1			KMBM _U20, KMBM _K02, KMBM _K03	15	30	1	1	0,7	T	z		DN	P	S
11.	W10MBM-SI2019W	Planowanie wytwarzania CAD/CAM	1					KMBM _W20	15	30	1	1	0,6	T	z		DN		S
12.	W10MBM-SI2019L	Planowanie wytwarzania CAD/CAM			2			KMBM _U17, KMBM_U20, KMBM_K04	30	60	2	2	1,4	T	z		DN	P	S
13.	W10MBM-SI2020W	Projektowanie procesów technologicznych	1					KMBM_W20, KMBM _K01	15	60	2	2	1,2	T	z		DN		S
14.	W10MBM-SI2020P	Projektowanie procesów technologicznych				2		KMBM_U20, KMBM _K01	30	60	2	2	1,4	T	z		DN	P	S
15.	W10MBM-SI2021W	Technologia i materiały stosowane w wytwarzaniu konstrukcji lekkich	1					KMBM_W20, KMBM _K02	15	30	1	1	0,6	T	z		DN		S
16.	W10MBM-SI2021L	Technologia i materiały stosowane w wytwarzaniu konstrukcji lekkich			1			KMBM _U20, KMBM _K02	15	30	1	1	0,7	T	z		DN	P	S
17.	W10MBM-SI2021P	Technologia i materiały stosowane w wytwarzaniu konstrukcji lekkich				1		KMBM_U20, KMBM _K02	15	30	1	1	0,7	T	z		DN	P	S
18.	W10MBM-SI2016P	Projektowanie procesów wytwarzania – obróbka bezubytkowa II				2		KMBM_U17, KMBM _U20, KMBM _K02	30	90	3	3	2,1	T	z		DN	P	S
19.	W10MBM-SI2027S	Seminarium dyplomowe					1	KMBM _U22, KMBM _U28, KMBM_K01, KMBM _K02, KMBM _K05	15	30	1		0,7	T	z			P	S
20.	W10MBM-SI2025W	Technologie laserowe w wytwarzaniu	1					KMBM _W20	15	30	1	1	0,6	T	z		DN		S
21.	W10MBM-SI2025L	Technologie laserowe w wytwarzaniu			1			KMBM _U20	15	60	2	2	1,4	T	z		DN	P	S
22.	W10MBM-SI2026W	Technologie wytwarzania wyrobów z tworzyw sztucznych	1					KMBM _W20	15	60	2	2	1,2	T	z		DN		S
23.	W10MBM-SI2026L	Technologie wytwarzania wyrobów z tworzyw sztucznych			1			KMBM _U20, KMBM _K05	15	30	1	1	0,7	T	z		DN	P	S
24.	W10MBM-SI2023W	Utrzymanie ruchu maszyn i urządzeń wytwórczych	1					KMBM _W13	15	30	1	1	0,6	T	z		DN		S
25.	W10MBM-SI2024W	Technologie przyrostowe w budowie maszyn	1					KMBM _W20	15	30	1	1	0,6	T	z		DN		S
26.	W10MBM-SI2024L	Technologie przyrostowe w budowie maszyn			1			KMBM _U20	15	30	1	1	0,7	T	z		DN	P	S
27.	**MBM-SI7W-TSW2**	**BLOK WYBIERALNY:**	**1**						15	60	2	2	1,2	T	z		DN		S
	W10MBM-SI2029W	Metrologia w procesach wytwarzania	1					KMBM _W10, KMBM _K04, KMBM _K05											
	W10MBM-SI2030W	Badanie jakości wyrobów	1					KMBM _W10, KMBM _K04											
		Razem	**13**	**0**	**8**	**9**	**1**		**465**	**1230**	**41**	**37**	**26,9**						

4.2.4.2 Blok Profil dyplomowania (min. …pkt ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin w	ć	l	p	s	Symbol efektu uczenia się	Liczba godzin ZZU	CNPS	Liczba pkt. ECTS łączna	zajęć DN[5]	zajęć BU[1]	Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
		Razem	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**						

Razem dla bloków specjalnościowych

Łączna liczba godzin w	ć	l	p	s
13	**0**	**8**	**9**	**1**

Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN[5]	Liczba punktów ECTS zajęć BU[1]
465	**1230**	**41**	**37**	**26,9**

4.3 Blok praktyk Uchwała RW 174/16/RW10/2021-2024 nt. zasad zaliczania praktyki – zał. nr 2.1 do opisu programu studiów

Nazwa praktyki				
Liczba punktów ECTS	Liczba punktów ECTS zajęć DN[5]	Liczba punktów ECTS zajęć BU[1]	Tryb zaliczenia praktyki	Kod
3	3	3	raport	W10MBM-SI0099
Czas trwania praktyki	Cel praktyki			
4 tygodnie	Celem praktyki jest zdobycie doświadczenia przemysłowego, zapoznanie się z podstawowym wyposażeniem technicznym i technologicznym zakładów, zapoznanie się z pracą wyższego dozoru technicznego zakładu, a w szczególności: • poszerzenie wiedzy zdobytej na studiach i rozwijanie umiejętności jej wykorzystania, • zapoznanie się ze specyfiką środowiska zawodowego, • kształtowanie konkretnych umiejętności zawodowych związanych bezpośrednio z miejscem odbywania praktyki, • kształtowanie umiejętności skutecznego komunikowania się, • poznanie zasad organizacji pracy i podziału kompetencji, procedur, procesu planowania pracy, kontroli, • doskonalenie umiejętności organizacji pracy własnej, pracy zespołowej, efektywnego zarządzania czasem, sumienności, odpowiedzialności za powierzone zadania, • doskonalenie umiejętności posługiwania się językiem obcym w sytuacjach zawodowych. Poprzez swobodny wybór miejsca odbywania praktyki, m. in. przez własny wybór „firmy", student może realizować swoje zainteresowania zawodowe. Wynikiem tego może być sformułowanie indywidualnego tematu pracy dyplomowej inżynierskiej. Pierwsza praca zawodowa odbywa się często w miejscu praktyki.			

4.4 Blok "praca dyplomowa"

Typ pracy dyplomowej	~~licencjacka~~ / inżynierska / ~~magisterska~~	
Liczba semestrów pracy dyplomowej	**Liczba punktów ECTS**	**Kod**
1	**12**	**W10MBM-SI2028D**
Charakter pracy dyplomowej		
Praca dyplomowa inżynierska ma charakter użyteczny dla praktyki inżynierskiej. Jej przedmiotem jest w szczególności rozwiązanie zadania z zakresu: projektowania, eksperymentu pomiarowego, opracowania programu komputerowego oraz analizy części lub całości procesów o charakterze technicznym, organizacyjno-technicznym, ekonomiczno-technicznym. Nie ma ona wyłącznie charakteru opisowego, a jest w niej widoczna część będąca wkładem własnym studenta.		
Liczba punktów ECTS BU[1]	**8,4**	
Liczba punktów ECTS DN[5]	**12**	

5. Sposoby weryfikacji zakładanych efektów uczenia się

Typ zajęć	Sposoby weryfikacji zakładanych efektów uczenia się
wykład	*egzamin, kolokwium, kartkówka, odpowiedź ustna, udział w dyskusji*
ćwiczenia	*test, kolokwium, ocena przygotowania projektu, kartkówka, odpowiedź ustna, sprawdzian*
laboratorium	*wejściówka, sprawozdanie z laboratorium, kartkówka, odpowiedź ustna, sprawdzian, aktywność, referat, dyskusja*
projekt	*obrona projektu, kolokwium, kartkówka, test, dyskusja problemowa, prezentacja projektu, raport, odpowiedź ustna*
seminarium	*udział w dyskusji, prezentacja tematu, aktywność, raport*
praktyka	*raport z praktyki*
praca dyplomowa	*przygotowana praca dyplomowa*

6. Zakres egzaminu dyplomowego

Egzamin dyplomowy jest egzaminem ustnym sprawdzającym wiedzę nabytą przez studenta w czasie jego studiów, w zakresie danego planu i programu studiów a szczególności kartach przedmiotów. W czasie egzaminu studentowi zadawane są 3 pytania po jednym z poszczególnych grup.
•Grupa A skupia się na przedmiotach podstawowych w obszarze tematycznym ogólnie pojętej Mechaniki, Wytrzymałości Materiałów i Materiałoznawstwa.
•Grupa B – zakresem obejmuje zagadnienia związane z konstruowaniem, czyli obszar Podstaw Konstrukcji Maszyn, Teorii Maszyn i Mechanizmów oraz Podstaw Metody Elementów Skończonych.
•Grupa C swoim zakresem obejmuje metody pomiarowe oraz procesy technologii wytwarzania, związane Mechaniką i Budową Maszyn.
Lista obowiązujących pytań (zagadnień) egzaminacyjnych jest zatwierdzana i aktualizowana przez Komisję Programową i publikowana na stronie Wydziału. Pytania zadawane na egzaminie nie mogą wykraczać poza materiał kursów realizowanych przez studenta w toku kształcenia.

7. Wymagania dotyczące terminu zaliczenia określonych kursów/grup kursów lub wszystkich kursów w poszczególnych blokach

Lp.	Kod kursu	Nazwa kursu	Termin zaliczenia do... (numer semestru)

8. Plan studiów (załącznik nr 3 do programu studiów)

Zał. nr 4 do ZW 121/2020 Zał. nr 2 do Programu studiów

OPIS PROGRAMU STUDIÓW

Kierunek studiów: MECHANIKA i BUDOWA MASZYN
specjalność: Mechanical Engineering Design
Poziom studiów: studia I stopnia

Profil: ogólnoakademicki
Forma studiów: stacjonarna

1. Opis ogólny

1.1 Liczba semestrów: **7**	1.2 Całkowita liczba punktów ECTS konieczna do ukończenia studiów na danym poziomie: **210**
1.3 Łączna liczba godzin zajęć: **2550**	1.4 Wymagania wstępne (w szczególności w przypadku studiów drugiego stopnia): Podstawą decyzji o przyjęciu na studia jest WSKAŹNIK REKRUTACYJNY. O jego wartości decydują wybrane wyniki egzaminu dojrzałości. WSKAŹNIK REKRUTACYJNY jest sumą punktów z przedmiotów kwalifikacyjnych (matematyka, fizyka, język polski, język obcy nowożytny), obliczanym zgodnie z uchwalonymi przez Senat zasadami przyjęć kandydatów. Wartość progowa wskaźnika rekrutacyjnego ustalana jest w zależności od liczby kandydatów.
1.5 Tytuł zawodowy nadawany po zakończeniu studiów: **inżynier**	1.6 Sylwetka absolwenta, możliwości zatrudnienia: Sylwetka absolwenta, możliwości zatrudnienia: Absolwenci studiów pierwszego stopnia posiadają podstawową wiedzę i umiejętności konieczne do zrozumienia zagadnień z zakresu budowy, wytwarzania i eksploatacji maszyn. Posiadają gruntowną znajomość zasad mechaniki oraz projektowania z wykorzystaniem nowoczesnych narzędzi obliczeniowych. Absolwenci są przygotowani do: (1) realizacji procesów wytwarzania, montażu i eksploatacji maszyn, (2) prac wspomagających projektowanie maszyn, dobór materiałów inżynierskich stosowanych jako elementy maszyn oraz nadzór nad ich eksploatacją, (3) pracy w zespole, (4) koordynacji prac i oceny ich wyników, (5) sprawnego posługiwania się nowoczesnymi technikami komputerowymi. Absolwenci studiów powinni znać język obcy na poziomie biegłości B2 Europejskiego Systemu Opisu Kształcenia Językowego Rady Europy oraz posiadać umiejętności posługiwania się językiem specjalistycznym z zakresu kierunku kształcenia. Absolwenci powinni być przygotowani do podjęcia studiów drugiego stopnia. Absolwenci są przygotowani do pracy w: (1) przedsiębiorstwach przemysłu maszynowego oraz w innych zajmujących się wytwarzaniem i eksploatacją maszyn, (2) jednostkach projektowych, konstrukcyjnych i technologicznych oraz związanych z organizacją produkcji i automatyzacją procesów technologicznych, (3) jednostkach odbioru technicznego produktów i materiałów, jednostkach akredytacyjnych i atestacyjnych, (4) jednostkach naukowo-badawczych i konsultingowych oraz (5) innych jednostkach gospodarczych, administracyjnych i edukacyjnych wymagających wiedzy technicznej i informatycznej.
1.7 Możliwość kontynuacji studiów: **możliwość ubiegania się o przyjęcie na studia drugiego stopnia i studia podyplomowe**	1.8 Wskazanie związku z misją Uczelni i strategia jej rozwoju: Wydział Mechaniczny Politechniki Wrocławskiej posiada misję, która zawarta jest na stronie Wydziału Mechanicznego (https://wm.pwr.edu.pl/o-wydziale/misja-wydzialu). Jest ona zgodna z misją i strategia Politechniki Wrocławskiej. Misja Wydziału wyraźnie odnosi się dydaktyki oferowanej na Wydziale: „Przewodzenie w rozwoju cywilizacji technicznej, odkrywanie i przekazywanie wiedzy w obszarze inżynierii mechanicznej, poprzez kształcenie uniwersyteckie oparte na zaawansowanych badaniach naukowych, rozwoju wiedzy oraz transferze nowych technologii i wdrożeniach przemysłowych". Plany i programy studiów dyskutowane są z Radą Społeczną Wydziału Mechanicznego (https://wm.pwr.edu.pl/o-wydziale/wladze/rada-spoleczna) jako głosu otoczenia społeczno-gospodarczego. Ma to na celu powiązanie misji i strategii Uczelni i Wydziału z potrzebami otoczenia społeczno-gospodarczego, by sprostać wymaganiom stawianym specjalistom w zakresie Mechaniki i Budowy Maszyn. Wyraźnym przesłaniem zgodnym z misją i strategią uczelni jest, by nasz student zdobył wiedzę, która będzie mogła zaowocować nie tylko sukcesami w przyszłym życiu zawodowym, ale również ma na celu ukształtować człowieka ze zmysłem przedsiębiorcy, twórczego i otwartego na nowe wyzwania.

2. Opis szczegółowy

2.1 Całkowita liczba efektów uczenia się w programie studiów: W (wiedza)= 21, U (umiejętności)= 31, K (kompetencje)= 13, W+U+K= 65

2.2 Dla kierunku studiów przyporządkowanego do więcej niż jednej dyscypliny - liczba efektów uczenia się przypisana do dyscypliny:
D1 (wiodąca)…., D2….., D3….., D4…..

2.3 Dla kierunku studiów przyporządkowanego do więcej niż jednej dyscypliny - procentowy udział liczby punktów ECTS dla każdej z dyscyplin:
D1…..% punktów ECTS, D2…..% punktów ECTS, D3…..% punktów ECTS, D4…..% punktów ECTS

2.4a. Dla kierunku studiów o profilu ogólnoakademickim - liczba punktów ECTS przypisana zajęciom związanym z prowadzoną w Uczelni działalnością naukową w dyscyplinie lub dyscyplinach, do których przyporządkowany jest kierunek studiów (*musi być większa niż 50% całkowitej liczby punktów ECTS z p.1.2*).....

162

2.4b. Dla kierunku studiów o profilu praktycznym - liczba punktów ECTS przypisana zajęciom kształtującym umiejętności praktyczne (*musi być większa niż 50% całkowitej liczby punktów ECTS z p.1.2*).....

2.5 Zwięzła analiza zgodności zakładanych efektów uczenia się z potrzebami rynku pracy

Efekty uczenia odnoszą się nie tylko do mechaniki i budowy maszyn ale również ze względu na wymagania nowoczesnego przemysłu do mechaniki, automatyki i robotyki, mechatroniki oraz informatyki i technologii informatycznych. Uzyskanie zakładanych efektów uczenia się pozwoli absolwentowi na znalezienie atrakcyjnej i ciekawej pracy we wszystkich gałęziach przemysłu, jak również na uruchomienie własnej działalności gospodarczej. Prace nad efektami uczenia się były referowane i dyskutowane na zebraniach Konwentu Wydziału Mechanicznego, w skład którego wchodzą między innymi przedstawiciele zakładów przemysłowych z Polski, ze szczególnym uwzględnieniem Dolnego Śląska i województw sąsiednich.

2.6 Łączna liczba punktów ECTS, którą student musi uzyskać na zajęciach wymagających bezpośredniego udziału nauczycieli akademickich lub innych osób prowadzących zajęcia (wpisać sumę punktów ECTS dla kursów/ grup kursów oznaczonych kodem BU[1], przy czym dla studiów stacjonarnych liczba ta musi być większa niż 50 % całkowitej liczby punktów ECTS z p. 1.2)

134,8 ECTS

2.7 Łączna liczba punktów ECTS, którą student musi uzyskać w ramach zajęć z zakresu nauk podstawowych

Liczba punktów ECTS z przedmiotów obowiązkowych	**65**
Liczba punktów ECTS z przedmiotów wybieralnych	**0**
Łączna liczba punktów ECTS	**65**

2.8 Łączna liczba punktów ECTS, którą student musi uzyskać w ramach zajęć o charakterze praktycznym, w tym zajęć laboratoryjnych i projektowych (wpisać sumę punktów ECTS kursów/grup kursów oznaczonych kodem P)

Liczba punktów ECTS z przedmiotów obowiązkowych	**66**
Liczba punktów ECTS z przedmiotów wybieralnych	**43**
Łączna liczba punktów ECTS	**109**

2.9 Minimalna liczba punktów ECTS, którą student musi uzyskać, realizując bloki kształcenia oferowane na zajęciach ogólnouczelnianych lub na innym kierunku studiów (wpisać sumę punktów ECTS kursów/grup kursów oznaczonych kodem O)

31 ECTS

2.10 Łączna liczba punktów ECTS, którą student może uzyskać, realizując bloki wybieralne (min. 30 % całkowitej liczby punktów ECTS)

65 ECTS

3. Opis procesu prowadzącego do uzyskania efektów uczenia się:

* Student rozpoczynający zajęcia posiada odpowiedni poziom wiedzy i umiejętności stanowiący wymagania wstępne.
* Student uczestniczy w zajęciach zorganizowanych na uczelni
* Student realizuje prace projektowe, laboratoryjne, obliczeniowe, analizy, prezentacje, studiuje literaturę i zalecane materiały.
* Student uczestniczy w sprawdzianach wiedzy i umiejętności, zapoznaje się z prawidłowymi odpowiedziami, ocenami i uwagami prowadzącego.
* Student w ramach wyszczególnionych przedmiotów uczy się pracy grupowej.
* Student jest zachęcany do angażowanie się w pracę kół naukowych.
* Student uczestniczy w spotkaniach z przedsiębiorcami, wycieczkach technicznych, targach pracy.

4. Lista bloków zajęć:

4.1. Lista bloków zajęć obowiązkowych:

4.1.1 Lista bloków kształcenia ogólnego

4.1.1.1 Blok Przedmioty humanistyczno-menedżerskie (min. 2 pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI3071W	Essential of Management (Podstawy zarządzania)	1					KMBM _W16, KMBM_K02, KMBM_K04, KMBM_K05, KMBM_K09, KMBM_K11	15	30	1		0,6	T	z				KO
2.	W10MBM-SI3125W	Management in production (Zarządzanie w produkcji)	1					KMBM _W16	15	30	1		0,6	T	z				KO
		Razem	**2**	**0**	**0**	**0**	**0**		**30**	**60**	**2**	**0**	**1,2**						

4.1.1.2 Blok Języki obce (min. ...... pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
		Razem	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**						

4.1.1.3 Blok Zajęcia sportowe (0 pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
		Razem	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**						

4.1.1.4 Technologie informacyjne (min. 2 pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI3075W	Information Technologies (Technologie informacyjne)	2					KMBM _W04	30	60	2		1,2	T	z				PD
		Razem	**2**	**0**	**0**	**0**	**0**		**30**	**60**	**2**	**0**	**1,2**						

Razem dla bloków kształcenia ogólnego

Łączna liczba godzin						Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN[5]	Liczba punktów ECTS zajęć BU[1]
w	ć	l	p	s						
4	**0**	**0**	**0**	**0**		**60**	**120**	**4**	**0**	**2,4**

4.1.2 Lista bloków z zakresu nauk podstawowych

4.1.2.1 Blok Matematyka

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W13MBM-SI3004W	Linear Algebra with Analytic Geometry B (Algebra liniowa z geometrią analityczną B)	2					KMBM_W01	30	50	2		1,5	T	E	O			PD
2.	W13MBM-SI3004C	Linear Algebra with Analytic Geometry B(Algebra liniowa z geometrią analityczną B)		1				KMBM_U01, KMBM_K12	15	50	2		0,7	T	z	O		P	PD
3.	W13MBM-SI3005W	Mathematical Analysis 1A (Analiza matematyczna 1A)	2					KMBM_W01	30	125	5		1,5	T	E	O			PD
4.	W13MBM-SI3005C	Mathematical Analysis 1A (Analiza matematyczna 1A)		2				KMBM_U01, KMBM_K12	30	75	3		1,5	T	z	O		P	PD
5.	W13MBM-SI3006W	Elements of Mathematical Analysis E (Elementy analizy matematycznej 2)	1					KMBM_W01	15	50	2		0,7	T	E	O			PD
6.	W13MBM-SI3006C	Elements of Mathematical Analysis E (Elementy analizy matematycznej 2)		1				KMBM_U01, KMBM_K12	15	50	2		0,7	T	z	O		P	PD
7.	W10MBM-SI3085W	Statistics for Engineers (Statystyka inżynierska)	1					KMBM _W01	15	30	1		0,6	T	z				PD
8.	W10MBM-SI3085P	Statistics for Engineers (Statystyka inżynierska)				1		KMBM _U01, KMBM _K04, KMBM_K12	15	30	1		0,7	T	z			P	PD
9.	W10MBM-SI3093W	Ordinary Differential Equations (Równania różniczkowe zwyczajne)	1					KMBM _W01	15	30	1		0,6	T	z				PD
10.	W10MBM-SI3093C	Ordinary Differential Equations (Równania różniczkowe zwyczajne)		1				KMBM _U01, KMBM_K03, KMBM_K04, KMBM_K12	15	30	1		0,7	T	z			P	PD
		Razem	**7**	**5**	**0**	**1**	**0**		**195**	**520**	**20**	**0**	**9,2**						

4.1.2.2 Blok Fizyka

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W11MBM-SI3002W	Physics 1A (Fizyka 1A)	2					KMBM_W02, KMBM_K13	30	75	3		1,5	T	E	O			PD
2.	W11MBM-SI3002C	Physics 1A (Fizyka 1A)		1				KMBM_U02, KMBM_K13	15	50	2		1,4	T	z	O		P	PD
3.	W11MBM-SI3003L	Basic physics laboratory (Laboratorium podstaw fizyki)			1			KMBM_U03, KMBM_K13	15	50	2		1,4	T	z	O		P	PD
		Razem	**2**	**1**	**1**	**0**	**0**		**60**	**175**	**7**	**0**	**4,3**						

4.1.2.3 Blok Chemia

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI3076W	Chemistry (Chemia)	2					KMBM _W03	30	60	2		1,2	T	z				PD
		Razem	**2**	**0**	**0**	**0**	**0**		**30**	**60**	**2**	**0**	**1,2**						

4.1.2.4 Blok przedmioty podstawowe

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI3074W	Engineering Graphics: Descriptive Geometry (Grafika inżynierska-geometria wykreślna)	1					KMBM _W05	15	30	1		0,6	T	z				PD
2.	W10MBM-SI3074C	Engineering Graphics: Descriptive Geometry (Grafika inżynierska-geometria wykreślna)		2				KMBM _U04	30	60	2		1,4	T	z			P	PD
3.	W10MBM-SI3080W	Thermodynamics (Termodynamika techniczna)	2					KMBM _W19	30	60	2	2	1,2	T	z		DN		PD
4.	W10MBM-SI3080L	Thermodynamics (Termodynamika techniczna)			1			KMBM _U10, KMBM _K01, KMBM _K02, KMBM _K06	15	60	2	2	1,4	T	z		DN	P	PD
5.	W10MBM-SI3078W	Engineering Graphics: Engineering Drawing (Grafika inżynierska-zapis konstrukcji)	1					KMBM _W06	15	30	1	1	0,6	T	z		DN		PD
6.	W10MBM-SI3078P	Engineering Graphics: Engineering Drawing (Grafika inżynierska-zapis konstrukcji)				2		KMBM _U05	30	60	2	2	1,4	T	z		DN	P	PD
7.	W10MBM-SI3081W	Fundamentals of Materials Science (Podstawy materiałoznawstwa)	2					KMBM _W07	30	60	2	2	1,2	T	z		DN		PD
8.	W10MBM-SI3081L	Fundamentals of Materials Science (Podstawy materiałoznawstwa)			1			KMBM _U06	15	30	1	1	0,7	T	z		DN	P	PD
9.	W10MBM-SI3082W	Mechanics I (Mechanika I)	2					KMBM _W08	30	60	2	2	1,2	T	z		DN		PD
10.	W10MBM-SI3082C	Mechanics I (Mechanika I)		2				KMBM _U07	30	60	2	2	1,4	T	z		DN	P	PD
11.	W10MBM-SI3088W	Materials Science (Materiałoznawstwo)	2					KMBM _W07	30	90	3	3	1,8	T	E		DN		PD
12.	W10MBM-SI3088L	Materials Science (Materiałoznawstwo)			1			KMBM _U06	15	60	2	2	1,4	T	z		DN	P	PD
13.	W10MBM-SI3089W	Mechanics II (Mechanika II)	2					KMBM _W08	30	60	2	2	1,2	T	E		DN		PD
14.	W10MBM-SI3089C	Mechanics II (Mechanika II)		2				KMBM _U07	30	60	2	2	1,4	T	z		DN	P	PD
15.	W10MBM-SI3099W	Geometric Metrology (Metrologia wielkości geometrycznych)	1					KMBM _W10	15	30	1	1	0,6	T	z		DN		PD
16.	W10MBM-SI3099L	Geometric Metrology (Metrologia wielkości geometrycznych)			1			KMBM _U09	15	30	1	1	0,7	T	z		DN	P	PD
17.	W10MBM-SI3092W	Fundamentals of Materials Strength (Podstawy wytrzymałości materiałów)	2					KMBM _W09	30	60	2	2	1,2	T	z		DN		PD
18.	W10MBM-SI3092C	Fundamentals of Materials Strength (Podstawy wytrzymałości materiałów)		1				KMBM _U08	15	30	1	1	0,7	T	z		DN	P	PD
19.	W10MBM-SI3102W	Strength of Materials (Wytrzymałość materiałów)	2					KMBM _W09	30	60	2	2	1,2	T	E		DN		PD
20.	W10MBM-SI3102C	Strength of Materials (Wytrzymałość materiałów)		1				KMBM _U08, KMBM_U07, KMBM _K01, KMBM _K03	15	60	2	2	1,4	T	z		DN	P	PD
21.	W10MBM-SI3094L	Fundamentals of Materials Strength (Podstawy wytrzymałości materiałów)			1			KMBM _U08	15	30	1	1	0,7	T	z		DN	P	PD
		Razem	**17**	**8**	**5**	**2**	**0**		**480**	**1080**	**36**	**33**	**23,4**						

Razem dla bloków z zakresu nauk podstawowych

Łączna liczba godzin					Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN[5]	Liczba punktów ECTS zajęć BU[1]
w	ć	l	p	s					
28	**14**	**6**	**3**	**0**	**765**	**1835**	**65**	**33**	**38,1**

4.1.3 Lista bloków kierunkowych

4.1.3.1 Blok Przedmioty obowiązkowe kierunkowe

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI3073W	Fundamentals of metrology (Podstawy metrologii)	1					KMBM _W10, KMBM _K04	15	30	1		0,6	T	z				K
2.	W10MBM-SI3072W	Ergonomy and Safety (Ergonomia i BHP)	1					KMBM _W17, KMBM _K02, KMBM_K03	15	30	1		0,6	T	z				KO
3.	W10MBM-SI3083W	Ecology (Ekologia)	1					KMBM _W17, KMBM_W18, KMBM_K08, KMBM_K10, KMBM_K11	15	30	1		0,6	T	z				K
4.	W10MBM-SI3079W	Engineering Materials Technology (Technologia materiałów inżynierskich)	1					KMBM _W07	15	60	2	2	1,2	T	z		DN		K
5.	W10MBM-SI3079L	Engineering Materials Technology (Technologia materiałów inżynierskich)			1			KMBM _U06, KMBM _K04	15	60	2	2	1,4	T	z		DN	P	K
6.	W10MBM-SI3077W	Theory of Machines (Maszynoznawstwo)	1					KMBM_W13	15	30	1	1	0,6	T	z		DN		K
7.	W05MBM-SI3003W	Electrical Engineering (Elektrotechnika)	2					KMBM _W12	30	60	2		1,2	T	z				K
8.	W12MBM-SI3002W	Electronics (Elektronika)	2					KMBM_W12, KMBM _K04	30	60	2		1,2	T	z				K
9.	W10MBM-SI3086P	Engineering Graphics 3D (Grafika inżynierska 3D)				2		KMBM _U05, KMBM _K04	30	60	2	2	1,4	T	z		DN	P	K
10.	W05MBM-SI3004L	Electrical Engineering (Elektrotechnika)			1			KMBM _U16, KMBM _K04	15	30	1		0,7	T	z			P	K
11.	W10MBM-SI3087W	Fluid Mechanics (Mechanika płynów)	2					KMBM _W08, KMBM _W02	30	60	2	2	1,2	T	z		DN		K
12.	W10MBM-SI3087C	Fluid Mechanics (Mechanika płynów)		1				KMBM _U15, KMBM _U02	15	30	1	1	0,7	T	z		DN	P	K
13.	W10MBM-SI3090W	Polymers I (Tworzywa sztuczne)	2					KMBM _W07, KMBM_W20	30	60	2	2	1,2	T	z		DN		K
14.	W10MBM-SI3090L	Polymers I (Tworzywa sztuczne)			1			KMBM _U06, KMBM_U20, KMBM _K09	15	30	1	1	0,7	T	z		DN	P	K
15.	W10MBM-SI3091W	Chipless Processes -Casting (Techniki wytwarzania - odlewnictwo)	1					KMBM _W20	15	60	2	2	1,2	T	z		DN		K
16.	W10MBM-SI3091L	Chipless Processes -Casting (Techniki wytwarzania - odlewnictwo)			1			KMBM _U20, KMBM _K01, KMBM _K04, KMBM _K06	15	30	1	1	0,7	T	z		DN	P	K
17.	W10MBM-SI3084P	Programming in MATLAB (Informatyka podstawy programowania Matlab)				2		KMBM _U17, KMBM _K04	30	60	2		1,4	T	z			P	K
18.	W10MBM-SI3097W	Fundamentals of Machine Design I (Podstawy konstrukcji maszyn I)	2					KMBM _W13	30	90	3	3	1,8	T	E		DN		K
19.	W10MBM-SI3097L	Fundamentals of Machine Design I (Podstawy konstrukcji maszyn I)			1			KMBM _U18, KMBM _U08, KMBM _U23, KMBM _K10	15	60	2	2	1,4	T	z		DN	P	K
20.	W10MBM-SI3097P	Fundamentals of Machine Design I (Podstawy konstrukcji maszyn I)				2		KMBM _U18, KMBM _U08, KMBM _U23, KMBM _K10	30	60	2	2	1,4	T	z		DN	P	K
21.	W10MBM-SI3098W	Theory of Mechanisms and Manipulators E (Teoria mechanizmów i manipulatorów)	2					KMBM _W15, KMBM_W08	30	60	2	2	1,2	T	E		DN		K
22.	W10MBM-SI3098P	Theory of Mechanisms and Manipulators E (Teoria mechanizmów i manipulatorów)				2		KMBM _U07, KMBM_U14, KMBM _K04	30	90	3	3	2,1	T	z		DN	P	K
23.	W10MBM-SI3100W	Chipless Processes -Plastic Forming (Technki wytwarzania-przeróbka plastyczna)	1					KMBM _W20	15	60	2	2	1,2	T	z		DN		K
24.	W10MBM-SI3100L	Chipless Processes -Plastic Forming (Technki wytwarzania-przeróbka plastyczna)			1			KMBM _U20, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
25.	W10MBM-SI3101W	Chipless Processes -Welding Metallurgy (Techniki wytwarzania-spawalnictwo)	1					KMBM _W20	15	60	2	2	1,2	T	z		DN		K
26.	W10MBM-SI3101L	Chipless Processes -Welding Metallurgy (Techniki wytwarzania-spawalnictwo)			1			KMBM _U20, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
29.	W10MBM-SI3096W	Drive Systems (Układy napędowe pojazdów)	1					KMBM _W14	15	30	1	1	0,6	T	z		DN		K
30.	W10MBM-SI3096L	Drive Systems (Układy napędowe pojazdów)			1			KMBM _U27, KMBM _U19, KMBM _K02, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
31.	W10MBM-SI3095L	Industrial Metrology (Metrologia przemysłowa)			1			KMBM _U09, KMBM_U13, KMBM _K01, KMBM _K03	15	30	1	1	0,7	T	z		DN	P	K

32.	W10MBM-SI3106W	Hydraulic, Hydrotronic and Pneumatic Systems (Hydrostatyczne układy napędowe)	1					KMBM _W13	15	30	1	1	0,6	T	z		DN		K
33.	W10MBM-SI3106L	Hydraulic, Hydrotronic and Pneumatic Systems (Hydrostatyczne układy napędowe)			1			KMBM _U14, KMBM_K09	15	30	1	1	0,7	T	z		DN	P	K
34.	W10MBM-SI3107W	Finite Elements Method (Metoda elementów skończonych)	1					KMBM _W20, KMBM _W13, KMBM_W09	15	30	1	1	0,6	T	z		DN		K
35.	W10MBM-SI3107P	Finite Elements Method (Metoda elementów skończonych)				2		KMBM _U17, KMBM _U08, KMBM_K02	30	60	2	2	1,4	T	z		DN	P	K
36.	W10MBM-SI3108W	Fundamentals of Machine Design II (Podstawy konstrukcji maszyn II)	2					KMBM _W13	30	60	2	2	1,2	T	E		DN		K
37.	W10MBM-SI3108P	Fundamentals of Machine Design II (Podstawy konstrukcji maszyn II)				2		KMBM _U18, KMBM _U08, KMBM _K02, KMBM _K03, KMBM _K05, KMBM _K11	30	90	3	3	2,1	T	z		DN	P	K
38.	W10MBM-SI3109W	Fundamentals of Automatic Control (Podstawy automatyki)	2					KMBM _W01, KMBM _W12	30	60	2	2	1,2	T	E		DN		K
39.	W10MBM-SI3109L	Fundamentals of Automatic Control (Podstawy automatyki)			2			KMBM _U19, KMBM_K05	30	60	2	2	1,4	T	z		DN	P	K
40.	W10MBM-SI3110W	Manufacturing Processes - Machining (Techki wytwarzania-obróbka ubytkowa)	3					KMBM _W20, KMBM _W13, KMBM_W09	45	60	2	2	1,2	T	E		DN		K
41.	W10MBM-SI3110L	Manufacturing Processes - Machining (Techki wytwarzania-obróbka ubytkowa)			2			KMBM _U20, KMBM _U17, KMBM _K04	30	60	2	2	1,4	T	z		DN	P	K
42.	W10MBM-SI3116W	Safety of machines and technological processes (Bezpieczeństwo maszyn i procesów technologicznych)	1					KMBM _W21	15	60	2	2	1,2	T	E		DN		K
43.	W10MBM-SI3116S	Safety of machines and technological processes (Bezpieczeństwo maszyn i procesów technologicznych)					1	KMBM _U21, KMBM_U26	15	30	1	1	0,7	T	z		DN	P	K
44.	W10MBM-SI3117W	Manufacturing Systems CNC (Maszyny technologiczne CNC i roboty)	1					KMBM _W20	15	30	1	1	0,6	T	z		DN		K
45.	W10MBM-SI3117L	Manufacturing Systems CNC (Maszyny technologiczne CNC i roboty)			1			KMBM _U20, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
46.	W10MBM-SI3117P	Manufacturing Systems CNC (Maszyny technologiczne CNC i roboty)				1		KMBM _U20, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
47.	W10MBM-SI3124W	Fundamentals of Exploitation and Repair (Podstawy eksploatacji i remontów maszyn)	2					KMBM _W20, KMBM _W21	30	60	2	2	1,2	T	z		DN		K
48.	W10MBM-SI3124L	Fundamentals of Exploitation and Repair (Podstawy eksploatacji i remontów maszyn)			1			KMBM _U21, KMBM_U27, KMBM _K02, KMBM _K05, KMBM _K10, KMBM _K11	15	30	1	1	0,7	T	z		DN	P	K
49.	W10MBM-SI3121W	Production System Organisation (Podstawy organizacji produkcji)	2					KMBM _W16	30	60	2		1,2	T	z				K
		Razem	**36**	**1**	**16**	**13**	**1**		**1005**	**2280**	**76**	**64**	**49,1**						

Razem dla bloków kierunkowych

Łączna liczba godzin				
w	ć	l	p	s
36	**1**	**16**	**13**	**1**

Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN[5]	Liczba punktów ECTS zajęć BU[1]
1005	**2280**	**76**	**64**	**49,1**

4.2. Lista bloków wybieralnych:

4.2.1 Lista bloków kształcenia ogólnego

4.2.1.1 Blok Przedmioty humanistyczno-menedżerskie (min. 3 pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	**MBM-SI1W-MEC1**	**Block of humanistic courses**	2					KMBM_W18, KMBM_K08, KMBM_K09	30	60	2		1,2	T	z	O			KO
	W08MBM-SI3002W	Introduction to Philosophy (Wstęp do filozofii)	2																
	W10MBM-SI3128W	Military technology in armed conflicts	2																
2.	**MBM-SI2W-MEC1**	**Block of humanistic courses**	1					KMBM _W11, KMBM_K10	15	30	1		0,6	T	z	O			KO
	W10MBM-SI3129W	Intellectual Property Law (Ochrona własności intelektualnej)	1																
	W08MBM-SI3003W	Patent and copyright (Prawo wynalazcze i autorskie)	1																
		Razem	**3**	**0**	**0**	**0**	**0**		**45**	**90**	**3**	**0**	**1,8**						

4.2.1.2 Blok Języki obce (min. 5 pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	SJO-SI0001	Foreign Language A1/A2/B1/B2.1/C1.1 (Języki obce)		4				KMBM_U11, KMBM_U24,KMBM_U28, KMBM_U29, KMBM_K06	60	60	2		2	T	z	O		P	KO
2.	SJO-SI0002	Foreign Language B2.2/C1.2 (Języki obce)		4				KMBM_U11, KMBM_U24,KMBM_U28, KMBM_U29, KMBM_K06	60	90	3		2,5	T	z	O		P	KO
		Razem	**0**	**8**	**0**	**0**	**0**		**120**	**150**	**5**	**0**	**4,5**						

4.2.1.3 Blok Zajęcia sportowe (min. 0 pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	SWF-S00001	Sport (Zajęcia sportowe)		2				KMBM _K07	30	0	0		0	T	z	O		P	KO
2.	SWF-S00001	Sport (Zajęcia sportowe)		2				KMBM _K07	30	0	0		0	T	z	O		P	KO
		Razem	**0**	**4**	**0**	**0**	**0**		**60**	**0**	**0**		**0**						

4.2.1.4 Technologie informacyjne (min. ...... pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
		Razem	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**						

Razem dla bloków kształcenia ogólnego

Łączna liczba godzin				
w	ć	l	p	s
3	**12**	**0**	**0**	**0**

Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN[5]	Liczba punktów ECTS zajęć BU[1]
225	**240**	**8**	**0**	**6,3**

4.2.2 Lista bloków z zakresu nauk podstawowych

4.2.2.1 Blok Matematyka (min. ...... pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2]kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
		Razem	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**						

4.2.2.2 Blok Fizyka (min. ...... pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2]kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
		Razem	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**						

4.2.2.3 Blok Chemia (min. ...... pkt. ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2]kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
		Razem	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**						

Razem dla bloków z zakresu nauk podstawowych

Łączna liczba godzin				
w	ć	l	p	s
0	**0**	**0**	**0**	**0**

Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN[5]	Liczba punktów ECTS zajęć BU[1]
0	**0**	**0**	**0**	**0**

4.2.3 Lista bloków kierunkowych

4.2.3.1 Blok Programowanie, modelowanie numeryczne

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	**MBM-SI5W-MEC1**	**Selectable Courses (Blok wybieralny)**				1		KMBM_U17, KMBM_K04	15	30	1	1	0,7	T	z		DN	P	S
	W10MBM-SI3130P	FEM analysis of strongly nonlinear applications in the MSC.MARC package				1													
	W10MBM-SI3131P	3D Engineering Graphics - SolidWorks				1													
	W10MBM-SI3132P	Dimensional and shape inspection with GOM Inspect and Solidworks				1													
	W10MBM-SI3133P	Computer-aided manufacturing in the CAD-CAM				1													
	W10MBM-SI3134P	Solid and surface modeling in CATIA				1													
	W10MBM-SI3135P	Numerical modelling				1													
	W10MBM-SI3136P	Engineering calculations with usage of spreadsheet				1													
	W10MBM-SI3137P	Geometry modelling and drawing creation with PTC Creo Parametric (formerly Pro/Engineer)				1													
	W10MBM-SI3138P	Planning high speed machining with Inventor HSM				1													
	W10MBM-SI3139P	Designing injection moulding and die casting tools in Solidworks				1													
	W10MBM-SI3140P	Computer Aided Design of heavy machinery assemblies (Inventor, AutoCAD)				1													
	W10MBM-SI3141P	Solving mechanics problems using Abaqus				1													
	W10MBM-SI3142P	Design techniques in solidworks				1													
	W10MBM-SI3143P	Creating technical drawings in Solidworks				1													
	W10MBM-SI3144P	Advanced functions and programming in Microsoft Excel				1													
	W10MBM-SI3145P	Advanced methods of modeling and analysis in CAD / FEM systems				1													
	W10MBM-SI3146P	Managing configurations and building parameterized libraries with Solidworks and Microsoft Excel				1													
	W10MBM-SI3147P	Advanced Computer Aided Engineering in the Catia system				1													
	W10MBM-SI3148P	Computer analysis of measurements data				1													
		Razem	**0**	**0**	**0**	**1**	**0**		**15**	**30**	**1**	**1**	**0,7**						

Razem dla bloków kierunkowych

Łączna liczba godzin					Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN[5]	Liczba punktów ECTS zajęć BU[1]
w	ć	l	p	s					
0	**0**	**0**	**1**	**0**	**15**	**30**	**1**	**1**	**0,7**

4.2.4 Lista bloków specjalnościowych

4.2.4.1 Blok Przedmioty specjalnościowe (min. 41 pkt ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI3104W	Vehicle Engineering (Budowa pojazdów samochodowych)	2					KMBM _W13	30	90	3	3	1,8	T	z		DN		S
2.	W10MBM-SI3105W	Trybology (Podstawy tribologii)	1					KMBM _W07, KMBM_W20	15	60	2	2	1,2	T	z		DN		S
3.	W10MBM-SI3105L	Trybology (Podstawy tribologii)			1			KMBM _U01, KMBM _U03, KMBM _K02, KMBM _K03, KMBM _K04	15	60	2	2	1,4	T	z		DN	P	S
4.	W10MBM-SI3103P	Computer Aided Machine Design I (Modelowanie komputerowe w projektowaniu)				1		KMBM_U08, KMBM _U14, KMBM _U17, KMBM_U18, KMBM_U27, KMBM _K04, KMBM _K05	15	30	1	1	0,7	T	z		DN	P	S
5.	W10MBM-SI3118P	Introduction to diploma dissertation (Wstęp do pracy dyplomowej)				1		KMBM _U01, KMBM _U02, KMBM _U22, KMBM _U25, KMBM _U28, KMBM _U31, KMBM _K03, KMBM _K04, KMBM _K05	15	90	3		2,1	T	z			P	S
6.	W10MBM-SI3112W	Offroad Vehicles Engineering (Inżynieria pojazdów przemysłowych)	2					KMBM _W01, KMBM _W14	30	60	2	2	1,2	T	z		DN		S
7.	W10MBM-SI3112L	Offroad Vehicles Engineering (Inżynieria pojazdów przemysłowych)			2			KMBM _U01, KMBM_U27	30	60	2	2	1,4	T	z		DN	P	S
8.	W10MBM-SI3112P	Offroad Vehicles Engineering (Inżynieria pojazdów przemysłowych)				1		KMBM _U01, KMBM_U27, KMBM _K01, KMBM _K04, KMBM _K10	15	30	1	1	0,7	T	z		DN	P	S
9.	W10MBM-SI3113W	Hydraulic Drive Systems (Napęd hydrauliczny)	2					KMBM_W14	30	60	2	2	1,2	T	E		DN		S
10.	W10MBM-SI3113L	Hydraulic Drive Systems (Napęd hydrauliczny)			2			KMBM_U14, KMBM _K04, KMBM _K09	30	60	2	2	1,4	T	z		DN	P	S
11.	W10MBM-SI3113P	Hydraulic Drive Systems (Napęd hydrauliczny)				1		KMBM_U14, KMBM _K04, KMBM _K09	15	30	1	1	0,7	T	z		DN	P	S
12.	W10MBM-SI3114W	Internal Combustion Engines (Silniki spalinowe)	1					KMBM _W13, KMBM _W14	15	30	1	1	0,6	T	z		DN		S
13.	W10MBM-SI3114L	Internal Combustion Engines (Silniki spalinowe)			1			KMBM _U27, KMBM _K01, KMBM _K02	15	30	1	1	0,7	T	z		DN	P	S
14.	W10MBM-SI3115W	Carrying Structures (Ustroje nośne)	1					KMBM _W13, KMBM _W14	15	30	1	1	0,6	T	z		DN		S
15.	W10MBM-SI3115P	Carrying Structures (Ustroje nośne)				2		KMBM_U18, KMBM_U14, KMBM _K04, KMBM _K05	30	60	2	2	1,4	T	z		DN	P	S
16.	W10MBM-SI3111P	Computer Aided Machine Design II (Modelowanie komputerowe w projektowaniu)				2		KMBM_U08, KMBM _U14, KMBM _U17, KMBM_U18, KMBM_U27, KMBM _K04, KMBM _K05	30	90	3	3	2,1	T	z		DN	P	S
17.	W10MBM-SI3126S	Thesis, Seminar (Seminarium dyplomowe)					1	KMBM _U22, KMBM _U28, KMBM_K01, KMBM _K02, KMBM _K05	15	30	1		0,7	T	z			P	S
18.	W10MBM-SI3122W	Polymers in Engineering (Tworzywa sztuczne konstrukcyjne)	2					KMBM _W20	30	90	3	3	1,8	T	z		DN		S
19.	W10MBM-SI3123W	Vehicles Loading Modelling (Modelowanie obciążeń pojazdów samochodowych)	1					KMBM _W20, KMBM_W21	15	60	2	2	1,2	T	z		DN		S
20.	W10MBM-SI3123P	Vehicles Loading Modelling (Modelowanie obciążeń pojazdów samochodowych)				1		KMBM _U18, KMBM _K01, KMBM _K05, KMBM _K09	15	60	2	2	1,4	T	z		DN	P	S
21.	W10MBM-SI3120W	Legal aspects of engineering activities (Uwarunkowania prawne działalności inżyniera)	1					KMBM _W18, KMBM _K01, KMBM _K05, KMBM _K09	15	30	1	1	0,6	T	z		DN		S
22.	W10MBM-SI3120P	Legal aspects of engineering activities (Uwarunkowania prawne działalności inżyniera)				1		KMBM _U25, KMBM _U26, KMBM _K01, KMBM _K05, KMBM _K09	15	30	1	1	0,7	T	z		DN	P	S
23.	**MBM-SI7W-MEC1**	**Selectable Courses**	**1**						15	60	2	2	1,2	T	z		DN		S
	W10MBM-SI3149W	Biomedical Engineering	1					KMBM _W09, KMBM _W08											
	W10MBM-SI3150W	Technique in Medicine	1					KMBM _W09, KMBM _W08, KMBM _K01, KMBM _K02, KMBM _K06, KMBM _K08											
		Razem	**14**	**0**	**6**	**10**	**1**		**465**	**1230**	**41**	**37**	**26,8**						

4.2.4.2 Blok Profil dyplomowania (min. …pkt ECTS):

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
		Razem	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**						

Razem dla bloków specjalnościowych

Łączna liczba godzin						Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN[5]	Liczba punktów ECTS zajęć BU[1]
w	ć	l	p	s						
14	**0**	**6**	**10**	**1**		**465**	**1230**	**41**	**37**	**26,8**

4.3 Blok praktyk Uchwała RW 174/16/RW10/2021-2024 nt. zasad zaliczania praktyki – zał. nr 2.1 do opisu programu studiów

Nazwa praktyki				
Liczba punktów ECTS	**Liczba punktów ECTS zajęć DN[5]**	**Liczba punktów ECTS zajęć BU[1]**	**Tryb zaliczenia praktyki**	**Kod**
3	3	3	**raport**	W10MBM-SI3119
Czas trwania praktyki	**Cel praktyki**			
4 tygodnie	Celem praktyki jest zdobycie doświadczenia przemysłowego, zapoznanie się z podstawowym wyposażeniem technicznym i technologicznym zakładów, zapoznanie się z pracą wyższego dozoru technicznego zakładu, a w szczególności: • poszerzenie wiedzy zdobytej na studiach i rozwijanie umiejętności jej wykorzystania, • zapoznanie się ze specyfiką środowiska zawodowego, • kształtowanie konkretnych umiejętności zawodowych związanych bezpośrednio z miejscem odbywania praktyki, • kształtowanie umiejętności skutecznego komunikowania się, • poznanie zasad organizacji pracy i podziału kompetencji, procedur, procesu planowania pracy, kontroli, • doskonalenie umiejętności organizacji pracy własnej, pracy zespołowej, efektywnego zarządzania czasem, sumienności, odpowiedzialności za powierzone zadania, • doskonalenie umiejętności posługiwania się językiem obcym w sytuacjach zawodowych. Poprzez swobodny wybór miejsca odbywania praktyki, m. in. przez własny wybór „firmy", student może realizować swoje zainteresowania zawodowe. Wynikiem tego może być sformułowanie indywidualnego tematu pracy dyplomowej inżynierskiej. Pierwsza praca zawodowa odbywa się często w miejscu praktyki.			

4.4 Blok "praca dyplomowa"

Typ pracy dyplomowej	~~licencjacka~~ / inżynierska / ~~magisterska~~	
Liczba semestrów pracy dyplomowej	**Liczba punktów ECTS**	**Kod**
1	**12**	**W10MBM-SI3127D**
Charakter pracy dyplomowej		
Praca dyplomowa inżynierska ma charakter użyteczny dla praktyki inżynierskiej. Jej przedmiotem jest w szczególności rozwiązanie zadania z zakresu: projektowania, eksperymentu pomiarowego, opracowania programu komputerowego oraz analizy części lub całości procesów o charakterze technicznym, organizacyjno-technicznym, ekonomiczno-technicznym. Nie ma ona wyłącznie charakteru opisowego, a jest w niej widoczna część będąca wkładem własnym studenta.		
Liczba punktów ECTS BU[1]	**8,4**	
Liczba punktów ECTS DN[5]	**12**	

5. Sposoby weryfikacji zakładanych efektów uczenia się

Typ zajęć	**Sposoby weryfikacji zakładanych efektów uczenia się**
wykład	*egzamin, kolokwium, kartkówka, odpowiedź ustna, udział w dyskusji*
ćwiczenia	*test, kolokwium, ocena przygotowania projektu, kartkówka, odpowiedź ustna, sprawdzian*
laboratorium	*wejściówka, sprawozdanie z laboratorium, kartkówka, odpowiedź ustna, sprawdzian, aktywność, referat, dyskusja*
projekt	*obrona projektu, kolokwium, kartkówka, test, dyskusja problemowa, prezentacja projektu, raport, odpowiedź ustna*
seminarium	*udział w dyskusji, prezentacja tematu, aktywność, raport*
praktyka	*raport z praktyki*
praca dyplomowa	*przygotowana praca dyplomowa*

6. Zakres egzaminu dyplomowego

Egzamin dyplomowy jest egzaminem ustnym sprawdzającym wiedzę nabytą przez studenta w czasie jego studiów, w zakresie danego planu i programu studiów a szczególności kartach przedmiotów. W czasie egzaminu studentowi zadawane są 3 pytania po jednym z poszczególnych grup.
•Grupa A skupia się na przedmiotach podstawowych w obszarze tematycznym ogólnie pojętej Mechaniki, Wytrzymałości Materiałów i Materiałoznawstwa.
•Grupa B – zakresem obejmuje zagadnienia związane z konstruowaniem, czyli obszar Podstaw Konstrukcji Maszyn, Teorii Maszyn i Mechanizmów oraz Podstaw Metody Elementów Skończonych.
•Grupa C swoim zakresem obejmuje metody pomiarowe oraz procesy technologii wytwarzania, związane Mechaniką i Budową Maszyn.
Lista obowiązujących pytań (zagadnień) egzaminacyjnych jest zatwierdzana i aktualizowana przez Komisję Programową i publikowana na stronie Wydziału. Pytania zadawane na egzaminie nie mogą wykraczać poza materiał kursów realizowanych przez studenta w toku kształcenia.

7. Wymagania dotyczące terminu zaliczenia określonych kursów/grup kursów lub wszystkich kursów w poszczególnych blokach

Lp.	Kod kursu	Nazwa kursu	Termin zaliczenia do... (numer semestru)

8. Plan studiów (załącznik nr 3 do programu studiów)

Zaopiniowane przez właściwy organ uchwałodawczy Samorządu Studenckiego:

SAMORZĄD STUDENCKI
Paulina Osuchowska
Wydziału Mechanicznego

31.03.2023 r.
....
Data

....
Imię, nazwisko i podpis przedstawiciela studentów

DZIEKAN
WYDZIAŁU MECHANICZNEGO

prof. dr hab. inż. CELINA PEZOWICZ

31.03.2023 r.
....
Data

....
Podpis Dziekana Wydziału / Dyrektora Filii

*niepotrzebne skreślić

[1]BU – liczba punktów ECTS przypisanych zajęciom wymagających bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia
[2]Tradycyjna – T, zdalna – Z
[3]Egzamin – E, zaliczenie na ocenę – Z. W grupie kursów po literze E lub Z w nawiasie wpisać formę kursu końcowego (w, c, l, p, s)
[4]Kurs/ grupa kursów Ogólnouczelniany – O
[5]Kurs/ grupa kursów związany/-na z prowadzoną działalnością naukową – DN
[6] Kurs / grupa kursów o charakterze praktycznym – P. W grupie kursów w nawiasie wpisać liczbę punktów ECTS dla kursów cząstkowych o charakterze praktycznym
[7]KO - kształcenia ogólnego, PD – podstawowy, K – kierunkowy, S – specjalnościowy

Załącznik nr 5 do Programu studiów ZW 121/2020
Załącznik nr 3 do programu studiów

PLAN STUDIÓW

WYDZIAŁ:	**MECHANICZNY**
KIERUNEK STUDIÓW:	**MECHANIKA i BUDOWA MASZYN**
POZIOM KSZTAŁCENIA:	**studia pierwszego stopnia (~~licencjackie~~ / inżynierskie*)** ~~/ studia drugiego stopnia / jednolite studia magisterskie~~ * FORMA STUDIÓW: **stacjonarna** / ~~niestacjonarna~~*
PROFIL:	**ogólnoakademicki** / ~~praktyczny~~ ***** **ogólnoakademicki**
SPECJALNOŚĆ:	**konstrukcja maszyn, urządzeń i pojazdów**
JĘZYK PROWADZENIA STUDIÓW:	**polski**
OBOWIĄZUJE OD CYKLU KSZTAŁCENIA:	**2023/2024**

*niepotrzebne skreślić

Struktura planu studiów (opcjonalnie)
w układzie punktowym oraz w układzie godzinowym

załącznik 3.1

1. Zestaw kursów / grup kursów obowiązkowych i wybieralnych w układzie semestralnym

Semestr 1

Kursy/grupy kursów obowiązkowe **liczba punktów ECTS 28**

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin: w	ć	l	p	s	Symbol efektu uczenia się	Liczba godzin: ZZU	CNPS	Liczba pkt. ECTS: łączna	zajęć DN[5]	zajęć BU[1]	Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów: ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI0065W	Grafika inżynierska - geometria wykreślna	1					KMBM _W05	15	30	1		0,6	T	z				PD
2.	W10MBM-SI0065C	Grafika inżynierska - geometria wykreślna		2				KMBM _U04	30	60	2		1,4	T	z			P	PD
3.	W10MBM-SI0066W	Chemia	2					KMBM _W03	30	60	2		1,2	T	z				PD
4.	W10MBM-SI0064W	Technologie informacyjne	2					KMBM _W04	30	60	2		1,2	T	z				PD
5.	W10MBM-SI0063W	Podstawy metrologii	1					KMBM _W10, KMBM _K04	15	30	1		0,6	T	z				K
6.	W10MBM-SI0062W	Ergonomia i BHP	1					KMBM _W17, KMBM _K02, KMBM_K03	15	30	1		0,6	T	z				KO
7.	W13MBM-SI0004W	Algebra liniowa z geometrią analityczną B	2					KMBM_W01	30	50	2		1,5	T	E	O			PD
8.	W13MBM-SI0004C	Algebra liniowa z geometrią analityczną B		1				KMBM_U01, KMBM_K12	15	50	2		0,7	T	z	O		P	PD
9.	W13MBM-SI0005W	Analiza matematyczna 1A	2					KMBM_W01	30	125	5		1,5	T	E	O			PD
10.	W13MBM-SI0005C	Analiza matematyczna 1A		2				KMBM_U01, KMBM_K12	30	75	3		1,5	T	z	O		P	PD
11.	W11MBM-SI0002W	Fizyka 1A	2					KMBM_W02, KMBM_K13	30	75	3		1,5	T	E	O			PD
12.	W11MBM-SI0002C	Fizyka 1A		1				KMBM_U02, KMBM_K13	15	50	2		1,4	T	z	O		P	PD
13.	W11MBM-SI0003L	Laboratorium podstaw fizyki			1			KMBM_U03, KMBM_K13	15	50	2		1,4	T	z	O		P	PD
		Razem	**13**	**6**	**1**	**0**	**0**		**300**	**745**	**28**	**0**	**15,1**						

Kursy/grupy kursów wybieralne (minimum 30 godzin w semestrze, 2 punktów ECTS)

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin: w	ć	l	p	s	Symbol efektu uczenia się	Liczba godzin: ZZU	CNPS	Liczba pkt. ECTS: łączna	zajęć DN[5]	zajęć BU[1]	Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów: ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	MBM-SI1W-0001	**BLOK HUMANISTYCZNY**	2					KMBM_W18, KMBM_K08, KMBM_K09	30	60	2		1,2	T	z	O			KO
	W08MBM-SI0002W	Wstęp do filozofii	2																
	W10MBM-SI0103W	Technika wojskowa w konfliktach zbrojnych	2																
		Razem	**2**	**0**	**0**	**0**	**0**		**30**	**60**	**2**	**0**	**1,2**						

Razem w semestrze

Łączna liczba godzin: w	ć	l	p	s	Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN5	Liczba punktów ECTS zajęć BU1
15	**6**	**1**	**0**	**0**	**330**	**805**	**30**	**0**	**16,3**

Semestr 2

Kursy/grupy kursów obowiązkowe **liczba punktów ECTS** **29**

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI0071W	Grafika inżynierska - zapis konstrukcji	1					KMBM _W06	15	30	1	1	0,6	T	z		DN		PD
2.	W10MBM-SI0071P	Grafika inżynierska - zapis konstrukcji				2		KMBM _U05	30	60	2	2	1,4	T	z		DN	P	PD
3.	W10MBM-SI0068W	Technologia materiałów inżynierskich	1					KMBM _W07	15	60	2	2	1,2	T	z		DN		K
4.	W10MBM-SI0068L	Technologia materiałów inżynierskich			1			KMBM _U06, KMBM _K04	15	60	2	2	1,4	T	z		DN	P	K
5.	W13MBM-SI0006W	Elementy analizy matematycznej 2	1					KMBM_W01	15	50	2		0,7	T	E	O			PD
6.	W13MBM-SI0006C	Elementy analizy matematycznej 2		1				KMBM_U01, KMBM_K12	15	50	2		0,7	T	z	O		P	PD
7.	W10MBM-SI0069W	Termodynamika techniczna	2					KMBM _W19	30	60	2	2	1,2	T	z		DN		PD
8.	W10MBM-SI0069L	Termodynamika techniczna			1			KMBM _U10, KMBM _K01, KMBM _K02, KMBM _K06	15	60	2	2	1,4	T	z		DN	P	PD
9.	W10MBM-SI0072W	Podstawy materiałoznawstwa	2					KMBM _W07	30	60	2	2	1,2	T	z		DN		PD
10.	W10MBM-SI0072L	Podstawy materiałoznawstwa			1			KMBM _U06	15	30	1	1	0,7	T	z		DN	P	PD
11.	W10MBM-SI0073W	Mechanika I	2					KMBM _W08	30	60	2	2	1,2	T	z		DN		PD
12.	W10MBM-SI0073C	Mechanika I		2				KMBM _U07	30	60	2	2	1,4	T	z		DN	P	PD
13.	W10MBM-SI0070W	Ekologia	1					KMBM _W17, KMBM_W18, KMBM_K08, KMBM_K10, KMBM_K11	15	30	1		0,6	T	z				K
14.	W10MBM-SI0067W	Maszynoznawstwo	1					KMBM_W13	15	30	1	1	0,6	T	z		DN		K
15.	W10MBM-SI0061W	Podstawy zarządzania	1					KMBM _W16, KMBM_K02, KMBM_K04, KMBM_K05, KMBM_K09, KMBM_K11	15	30	1		0,6	T	z				KO
16.	W05MBM-SI0003W	Elektrotechnika	2					KMBM _W12	30	60	2		1,2	T	z				K
17.	W12MBM-SI0002W	Elektronika	2					KMBM_W12, KMBM _K04	30	60	2		1,2	T	z				K
		Razem	**16**	**3**	**3**	**2**	**0**		**360**	**850**	**29**	**19**	**17,3**						

Kursy/grupy kursów wybieralne (minimum 45 godzin w semestrze, 1 punktów ECTS)

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	SWF-S00001	Zajęcia sportowe		2				KMBM _K07	30	0	0		0	T	z	O		P	KO
2.	MBM-SI2W-0001	**BLOK HUMANISTYCZNY:**	1					KMBM _W11, KMBM_K10	15	30	1		0,6	T	z	O			KO
	W10MBM-SI0104W	Ochrona własności intelektualnej	1																
	W08MBM-SI0003W	Prawo wynalazcze i autorskie	1																
		Razem	**1**	**2**	**0**	**0**	**0**		**45**	**30**	**1**	**0**	**0,6**						

Razem w semestrze

Łączna liczba godzin				
w	ć	l	p	s
17	**5**	**3**	**2**	**0**

Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN5	Liczba punktów ECTS zajęć BU1
405	**880**	**30**	**19**	**17,9**

Semestr 3

Kursy/grupy kursów obowiązkowe **liczba punktów ECTS** **30**

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI0074P	Grafika inżynierska 3D				2		KMBM _U05, KMBM _K04	30	60	2	2	1,4	T	z		DN	P	K
2.	W05MBM-SI0004L	Elektrotechnika			1			KMBM _U16, KMBM _K04	15	30	1		0,7	T	z		DN	P	K
3.	W10MBM-SI0082W	Statystyka inżynierska	1					KMBM _W01	15	30	1		0,6	T	z				PD
4.	W10MBM-SI0082P	Statystyka inżynierska				1		KMBM _U01, KMBM _K04, KMBM_K12	15	30	1		0,7	T	z			P	PD
5.	W10MBM-SI0075W	Mechanika płynów	2					KMBM _W08, KMBM _W02	30	60	2	2	1,2	T	z		DN		K
6.	W10MBM-SI0075C	Mechanika płynów		1				KMBM _U15, KMBM _U02	15	30	1	1	0,7	T	z		DN	P	K
7.	W10MBM-SI0076W	Materiałoznawstwo	2					KMBM _W07	30	90	3	3	1,8	T	E		DN		PD
8.	W10MBM-SI0076L	Materiałoznawstwo			1			KMBM _U06	15	60	2	2	1,4	T	z		DN	P	PD
9.	W10MBM-SI0083W	Mechanika II	2					KMBM _W08	30	60	2	2	1,2	T	E		DN		PD
10.	W10MBM-SI0083C	Mechanika II		2				KMBM _U07	30	60	2	2	1,4	T	z		DN	P	PD
11.	W10MBM-SI0078W	Tworzywa sztuczne	2					KMBM _W07, KMBM_W20	30	60	2	2	1,2	T	z		DN		K
12.	W10MBM-SI0078L	Tworzywa sztuczne			1			KMBM _U06, KMBM_U20, KMBM _K09	15	30	1	1	0,7	T	z		DN	P	K
13.	W10MBM-SI0080W	Techniki wytwarzania - odlewnictwo	1					KMBM _W20	15	60	2	2	1,2	T	z		DN		K
14.	W10MBM-SI0080L	Techniki wytwarzania - odlewnictwo			1			KMBM _U20, KMBM _K01, KMBM _K04, KMBM _K06	15	30	1	1	0,7	T	z		DN	P	K
15.	W10MBM-SI0081W	Podstawy wytrzymałości materiałów	2					KMBM _W09	30	60	2	2	1,2	T	z		DN		PD
16.	W10MBM-SI0081C	Podstawy wytrzymałości materiałów		1				KMBM _U08	15	30	1	1	0,7	T	z		DN	P	PD
17.	W10MBM-SI0079P	Informatyka podstawy programowania (Matlab)				2		KMBM _U17, KMBM _K04	30	60	2		1,4	T	z			P	K
18.	W10MBM-SI0077W	Równania różniczkowe zwyczajne	1					KMBM _W01	15	30	1		0,6	T	z				PD
19.	W10MBM-SI0077C	Równania różniczkowe zwyczajne		1				KMBM _U01, KMBM_K03, KMBM_K04, KMBM_K12	15	30	1		0,7	T	z			P	PD
		Razem	**13**	**5**	**4**	**5**	**0**		**405**	**900**	**30**	**23**	**19,5**						

Kursy/grupy kursów wybieralne (np. nazwa specjalności) (minimum …… godzin w semestrze, ……. punktów ECTS)

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
		Razem	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**						

Razem w semestrze

Łączna liczba godzin				
w	ć	l	p	s
13	**5**	**4**	**5**	**0**

Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN5	Liczba punktów ECTS zajęć BU1
405	**900**	**30**	**23**	**19,5**

Semestr 4

Kursy/grupy kursów obowiązkowe **liczba punktów ECTS** **28**

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI0085W	Podstawy konstrukcji maszyn I	2					KMBM _W13	30	90	3	3	1,8	T	E		DN		K
2.	W10MBM-SI0085L	Podstawy konstrukcji maszyn I			1			KMBM _U18, KMBM _U08, KMBM _U23, KMBM _K10	15	60	2	2	1,4	T	z		DN	P	K
3.	W10MBM-SI0085P	Podstawy konstrukcji maszyn I				2		KMBM _U18, KMBM _U08, KMBM _U23, KMBM _K10	30	60	2	2	1,4	T	z		DN	P	K
4.	W10MBM-SI0086W	Teoria mechanizmów i manipulatorów	2					KMBM _W15, KMBM_W08	30	60	2	2	1,2	T	E		DN		K
5.	W10MBM-SI0086P	Teoria mechanizmów i manipulatorów				2		KMBM _U07, KMBM_U14, KMBM _K04	30	90	3	3	2,1	T	z		DN	P	K
6.	W10MBM-SI0088W	Techniki wytwarzania - przeróbka plastyczna	1					KMBM _W20	15	60	2	2	1,2	T	z		DN		K
7.	W10MBM-SI0088L	Techniki wytwarzania - przeróbka plastyczna			1			KMBM _U20, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
8.	W10MBM-SI0087W	Techniki wytwarzania - spawalnictwo	1					KMBM _W20	15	60	2	2	1,2	T	z		DN		K
9.	W10MBM-SI0087L	Techniki wytwarzania - spawalnictwo			1			KMBM _U20, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
10.	W10MBM-SI0091W	Metrologia wielkości geometrycznych	1					KMBM _W10	15	30	1	1	0,6	T	z		DN		PD
11.	W10MBM-SI0091L	Metrologia wielkości geometrycznych			1			KMBM _U09	15	30	1	1	0,7	T	z		DN	P	PD
12.	W10MBM-SI0090W	Układy napędowe pojazdów	1					KMBM _W14	15	30	1	1	0,6	T	z		DN		K
13.	W10MBM-SI0090L	Układy napędowe pojazdów			1			KMBM _U27, KMBM _U19, KMBM _K02, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
14.	W10MBM-SI0089W	Wytrzymałość materiałów	2					KMBM _W09	30	60	2	2	1,2	T	E		DN		PD
15.	W10MBM-SI0089C	Wytrzymałość materiałów		1				KMBM _U08, KMBM_U07, KMBM _K01, KMBM _K03	15	60	2	2	1,4	T	z		DN	P	PD
16.	W10MBM-SI0105L	Podstawy wytrzymałości materiałów			1			KMBM _U08	15	30	1	1	0,7	T	z		DN	P	PD
17.	W10MBM-SI0084W	Metrologia przemysłowa			1			KMBM _U09, KMBM_U13, KMBM _K01, KMBM _K03	15	30	1	1	0,7	T	z		DN	P	K
		Razem	**10**	**1**	**7**	**4**	**0**		**330**	**840**	**28**	**28**	**18,3**						

Kursy/grupy kursów wybieralne (minimum 90 godzin w semestrze, 2 punkty ECTS)

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	SJO-SI0001	Języki obce A1/A2/B1/B2.1/C1.1		4				KMBM_U11, KMBM_U24,KMBM_U28, KMBM_U29, KMBM_K06	60	60	2		2	T	z	O		P	KO
2.	SWF-S00001	Zajęcia sportowe		2				KMBM _K07	30	0	0		0	T	z	O		P	KO
		Razem	**0**	**6**	**0**	**0**	**0**		**90**	**60**	**2**	**0**	**2**						

Razem w semestrze

Łączna liczba godzin				
w	ć	l	p	s
10	**7**	**7**	**4**	**0**

Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN5	Liczba punktów ECTS zajęć BU1
420	**900**	**30**	**28**	**20,3**

Semestr 5

Kursy/grupy kursów obowiązkowe **liczba punktów ECTS** **18**

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin w	ć	l	p	s	Symbol efektu uczenia się	Liczba godzin ZZU	CNPS	Liczba pkt. ECTS łączna	zajęć DN[5]	zajęć BU[1]	Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI0092W	Hydrostatyczne układy napędowe	1					KMBM _W13	15	30	1	1	0,6	T	z		DN		K
2.	W10MBM-SI0092L	Hydrostatyczne układy napędowe			1			KMBM _U14, KMBM_K09	15	30	1	1	0,7	T	z		DN	P	K
3.	W10MBM-SI0093W	Metoda elementów skończonych	1					KMBM _W20, KMBM _W13, KMBM_W09	15	30	1	1	0,6	T	z		DN		K
4.	W10MBM-SI0093P	Metoda elementów skończonych				2		KMBM _U17, KMBM _U08, KMBM_K02	30	60	2	2	1,4	T	z		DN	P	K
5.	W10MBM-SI0094W	Podstawy konstrukcji maszyn II	2					KMBM _W13	30	60	2	2	1,2	T	E		DN		K
6.	W10MBM-SI0094P	Podstawy konstrukcji maszyn II				2		KMBM _U18, KMBM _U08, KMBM _K02, KMBM _K03, KMBM _K05, KMBM _K11	30	90	3	3	2,1	T	z		DN	P	K
7.	W10MBM-SI0095W	Podstawy automatyki	2					KMBM _W01, KMBM _W12	30	60	2	2	1,2	T	E		DN		K
8.	W10MBM-SI0095L	Podstawy automatyki			2			KMBM _U19, KMBM_K05	30	60	2	2	1,4	T	z		DN	P	K
9.	W10MBM-SI0096W	Techniki wytwarzania - obróbka ubytkowa	3					KMBM _W20, KMBM _W13, KMBM_W09	45	60	2	2	1,2	T	E		DN		K
10.	W10MBM-SI0096L	Techniki wytwarzania - obróbka ubytkowa			2			KMBM _U20, KMBM _U17, KMBM _K04	30	60	2	2	1,4	T	z		DN	P	K
		Razem	**9**	**0**	**5**	**4**	**0**		**270**	**540**	**18**	**18**	**11,8**						

Kursy/grupy kursów wybieralne (minimum 150 godzin w semestrze, 12 punktów ECTS)

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin w	ć	l	p	s	Symbol efektu uczenia się	Liczba godzin ZZU	CNPS	Liczba pkt. ECTS łączna	zajęć DN[5]	zajęć BU[1]	Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	SJO-SI0002	Języki obce B2.2/C1.2		4				KMBM_U11, KMBM_U24,KMBM_U28, KMBM_U29, KMBM_K06	60	90	3		2,5	T	z	O		P	KO
2.	W10MBM-SI1012W	Budowa pojazdów samochodowych	2					KMBM _W13	30	90	3	3	1,8	T	z		DN		S
3.	W10MBM-SI1013W	Podstawy tribologii	1					KMBM _W07, KMBM_W20	15	60	2	2	1,2	T	z		DN		S
4.	W10MBM-SI1013L	Podstawy tribologii			1			KMBM _U01, KMBM _U03, KMBM _K02, KMBM _K03, KMBM _K04	15	60	2	2	1,4	T	z		DN	P	S
5.	W10MBM-SI1011P	Modelowanie komputerowe w projektowaniu I				1		KMBM_U08, KMBM _U14, KMBM _U17, KMBM_U18, KMBM_U27, KMBM _K04, KMBM _K05	15	30	1	1	0,7	T	z		DN	P	S

6.	**MBM-SI5W-0001**	**BLOK WYBIERALNY:**				1		KMBM_U17, KMBM_K04	15	30	1	1	0,7	T	z		DN	P	S
	W10MBM-SI106P	Analiza MES w zastosowaniach silnie nieliniowych w pakiecie MSC.MARC				1													
	W10MBM-SI107P	Grafika inżynierska 3D-SolidWorks				1													
	W10MBM-SI108P	Inspekcja wymiarowo-kształtowa 3D z wykorzystaniem programów GOM Inspect i Solidworks				1													
	W10MBM-SI109P	Komputerowo wspomagane wytwarzanie w systemie CAD-CAM				1													
	W10MBM-SI110P	Modelowanie bryłowe i powierzchniowe w systemie CATIA				1													
	W10MBM-SI111P	Modelowanie numeryczne				1													
	W10MBM-SI112P	Obliczenia inżynierskie z użyciem arkusza kalkulacyjnego				1													
	W10MBM-SI113P	Podstawy modelowania geometrii i generowanie dokumentacji z wykorzystaniem oprogramowanie PTC Creo Parametric				1													
	W10MBM-SI114P	Programowanie obróbki szybkościowej w programie Inventor HSM				1													
	W10MBM-SI115P	Projektowanie form wtryskowych i odlewniczych w programie Solidworks				1													
	W10MBM-SI116P	Projektowanie zespołów maszyn roboczych w systemach CAD (Inventor, AutoCAD)				1													
	W10MBM-SI117P	Rozwiązywanie zagadanień mechaniki w systemie ABAQUS				1													
	W10MBM-SI118P	Techniki projektowania - SolidWorks				1													
	W10MBM-SI119P	Tworzenie dokumentacji technicznej w programie Solidworks				1													
	W10MBM-SI120P	Zaawansowane funkcje i programowanie w Microsoft Excel				1													
	W10MBM-SI121P	Zaawansowane metody modelowania i analizy w systemach CAD/FEM				1													
	W10MBM-SI122P	Zarządzanie konfiguracjami i budowanie sparametryzowanych bibliotej danych CAD z wykorzystaniem programów Solidworks i Microsoft Excel				1													
	W10MBM-SI123P	Zaawansowane wspomaganie wytwarzania w systemie CATIA				1													
	W10MBM-SI124P	Komputerowa analiza danych pomiarowych				1													
		Razem	**3**	**4**	**1**	**2**	**0**		**150**	**360**	**12**	**9**	**8,3**						

Razem w semestrze

Łączna liczba godzin				
w	ć	l	p	s
12	**4**	**6**	**6**	**0**

Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN5	Liczba punktów ECTS zajęć BU1
420	**900**	**30**	**27**	**20,1**

Semestr 6

Kursy/grupy kursów obowiązkowe **liczba punktów ECTS** **6**

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI0097W	Bezpieczeństwo maszyn i procesów technologicznych	1					KMBM _W21	15	60	2	2	1,2	T	E		DN		K
2.	W10MBM-SI0097S	Bezpieczeństwo maszyn i procesów technologicznych					1	KMBM _U21, KMBM_U26	15	30	1	1	0,7	T	z		DN	P	K
3.	W10MBM-SI0098W	Maszyny technologiczne CNC i roboty	1					KMBM _W20	15	30	1	1	0,6	T	z		DN		K
4.	W10MBM-SI0098L	Maszyny technologiczne CNC i roboty			1			KMBM _U20, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
5.	W10MBM-SI0098P	Maszyny technologiczne CNC i roboty				1		KMBM _U20, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
		Razem	**2**	**0**	**1**	**1**	**1**		**75**	**180**	**6**	**6**	**3,9**						

Kursy/grupy kursów wybieralne (minimum 270 godzin w semestrze, 24 punkty ECTS)

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI0099	PRAKTYKA						KMBM_U30, KMBM_U25, KMBM_U23, KMBM_K03, KMBM_K04, KMBM_K05	0	90	3	3	3	T	z		DN	P	K
2.	W10MBM-SI1019P	Wstęp do pracy dyplomowej				1		KMBM _U01, KMBM _U02, KMBM _U22, KMBM _U25, KMBM _U28, KMBM _U31, KMBM _K03, KMBM _K04, KMBM _K05	15	90	3		2,1	T	z			P	S
3.	W10MBM-SI1016W	Inżynieria pojazdów przemysłowych	2					KMBM _W01, KMBM _W14	30	60	2	2	1,2	T	z		DN		S
4.	W10MBM-SI1016L	Inżynieria pojazdów przemysłowych			2			KMBM _U01, KMBM_U27	30	60	2	2	1,4	T	z		DN	P	S
5.	W10MBM-SI1016P	Inżynieria pojazdów przemysłowych				1		KMBM _U01, KMBM_U27, KMBM _K01, KMBM _K04, KMBM _K10	15	30	1	1	0,7	T	z		DN	P	S
6.	W10MBM-SI1017W	Napęd hydrauliczny	2					KMBM_W14	30	60	2	2	1,2	T	E		DN		S
7.	W10MBM-SI1017L	Napęd hydrauliczny			2			KMBM_U14, KMBM _K04, KMBM _K09	30	60	2	2	1,4	T	z		DN	P	S
8.	W10MBM-SI1017P	Napęd hydrauliczny				1		KMBM_U14, KMBM _K04, KMBM _K09	15	30	1	1	0,7	T	z		DN	P	S
9.	W10MBM-SI1018W	Silniki spalinowe	1					KMBM _W13, KMBM _W14	15	30	1	1	0,6	T	z		DN		S
10.	W10MBM-SI1018L	Silniki spalinowe			1			KMBM _U27, KMBM _K01, KMBM _K02	15	30	1	1	0,7	T	z		DN	P	S
11.	W10MBM-SI1015W	Ustroje nośne	1					KMBM _W13, KMBM _W14	15	30	1	1	0,6	T	z		DN		S
12.	W10MBM-SI1015P	Ustroje nośne				2		KMBM_U18, KMBM_U14, KMBM _K04, KMBM _K05	30	60	2	2	1,4	T	z		DN	P	S
13.	W10MBM-SI1014P	Modelowanie komputerowe w projektowaniu II				2		KMBM_U08, KMBM _U14, KMBM _U17, KMBM_U18, KMBM_U27, KMBM _K04, KMBM _K05	30	90	3	3	2,1	T	z		DN	P	S
		Razem	**6**	**0**	**5**	**7**	**0**		**270**	**720**	**24**	**21**	**17,1**						

Razem w semestrze

Łączna liczba godzin				
w	ć	l	p	s
8	**0**	**6**	**8**	**1**

Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN5	Liczba punktów ECTS zajęć BU1
345	**900**	**30**	**27**	**21**

Semestr 7

Kursy/grupy kursów obowiązkowe **liczba punktów ECTS** **6**

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI0101W	Podstawy eksploatacji i remontów maszyn	2					KMBM _W20, KMBM _W21	30	60	2	2	1,2	T	z		DN		K
2.	W10MBM-SI0101L	Podstawy eksploatacji i remontów maszyn			1			KMBM _U21, KMBM_U27, KMBM _K02, KMBM _K05, KMBM _K10, KMBM _K11	15	30	1	1	0,7	T	z		DN	P	K
3.	W10MBM-SI0102W	Zarządzanie w produkcji	1					KMBM _W16	15	30	1		0,6	T	z				KO
4.	W10MBM-SI0100W	Podstawy organizacji produkcji	2					KMBM _W16	30	60	2		1,2	T	z				K
		Razem	**5**	**0**	**1**	**0**	**0**		**90**	**180**	**6**	**3**	**3,7**						

Kursy/grupy kursów wybieralne (minimum 135 godzin w semestrze, 24 punkty ECTS)

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI1023S	Seminarium dyplomowe					1	KMBM _U22, KMBM _U28, KMBM_K01, KMBM _K02, KMBM _K05	15	30	1		0,7	T	z			P	S
2.	W10MBM-SI1024D	PRACA DYPLOMOWA				1		KMBM _U22, KMBM _U28, KMBM _U29, KMBM_U30, KMBM_U31, KMBM _K01, KMBM _K02, KMBM _K03, KMBM _K04, KMBM _K05, KMBM _K06, KMBM _K08, KMBM _K09, KMBM _K10,	15	360	12	12	8,4	T	z		DN	P	S
3.	W10MBM-SI1022W	Projektowanie elementów z tworzyw sztucznych	2					KMBM _W20	30	90	3	3	1,8	T	z		DN		S
4.	W10MBM-SI1020W	Modelowanie obciążeń pojazdów samochodowych	1					KMBM _W20, KMBM_W21	15	60	2	2	1,2	T	z		DN		S
5.	W10MBM-SI1020P	Modelowanie obciążeń pojazdów samochodowych				1		KMBM _U18, KMBM _K01, KMBM _K05, KMBM _K09	15	60	2	2	1,4	T	z		DN	P	S
6.	W10MBM-SI1021W	Uwarunkowania prawne działalności inżyniera	1					KMBM _W18, KMBM _K01, KMBM _K05, KMBM _K09	15	30	1	1	0,6	T	z		DN		S
7.	W10MBM-SI1021P	Uwarunkowania prawne działalności inżyniera				1		KMBM _U25, KMBM _U26, KMBM _K01, KMBM _K05, KMBM _K09	15	30	1	1	0,7	T	z		DN	P	S
8.	**MBM-SI7W-KMP2**	**BLOK WYBIERALNY:**	**1**						15	60	2	2	1,2	T	z		DN		S
	W10MBM-SI1025W	Biomechanika inżynierska	1					KMBM _W09, KMBM _W08											
	W10MBM-SI1026W	Technika w medycynie	1					KMBM _W09, KMBM _W08, KMBM _K01, KMBM _K02, KMBM _K06, KMBM _K08											
		Razem	**5**	**0**	**0**	**3**	**1**		**135**	**720**	**24**	**23**	**16**						

Razem w semestrze

Łączna liczba godzin					Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN5	Liczba punktów ECTS zajęć BU1
w	ć	l	p	s					
10	**0**	**1**	**3**	**1**	**225**	**900**	**30**	**26**	**19,7**

2. Zestaw egzaminów w układzie semestralnym

Kod kursu/grupy kursów	Nazwy kursów/ grup kursów kończących się egzaminem	Semestr
W13MBM-SI0004W	Algebra liniowa z geometrią analityczną B	1
W13MBM-SI0005W	Analiza matematyczna 1A	
W111MBM-SI0002W	Fizyka 1A	
W13MBM-SI0006W	Elementy analizy matematycznej 2	2
W10MBM-SI0076W	Materiałoznawstwo	3
W10MBM-SI0083W	Mechanika II	
W10MBM-SI0085W	Podstawy konstrukcji maszyn I	4
W10MBM-SI0086W	Teoria mechanizmów i manipulatorów	
W10MBM-SI0089W	Wytrzymałość materiałów	
W10MBM-SI0094W	Podstawy konstrukcji maszyn II	5
W10MBM-SI0095W	Podstawy automatyki	
W10MBM-SI0096W	Techniki wytwarzania - obróbka ubytkowa	
W10MBM-SI0097W	Bezpieczeństwo maszyn i procesów technologicznych	6
W10MBM-SI1017W	Napęd hydrauliczny	

3. Liczby dopuszczalnego deficytu punktów ECTS po poszczególnych semestrach

Semestr	Dopuszczalny deficyt punktów ECTS po semestrze
1	13
2	13
3	10
4	10
5	7
6	0
7	0

[1]BU – liczba punktów ECTS przypisanych zajęciom wymagających bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia
[2]Tradycyjna – T, zdalna – Z
[3]Egzamin – E, zaliczenie na ocenę – Z. W grupie kursów po literze E lub Z wpisać w nawiasie formę kursu końcowego (w, c, l, p, s)
[4]Kurs/ grupa kursów Ogólnouczelniany – O
[5]Kurs/ grupa kursów związany/-na z prowadzoną działalnością naukową – DN
[6] Kurs / grupa kursów o charakterze praktycznym – P. W grupie kursów w nawiasie wpisać liczbę punktów ECTS dla kursów o charakterze praktycznym
[7] KO - kształcenia ogólnego, PD – podstawowy, K – kierunkowy, S – specjalnościowy

Załącznik nr 5 do Programu studiów ZW 121/2020
Załącznik nr 3 do programu studiów

PLAN STUDIÓW

WYDZIAŁ:	**MECHANICZNY**
KIERUNEK STUDIÓW:	**MECHANIKA i BUDOWA MASZYN**
POZIOM KSZTAŁCENIA:	**studia pierwszego stopnia (~~licencjackie~~ / inżynierskie*)** ~~/ studia drugiego stopnia / jednolite studia magisterskie~~ * FORMA STUDIÓW: **stacjonarna** / ~~niestacjonarna~~*
PROFIL:	**ogólnoakademicki** / ~~praktyczny~~ ***** **ogólnoakademicki**
SPECJALNOŚĆ:	**technologie i systemy wytwórcze**
JĘZYK PROWADZENIA STUDIÓW:	**polski**
OBOWIĄZUJE OD CYKLU KSZTAŁCENIA:	**2023/2024**

*niepotrzebne skreślić

Struktura planu studiów (opcjonalnie)
w układzie punktowym oraz w układzie godzinowym

załącznik 3.1

1. Zestaw kursów / grup kursów obowiązkowych i wybieralnych w układzie semestralnym

Semestr 1

Kursy/grupy kursów obowiązkowe **liczba punktów ECTS 28**

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI0065W	Grafika inżynierska - geometria wykreślna	1					KMBM _W05	15	30	1		0,6	T	z				PD
2.	W10MBM-SI0065C	Grafika inżynierska - geometria wykreślna		2				KMBM _U04	30	60	2		1,4	T	z			P	PD
3.	W10MBM-SI0066W	Chemia	2					KMBM _W03	30	60	2		1,2	T	z				PD
4.	W10MBM-SI0064W	Technologie informacyjne	2					KMBM _W04	30	60	2		1,2	T	z				PD
5.	W10MBM-SI0063W	Podstawy metrologii	1					KMBM _W10, KMBM _K04	15	30	1		0,6	T	z				K
6.	W10MBM-SI0062W	Ergonomia i BHP	1					KMBM _W17, KMBM _K02, KMBM_K03	15	30	1		0,6	T	z				KO
7.	W13MBM-SI0004W	Algebra liniowa z geometrią analityczną B	2					KMBM_W01	30	50	2		1,5	T	E	O			PD
8.	W13MBM-SI0004C	Algebra liniowa z geometrią analityczną B		1				KMBM_U01, KMBM_K12	15	50	2		0,7	T	z	O		P	PD
9.	W13MBM-SI0005W	Analiza matematyczna 1A	2					KMBM_W01	30	125	5		1,5	T	E	O			PD
10.	W13MBM-SI0005C	Analiza matematyczna 1A		2				KMBM_U01, KMBM_K12	30	75	3		1,5	T	z	O		P	PD
11.	W11MBM-SI0002W	Fizyka 1A	2					KMBM_W02, KMBM_K13	30	75	3		1,5	T	E	O			PD
12.	W11MBM-SI0002C	Fizyka 1A		1				KMBM_U02, KMBM_K13	15	50	2		1,4	T	z	O		P	PD
13.	W11MBM-SI0003L	Laboratorium podstaw fizyki			1			KMBM_U03, KMBM_K13	15	50	2		1,4	T	z	O		P	PD
		Razem	**13**	**6**	**1**	**0**	**0**		**300**	**745**	**28**	**0**	**15,1**						

Kursy/grupy kursów wybieralne (minimum 30 godzin w semestrze, 2 punktów ECTS)

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	MBM-SI1W-0001	**BLOK HUMANISTYCZNY**	2					KMBM_W18, KMBM_K08, KMBM_K09	30	60	2		1,2	T	z	O			KO
	W08MBM-SI0002W	Wstęp do filozofii	2																
	W10MBM-SI0103W	Technika wojskowa w konfliktach zbrojnych	2																
		Razem	**2**	**0**	**0**	**0**	**0**		**30**	**60**	**2**	**0**	**1,2**						

Razem w semestrze

Łączna liczba godzin					Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN5	Liczba punktów ECTS zajęć BU1
w	ć	l	p	s					
15	**6**	**1**	**0**	**0**	**330**	**805**	**30**	**0**	**16,3**

Semestr 2

Kursy/grupy kursów obowiązkowe **liczba punktów ECTS** **29**

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI0071W	Grafika inżynierska - zapis konstrukcji	1					KMBM _W06	15	30	1	1	0,6	T	z		DN		PD
2.	W10MBM-SI0071P	Grafika inżynierska - zapis konstrukcji				2		KMBM _U05	30	60	2	2	1,4	T	z		DN	P	PD
3.	W10MBM-SI0068W	Technologia materiałów inżynierskich	1					KMBM _W07	15	60	2	2	1,2	T	z		DN		K
4.	W10MBM-SI0068L	Technologia materiałów inżynierskich			1			KMBM _U06, KMBM _K04	15	60	2	2	1,4	T	z		DN	P	K
5.	W13MBM-SI0006W	Elementy analizy matematycznej 2	1					KMBM_W01	15	50	2		0,7	T	E	O			PD
6.	W13MBM-SI0006C	Elementy analizy matematycznej 2		1				KMBM_U01, KMBM_K12	15	50	2		0,7	T	z	O		P	PD
7.	W10MBM-SI0069W	Termodynamika techniczna	2					KMBM _W19	30	60	2	2	1,2	T	z		DN		PD
8.	W10MBM-SI0069L	Termodynamika techniczna			1			KMBM _U10, KMBM _K01, KMBM _K02, KMBM _K06	15	60	2	2	1,4	T	z		DN	P	PD
9.	W10MBM-SI0072W	Podstawy materiałoznawstwa	2					KMBM _W07	30	60	2	2	1,2	T	z		DN		PD
10.	W10MBM-SI0072L	Podstawy materiałoznawstwa			1			KMBM _U06	15	30	1	1	0,7	T	z		DN	P	PD
11.	W10MBM-SI0073W	Mechanika I	2					KMBM _W08	30	60	2	2	1,2	T	z		DN		PD
12.	W10MBM-SI0073C	Mechanika I		2				KMBM _U07	30	60	2	2	1,4	T	z		DN	P	PD
13.	W10MBM-SI0070W	Ekologia	1					KMBM _W17, KMBM_W18, KMBM_K08, KMBM_K10, KMBM_K11	15	30	1		0,6	T	z				K
14.	W10MBM-SI0067W	Maszynoznawstwo	1					KMBM_W13	15	30	1	1	0,6	T	z		DN		K
15.	W10MBM-SI0061W	Podstawy zarządzania	1					KMBM _W16, KMBM_K02, KMBM_K04, KMBM_K05, KMBM_K09, KMBM_K11	15	30	1		0,6	T	z				KO
16.	W05MBM-SI0003W	Elektrotechnika	2					KMBM _W12	30	60	2		1,2	T	z				K
17.	W12MBM-SI0002W	Elektronika	2					KMBM_W12, KMBM _K04	30	60	2		1,2	T	z				K
		Razem	**16**	**3**	**3**	**2**	**0**		**360**	**850**	**29**	**19**	**17,3**						

Kursy/grupy kursów wybieralne (minimum 45 godzin w semestrze, 1 punktów ECTS)

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	SWF-S00001	Zajęcia sportowe		2				KMBM _K07	30	0	0		0	T	z	O		P	KO
2.	MBM-SI2W-0001	**BLOK HUMANISTYCZNY:**	1					KMBM _W11, KMBM_K10	15	30	1		0,6	T	z	O			KO
	W10MBM-SI0104W	Ochrona własności intelektualnej	1																
	W08MBM-SI0003W	Prawo wynalazcze i autorskie	1																
		Razem	**1**	**2**	**0**	**0**	**0**		**45**	**30**	**1**	**0**	**0,6**						

Razem w semestrze

Łączna liczba godzin					Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN5	Liczba punktów ECTS zajęć BU1
w	ć	l	p	s					
17	**5**	**3**	**2**	**0**	**405**	**880**	**30**	**19**	**17,9**

Semestr 3

Kursy/grupy kursów obowiązkowe **liczba punktów ECTS** **30**

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI0074P	Grafika inżynierska 3D				2		KMBM _U05, KMBM _K04	30	60	2	2	1,4	T	z		DN	P	K
2.	W05MBM-SI0004L	Elektrotechnika			1			KMBM _U16, KMBM _K04	15	30	1		0,7	T	z			P	K
3.	W10MBM-SI0082W	Statystyka inżynierska	1					KMBM _W01	15	30	1		0,6	T	z				PD
4.	W10MBM-SI0082P	Statystyka inżynierska				1		KMBM _U01, KMBM _K04, KMBM_K12	15	30	1		0,7	T	z			P	PD
5.	W10MBM-SI0075W	Mechanika płynów	2					KMBM _W08, KMBM _W02	30	60	2	2	1,2	T	z		DN		K
6.	W10MBM-SI0075C	Mechanika płynów		1				KMBM _U15, KMBM _U02	15	30	1	1	0,7	T	z		DN	P	K
7.	W10MBM-SI0076W	Materiałoznawstwo	2					KMBM _W07	30	90	3	3	1,8	T	E		DN		PD
8.	W10MBM-SI0076L	Materiałoznawstwo			1			KMBM _U06	15	60	2	2	1,4	T	z		DN	P	PD
9.	W10MBM-SI0083W	Mechanika II	2					KMBM _W08	30	60	2	2	1,2	T	E		DN		PD
10.	W10MBM-SI0083C	Mechanika II		2				KMBM _U07	30	60	2	2	1,4	T	z		DN	P	PD
11.	W10MBM-SI0078W	Tworzywa sztuczne	2					KMBM _W07, KMBM_W20	30	60	2	2	1,2	T	z		DN		K
12.	W10MBM-SI0078L	Tworzywa sztuczne			1			KMBM _U06, KMBM_U20, KMBM _K09	15	30	1	1	0,7	T	z		DN	P	K
13.	W10MBM-SI0080W	Techniki wytwarzania - odlewnictwo	1					KMBM _W20	15	60	2	2	1,2	T	z		DN		K
14.	W10MBM-SI0080L	Techniki wytwarzania - odlewnictwo			1			KMBM _U20, KMBM _K01, KMBM _K04, KMBM _K06	15	30	1	1	0,7	T	z		DN	P	K
15.	W10MBM-SI0081W	Podstawy wytrzymałości materiałów	2					KMBM _W09	30	60	2	2	1,2	T	z		DN		PD
16.	W10MBM-SI0081C	Podstawy wytrzymałości materiałów		1				KMBM _U08	15	30	1	1	0,7	T	z		DN	P	PD
17.	W10MBM-SI0079P	Informatyka podstawy programowania (Matlab)				2		KMBM _U17, KMBM _K04	30	60	2		1,4	T	z			P	K
18.	W10MBM-SI0077W	Równania różniczkowe zwyczajne	1					KMBM _W01	15	30	1		0,6	T	z				PD
19.	W10MBM-SI0077C	Równania różniczkowe zwyczajne		1				KMBM _U01, KMBM_K03, KMBM_K04, KMBM_K12	15	30	1		0,7	T	z			P	PD
		Razem	**13**	**5**	**4**	**5**	**0**		**405**	**900**	**30**	**23**	**19,5**						

Kursy/grupy kursów wybieralne (np. nazwa specjalności) (minimum …… godzin w semestrze, ……. punktów ECTS)

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
		Razem	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**						

Razem w semestrze

Łączna liczba godzin						Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN5	Liczba punktów ECTS zajęć BU1
w	ć	l	p	s						
13	**5**	**4**	**5**	**0**		**405**	**900**	**30**	**23**	**19,5**

Semestr 4

Kursy/grupy kursów obowiązkowe **liczba punktów ECTS 28**

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI0085W	Podstawy konstrukcji maszyn I	2					KMBM _W13	30	90	3	3	1,8	T	E		DN		K
2.	W10MBM-SI0085L	Podstawy konstrukcji maszyn I			1			KMBM _U18, KMBM _U08, KMBM _U23, KMBM _K10	15	60	2	2	1,4	T	z		DN	P	K
3.	W10MBM-SI0085P	Podstawy konstrukcji maszyn I				2		KMBM _U18, KMBM _U08, KMBM _U23, KMBM _K10	30	60	2	2	1,4	T	z		DN	P	K
4.	W10MBM-SI0086W	Teoria mechanizmów i manipulatorów	2					KMBM _W15, KMBM_W08	30	60	2	2	1,2	T	E		DN		K
5.	W10MBM-SI0086P	Teoria mechanizmów i manipulatorów				2		KMBM _U07, KMBM_U14, KMBM _K04	30	90	3	3	2,1	T	z		DN	P	K
6.	W10MBM-SI0088W	Techniki wytwarzania - przeróbka plastyczna	1					KMBM _W20	15	60	2	2	1,2	T	z		DN		K
7.	W10MBM-SI0088L	Techniki wytwarzania - przeróbka plastyczna			1			KMBM _U20, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
8.	W10MBM-SI0087W	Techniki wytwarzania - spawalnictwo	1					KMBM _W20	15	60	2	2	1,2	T	z		DN		K
9.	W10MBM-SI0087L	Techniki wytwarzania - spawalnictwo			1			KMBM _U20, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
10.	W10MBM-SI0091W	Metrologia wielkości geometrycznych	1					KMBM _W10	15	30	1	1	0,6	T	z		DN		PD
11.	W10MBM-SI0091L	Metrologia wielkości geometrycznych			1			KMBM _U09	15	30	1	1	0,7	T	z		DN	P	PD
12.	W10MBM-SI0090W	Układy napędowe pojazdów	1					KMBM _W14	15	30	1	1	0,6	T	z		DN		K
13.	W10MBM-SI0090L	Układy napędowe pojazdów			1			KMBM _U27, KMBM _U19, KMBM _K02, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
14.	W10MBM-SI0089W	Wytrzymałość materiałów	2					KMBM _W09	30	60	2	2	1,2	T	E		DN		PD
15.	W10MBM-SI0089C	Wytrzymałość materiałów		1				KMBM _U08, KMBM_U07, KMBM _K01, KMBM _K03	15	60	2	2	1,4	T	z		DN	P	PD
16.	W10MBM-SI0105L	Podstawy wytrzymałości materiałów			1			KMBM _U08	15	30	1	1	0,7	T	z		DN	P	PD
17.	W10MBM-SI0084W	Metrologia przemysłowa			1			KMBM _U09, KMBM_U13, KMBM _K01, KMBM _K03	15	30	1	1	0,7	T	z		DN	P	K
		Razem	**10**	**1**	**7**	**4**	**0**		**330**	**840**	**28**	**28**	**18,3**						

Kursy/grupy kursów wybieralne (minimum 90 godzin w semestrze, 2 punkty ECTS)

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	SJO-SI0001	Języki obce A1/A2/B1/B2.1/C1.1		4				KMBM_U11, KMBM_U24,KMBM_U28, KMBM_U29, KMBM_K06	60	60	2		2	T	z	O		P	KO
2.	SWF-S00001	Zajęcia sportowe		2				KMBM _K07	30	0	0		0	T	z	O		P	KO
		Razem	**0**	**6**	**0**	**0**	**0**		**90**	**60**	**2**	**0**	**2**						

Razem w semestrze

Łączna liczba godzin				
w	ć	l	p	s
10	**7**	**7**	**4**	**0**

Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN5	Liczba punktów ECTS zajęć BU1
420	**900**	**30**	**28**	**20,3**

Semestr 5

Kursy/grupy kursów obowiązkowe **liczba punktów ECTS** **18**

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI0092W	Hydrostatyczne układy napędowe	1					KMBM _W13	15	30	1	1	0,6	T	z		DN		K
2.	W10MBM-SI0092L	Hydrostatyczne układy napędowe			1			KMBM _U14, KMBM_K09	15	30	1	1	0,7	T	z		DN	P	K
3.	W10MBM-SI0093W	Metoda elementów skończonych	1					KMBM _W20, KMBM _W13, KMBM_W09	15	30	1	1	0,6	T	z		DN		K
4.	W10MBM-SI0093P	Metoda elementów skończonych				2		KMBM _U17, KMBM _U08, KMBM_K02	30	60	2	2	1,4	T	z		DN	P	K
5.	W10MBM-SI0094W	Podstawy konstrukcji maszyn II	2					KMBM _W13	30	60	2	2	1,2	T	E		DN		K
6.	W10MBM-SI0094P	Podstawy konstrukcji maszyn II				2		KMBM _U18, KMBM _U08, KMBM _K02, KMBM _K03, KMBM _K05, KMBM _K11	30	90	3	3	2,1	T	z		DN	P	K
7.	W10MBM-SI0095W	Podstawy automatyki	2					KMBM _W01, KMBM _W12	30	60	2	2	1,2	T	E		DN		K
8.	W10MBM-SI0095L	Podstawy automatyki			2			KMBM _U19, KMBM_K05	30	60	2	2	1,4	T	z		DN	P	K
9.	W10MBM-SI0096W	Techniki wytwarzania - obróbka ubytkowa	3					KMBM _W20, KMBM _W13, KMBM_W09	45	60	2	2	1,2	T	E		DN		K
10.	W10MBM-SI0096L	Techniki wytwarzania - obróbka ubytkowa			2			KMBM _U20, KMBM _U17, KMBM _K04	30	60	2	2	1,4	T	z		DN	P	K
		Razem	**9**	**0**	**5**	**4**	**0**		**270**	**540**	**18**	**18**	**11,8**						

Kursy/grupy kursów wybieralne (minimum 165 godzin w semestrze, 12 punktów ECTS)

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	SJO-SI0002	Języki obce B2.2/C1.2		4				KMBM_U11, KMBM_U24,KMBM_U28, KMBM_U29, KMBM_K06	60	90	3		2,5	T	z	O		P	KO
2.	W10MBM-SI2013P	Projektowanie procesów wytwarzania – obróbka bezubytkowa I				1		KMBM_U17, KMBM _U20, KMBM _K02	15	30	1	1	0,7	T	z		DN	P	S
3.	W10MBM-SI2014W	Komputerowa symulacja procesów odlewania	1					KMBM _W20, KMBM _K01	15	60	2	2	1,2	T	z		DN		S
4.	W10MBM-SI2014P	Komputerowa symulacja procesów odlewania				1		KMBM _U17, KMBM _K01	15	30	1	1	0,7	T	z		DN	P	S
5.	W10MBM-SI2015W	Technologie spajania	2					KMBM _W20, KMBM _K02	30	60	2	2	1,2	T	z		DN		S
6.	W10MBM-SI2015L	Technologie spajania			1			KMBM _U20, KMBM _K02	15	60	2	2	1,4	T	z		DN	P	S
7.	**MBM-SI5W-0001**	**BLOK WYBIERALNY:**				**1**		KMBM_U17, KMBM_K04	15	30	1	1	0,7	T	z		DN	P	S
	W10MBM-SI106P	Analiza MES w zastosowaniach silnie nieliniowych w pakiecie MSC.MARC				1													
	W10MBM-SI107P	Grafika inżynierska 3D-SolidWorks				1													
	W10MBM-SI108P	Inspekcja wymiarowo-kształtowa 3D z wykorzystaniem programów GOM Inspect i Solidworks				1													
	W10MBM-SI109P	Komputerowo wspomagane wytwarzanie w systemie CAD-CAM				1													
	W10MBM-SI110P	Modelowanie bryłowe i powierzchniowe w systemie CATIA				1													
	W10MBM-SI111P	Modelowanie numeryczne				1													
	W10MBM-SI112P	Obliczenia inżynierskie z użyciem arkusza kalkulacyjnego				1													
	W10MBM-SI113P	Podstawy modelowania geometrii i generowanie dokumentacji z wykorzystaniem oprogramowanie PTC Creo Parametric				1													
	W10MBM-SI114P	Programowanie obróbki szybkościowej w programie Inventor HSM				1													
	W10MBM-SI115P	Projektowanie form wtryskowych i odlewniczych w programie Solidworks				1													
	W10MBM-SI116P	Projektowanie zespołów maszyn roboczych w systemach CAD (Inventor, AutoCAD)				1													
	W10MBM-SI117P	Rozwiązywanie zagadnień mechaniki w systemie ABAQUS				1													
	W10MBM-SI118P	Techniki projektowania - SolidWorks				1													
	W10MBM-SI119P	Tworzenie dokumentacji technicznej w programie Solidworks				1													
	W10MBM-SI120P	Zaawansowane funkcje i programowanie w Microsoft Excel				1													
	W10MBM-SI121P	Zaawansowane metody modelowania i analizy w systemach CAD/FEM				1													
	W10MBM-SI122P	Zarządzanie konfiguracjami i budowanie sparametryzowanych bibliotej danych CAD z wykorzystaniem programów Solidworks i Microsoft Excel				1													
	W10MBM-SI123P	Zaawansowane wspomaganie wytwarzania w systemie CATIA				1													
	W10MBM-SI124P	Komputerowa analiza danych pomiarowych				1													
		Razem	**3**	**4**	**1**	**3**	**0**		**165**	**360**	**12**	**9**	**8,4**						

Razem w semestrze

Łączna liczba godzin				
w	ć	l	p	s
12	**4**	**6**	**7**	**0**

Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN5	Liczba punktów ECTS zajęć BU1
435	**900**	**30**	**27**	**20,2**

Semestr 6

Kursy/grupy kursów obowiązkowe **liczba punktów ECTS** **6**

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI0097W	Bezpieczeństwo maszyn i procesów technologicznych	1					KMBM _W21	15	60	2	2	1,2	T	E		DN		K
2.	W10MBM-SI0097S	Bezpieczeństwo maszyn i procesów technologicznych					1	KMBM _U21, KMBM_U26	15	30	1	1	0,7	T	z		DN	P	K
3.	W10MBM-SI0098W	Maszyny technologiczne CNC i roboty	1					KMBM _W20	15	30	1	1	0,6	T	z		DN		K
4.	W10MBM-SI0098L	Maszyny technologiczne CNC i roboty			1			KMBM _U20, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
5.	W10MBM-SI0098P	Maszyny technologiczne CNC i roboty				1		KMBM _U20, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
		Razem	**2**	**0**	**1**	**1**	**1**		**75**	**180**	**6**	**6**	**3,9**						

Kursy/grupy kursów wybieralne (minimum 240 godzin w semestrze, 24 punkty ECTS)

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI0099	PRAKTYKA						KMBM_U30, KMBM_U25, KMBM_U23, KMBM_K03, KMBM_K04, KMBM_K05	0	90	3	3	3	T	z		DN	P	K
2.	W10MBM-SI2022P	Wstęp do pracy dyplomowej				1		KMBM _U01, KMBM _U02, KMBM _U22, KMBM _U25, KMBM _U28, KMBM _U31, KMBM _K03, KMBM _K04, KMBM _K05	15	90	3		2,1	T	z			P	S
3.	W10MBM-SI2017W	Komputerowa symulacja procesów kształtowania plastycznego	1					KMBM _W20	15	60	2	2	1,2	T	z		DN		S
4.	W10MBM-SI2017P	Komputerowa symulacja procesów kształtowania plastycznego				1		KMBM_U17, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	S
5.	W10MBM-SI2018W	Narzędzia skrawające	1					KMBM _W20	15	30	1	1	0,6	T	z		DN		S
6.	W10MBM-SI2018L	Narzędzia skrawające			1			KMBM _U20, KMBM _K02, KMBM _K03	15	30	1	1	0,7	T	z		DN	P	S
7.	W10MBM-SI2019W	Planowanie wytwarzania CAD/CAM	1					KMBM _W20	15	30	1	1	0,6	T	z		DN		S
8.	W10MBM-SI2019L	Planowanie wytwarzania CAD/CAM			2			KMBM _U17, KMBM_U20, KMBM_K04	30	60	2	2	1,4	T	z		DN	P	S
9.	W10MBM-SI2020W	Projektowanie procesów technologicznych	1					KMBM_W20, KMBM _K01	15	60	2	2	1,2	T	z		DN		S
10.	W10MBM-SI2020P	Projektowanie procesów technologicznych				2		KMBM_U20, KMBM _K01	30	60	2	2	1,4	T	z		DN	P	S
11.	W10MBM-SI2021W	Technologia i materiały stosowane w wytwarzaniu konstrukcji lekkich	1					KMBM_W20, KMBM _K02	15	30	1	1	0,6	T	z		DN		S
12.	W10MBM-SI2021L	Technologia i materiały stosowane w wytwarzaniu konstrukcji lekkich			1			KMBM _U20, KMBM _K02	15	30	1	1	0,7	T	z		DN	P	S
13.	W10MBM-SI2021P	Technologia i materiały stosowane w wytwarzaniu konstrukcji lekkich				1		KMBM_U20, KMBM _K02	15	30	1	1	0,7	T	z		DN	P	S
14.	W10MBM-SI2016P	Projektowanie procesów wytwarzania – obróbka bezubytkowa II				2		KMBM_U17, KMBM _U20, KMBM _K02	30	90	3	3	2,1	T	z		DN	P	S
		Razem	**5**	**0**	**4**	**7**	**0**		**240**	**720**	**24**	**21**	**17**						

Razem w semestrze

Łączna liczba godzin					Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN5	Liczba punktów ECTS zajęć BU1
w	ć	l	p	s					
7	**0**	**5**	**8**	**1**	**315**	**900**	**30**	**27**	**20,9**

Semestr 7

Kursy/grupy kursów obowiązkowe **liczba punktów ECTS** **6**

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI0101W	Podstawy eksploatacji i remontów maszyn	2					KMBM _W20, KMBM _W21	30	60	2	2	1,2	T	z		DN		K
2.	W10MBM-SI0101L	Podstawy eksploatacji i remontów maszyn			1			KMBM _U21, KMBM_U27, KMBM _K02, KMBM _K05, KMBM _K10, KMBM _K11	15	30	1	1	0,7	T	z		DN	P	K
3.	W10MBM-SI0102W	Zarządzanie w produkcji	1					KMBM _W16	15	30	1		0,6	T	z				KO
4.	W10MBM-SI0100W	Podstawy organizacji produkcji	2					KMBM _W16	30	60	2		1,2	T	z				K
		Razem	**5**	**0**	**1**	**0**	**0**		**90**	**180**	**6**	**3**	**3,7**						

Kursy/grupy kursów wybieralne (minimum 150 godzin w semestrze, 24 punkty ECTS)

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI2027S	Seminarium dyplomowe					1	KMBM _U22, KMBM _U28, KMBM_K01, KMBM _K02, KMBM _K05	15	30	1		0,7	T	z			P	S
2.	W10MBM-SI2028D	PRACA DYPLOMOWA				1		KMBM _U22, KMBM _U28, KMBM _U29, KMBM_U30, KMBM_U31, KMBM _K01, KMBM _K02, KMBM _K03, KMBM _K04, KMBM _K05, KMBM _K06, KMBM _K08, KMBM _K09, KMBM _K10,	15	360	12	12	8,4	T	z		DN	P	S
3.	W10MBM-SI2025W	Technologie laserowe w wytwarzaniu	1					KMBM _W20	15	30	1	1	0,6	T	z		DN		S
4.	W10MBM-SI2025L	Technologie laserowe w wytwarzaniu			1			KMBM _U20	15	60	2	2	1,4	T	z		DN	P	S
5.	W10MBM-SI2026W	Technologie wytwarzania wyrobów z tworzyw sztucznych	1					KMBM _W20	15	60	2	2	1,2	T	z		DN		S
6.	W10MBM-SI2026L	Technologie wytwarzania wyrobów z tworzyw sztucznych			1			KMBM _U20, KMBM _K05	15	30	1	1	0,7	T	z		DN	P	S
7.	W10MBM-SI2023W	Utrzymanie ruchu maszyn i urządzeń wytwórczych	1					KMBM _W13	15	30	1	1	0,6	T	z		DN		S
8.	W10MBM-SI2024W	Technologie przyrostowe w budowie maszyn	1					KMBM _W20	15	30	1	1	0,6	T	z		DN		S
9.	W10MBM-SI2024L	Technologie przyrostowe w budowie maszyn			1			KMBM _U20	15	30	1	1	0,7	T	z		DN	P	S
10.	**MBM-SI7W-TSW2**	**BLOK WYBIERALNY:**	**1**						15	60	2	2	1,2	T	z		DN		S
	W10MBM-SI2029W	Metrologia w procesach wytwarzania	1					KMBM _W10, KMBM _K04, KMBM _K05											
	W10MBM-SI2030W	Badanie jakości wyrobów	1					KMBM _W10, KMBM _K04											
		Razem	**5**	**0**	**3**	**1**	**1**		**150**	**720**	**24**	**23**	**16,1**						

Razem w semestrze

Łączna liczba godzin				
w	ć	l	p	s
10	**0**	**4**	**1**	**1**

Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN5	Liczba punktów ECTS zajęć BU1
240	**900**	**30**	**26**	**19,8**

2. Zestaw egzaminów w układzie semestralnym

Kod kursu/grupy kursów	Nazwy kursów/ grup kursów kończących się egzaminem	Semestr
W13MBM-SI0004W	Algebra liniowa z geometrią analityczną B	1
W13MBM-SI0005W	Analiza matematyczna 1A	
W111MBM-SI0002W	Fizyka 1A	
W13MBM-SI0006W	Elementy analizy matematycznej 2	2
W10MBM-SI0076W	Materiałoznawstwo	3
W10MBM-SI0083W	Mechanika II	
W10MBM-SI0085W	Podstawy konstrukcji maszyn I	4
W10MBM-SI0086W	Teoria mechanizmów i manipulatorów	
W10MBM-SI0089W	Wytrzymałość materiałów	
W10MBM-SI0094W	Podstawy konstrukcji maszyn II	5
W10MBM-SI0095W	Podstawy automatyki	
W10MBM-SI0096W	Techniki wytwarzania - obróbka ubytkowa	
W10MBM-SI0097W	Bezpieczeństwo maszyn i procesów technologicznych	6

3. Liczby dopuszczalnego deficytu punktów ECTS po poszczególnych semestrach

Semestr	Dopuszczalny deficyt punktów ECTS po semestrze
1	13
2	13
3	10
4	10
5	7
6	0
7	0

[1]BU – liczba punktów ECTS przypisanych zajęciom wymagających bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia

[2]Tradycyjna – T, zdalna – Z

[3]Egzamin – E, zaliczenie na ocenę – Z. W grupie kursów po literze E lub Z wpisać w nawiasie formę kursu końcowego (w, c, l, p, s)

[4]Kurs/ grupa kursów Ogólnouczelniany – O

[5]Kurs/ grupa kursów związany/-na z prowadzoną działalnością naukową – DN

[6] Kurs / grupa kursów o charakterze praktycznym – P. W grupie kursów w nawiasie wpisać liczbę punktów ECTS dla kursów o charakterze praktycznym

[7] KO - kształcenia ogólnego, PD – podstawowy, K – kierunkowy, S – specjalnościowy

Załącznik nr 5 do Programu studiów ZW 121/2020
Załącznik nr 3 do programu studiów

PLAN STUDIÓW

WYDZIAŁ:	**MECHANICZNY**
KIERUNEK STUDIÓW:	**MECHANIKA i BUDOWA MASZYN**
POZIOM KSZTAŁCENIA:	**studia pierwszego stopnia (~~licencjackie~~ / inżynierskie*)** ~~/ studia drugiego stopnia / jednolite studia magisterskie~~ * FORMA STUDIÓW: **stacjonarna** / ~~niestacjonarna~~*
PROFIL:	**ogólnoakademicki** / ~~praktyczny~~ ***** **ogólnoakademicki**
SPECJALNOŚĆ:	**Mechanical Engineering Design**
JĘZYK PROWADZENIA STUDIÓW:	**angielski**
OBOWIĄZUJE OD CYKLU KSZTAŁCENIA:	**2023/2024**

*niepotrzebne skreślić

Struktura planu studiów (opcjonalnie)
w układzie punktowym oraz w układzie godzinowym

załącznik 3.1

1. Zestaw kursów / grup kursów obowiązkowych i wybieralnych w układzie semestralnym

Semestr 1

Kursy/grupy kursów obowiązkowe **liczba punktów ECTS** **28**

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI3074W	Engineering Graphics: Descriptive Geometry (Grafika inżynierska-geometria wykreślna)	1					KMBM _W05	15	30	1		0,6	T	z				PD
2.	W10MBM-SI3074C	Engineering Graphics: Descriptive Geometry (Grafika inżynierska-geometria wykreślna)		2				KMBM _U04	30	60	2		1,4	T	z			P	PD
3.	W10MBM-SI3076W	Chemistry (Chemia)	2					KMBM _W03	30	60	2		1,2	T	z				PD
4.	W10MBM-SI3075W	Information Technologies (Technologie informacyjne)	2					KMBM _W04	30	60	2		1,2	T	z				PD
5.	W10MBM-SI3073W	Fundamentals of metrology (Podstawy metrologii)	1					KMBM _W10, KMBM _K04	15	30	1		0,6	T	z				K
6.	W10MBM-SI3072W	Ergonomy and Safety (Ergonomia i BHP)	1					KMBM _W17, KMBM _K02, KMBM_K03	15	30	1		0,6	T	z				KO
7.	W13MBM-SI3004W	Linear Algebra with Analytic Geometry B (Algebra liniowa z geometrią analityczną B)	2					KMBM_W01	30	50	2		1,5	T	E	O			PD
8.	W13MBM-SI3004C	Linear Algebra with Analytic Geometry B(Algebra liniowa z geometrią analityczną B)		1				KMBM_U01, KMBM_K12	15	50	2		0,7	T	z	O		P	PD
9.	W13MBM-SI3005W	Mathematical Analysis 1A (Analiza matematyczna 1A)	2					KMBM_W01	30	125	5		1,5	T	E	O			PD
10.	W13MBM-SI3005C	Mathematical Analysis 1A (Analiza matematyczna 1A)		2				KMBM_U01, KMBM_K12	30	75	3		1,5	T	z	O		P	PD
11.	W11MBM-SI3002W	Physics 1A (Fizyka 1A)	2					KMBM_W02, KMBM_K13	30	75	3		1,5	T	E	O			PD
12.	W11MBM-SI3002C	Physics 1A (Fizyka 1A)		1				KMBM_U02, KMBM_K13	15	50	2		1,4	T	z	O		P	PD
13.	W11MBM-SI3003L	Basic physics laboratory (Laboratorium podstaw fizyki)			1			KMBM_U03, KMBM_K13	15	50	2		1,4	T	z	O		P	PD
		Razem	**13**	**6**	**1**	**0**	**0**		**300**	**745**	**28**	**0**	**15,1**						

Kursy/grupy kursów wybieralne (minimum 30 godzin w semestrze, 2 punktów ECTS)

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	MBM-SI1W-MEC1	**Block of humanistic courses**	2					KMBM_W18, KMBM_K08, KMBM_K09	30	60	2		1,2	T	z	O			KO
	W08MBM-SI3002W	Introduction to Philosophy (Wstęp do filozofii)	2																
	W10MBM-SI3128W	Military technology in armed conflicts	2																
		Razem	**2**	**0**	**0**	**0**	**0**		**30**	**60**	**2**	**0**	**1,2**						

Razem w semestrze

Łączna liczba godzin					Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN5	Liczba punktów ECTS zajęć BU1
w	ć	l	p	s					
15	**6**	**1**	**0**	**0**	**330**	**805**	**30**	**0**	**16,3**

Semestr 2

Kursy/grupy kursów obowiązkowe **liczba punktów ECTS** **29**

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2]kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI3078W	Engineering Graphics: Engineering Drawing (Grafika inżynierska-zapis konstrukcji)	1					KMBM _W06	15	30	1	1	0,6	T	z		DN		PD
2.	W10MBM-SI3078P	Engineering Graphics: Engineering Drawing (Grafika inżynierska-zapis konstrukcji)				2		KMBM _U05	30	60	2	2	1,4	T	z		DN	P	PD
3.	W10MBM-SI3079W	Engineering Materials Technology (Technologia materiałów inżynierskich)	1					KMBM _W07	15	60	2	2	1,2	T	z		DN		K
4.	W10MBM-SI3079L	Engineering Materials Technology (Technologia materiałów inżynierskich)			1			KMBM _U06, KMBM _K04	15	60	2	2	1,4	T	z		DN	P	K
5.	W13MBM-SI3006W	Elements of Mathematical Analysis E (Elementy analizy matematycznej 2)	1					KMBM_W01	15	50	2		0,7	T	E	O			PD
6.	W13MBM-SI3006C	Elements of Mathematical Analysis E (Elementy analizy matematycznej 2)		1				KMBM_U01, KMBM_K12	15	50	2		0,7	T	z	O		P	PD
7.	W10MBM-SI3080W	Thermodynamics (Termodynamika techniczna)	2					KMBM _W19	30	60	2	2	1,2	T	z		DN		PD
8.	W10MBM-SI3080L	Thermodynamics (Termodynamika techniczna)			1			KMBM _U10, KMBM _K01, KMBM _K02, KMBM _K06	15	60	2	2	1,4	T	z		DN	P	PD
9.	W10MBM-SI3081W	Fundamentals of Materials Science (Podstawy materiałoznawstwa)	2					KMBM _W07	30	60	2	2	1,2	T	z		DN		PD
10.	W10MBM-SI3081L	Fundamentals of Materials Science (Podstawy materiałoznawstwa)			1			KMBM _U06	15	30	1	1	0,7	T	z		DN	P	PD
11.	W10MBM-SI3082W	Mechanics I (Mechanika I)	2					KMBM _W08	30	60	2	2	1,2	T	z		DN		PD
12.	W10MBM-SI3082C	Mechanics I (Mechanika I)		2				KMBM _U07	30	60	2	2	1,4	T	z		DN	P	PD
13.	W10MBM-SI3083W	Ecology (Ekologia)	1					KMBM _W17, KMBM_W18, KMBM_K08, KMBM_K10, KMBM_K11	15	30	1		0,6	T	z				KO
14.	W10MBM-SI3077W	Theory of Machines (Maszynoznawstwo)	1					KMBM_W13	15	30	1	1	0,6	T	z		DN		K
15.	W10MBM-SI3071W	Essential of Management (Podstawy zarządzania)	1					KMBM _W16, KMBM_K02, KMBM_K04, KMBM_K05, KMBM_K09, KMBM_K11	15	30	1		0,6	T	z				KO
16.	W05MBM-SI3003W	Electrical Engineering (Elektrotechnika)	2					KMBM _W12	30	60	2		1,2	T	z				K
17.	W12MBM-SI3002W	Electronics (Elektronika)	2					KMBM_W12, KMBM _K04	30	60	2		1,2	T	z				K
		Razem	**16**	**3**	**3**	**2**	**0**		**360**	**850**	**29**	**19**	**17,3**						

Kursy/grupy kursów wybieralne (minimum 45 godzin w semestrze, 1 punktów ECTS)

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2]kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	SWF-S00001	Sport (Zajęcia sportowe)		2				KMBM _K07	30	0	0		0	T	z	O		P	KO
2.	MBM-SI2W-MEC1	**Block of humanistic courses**	1					KMBM _W11, KMBM_K10	15	30	1		0,6	T	z	O			KO
	W10MBM-SI3129W	Intellectual Property Law (Ochrona własności intelektualnej)	1																
	W08MBM-SI3003W	Patent and copyright (Prawo wynalazcze i autorskie)	1																
		Razem	**1**	**2**	**0**	**0**	**0**		**45**	**30**	**1**	**0**	**0,6**						

Razem w semestrze

Łączna liczba godzin				
w	ć	l	p	s
17	**5**	**3**	**2**	**0**

Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN5	Liczba punktów ECTS zajęć BU1
405	**880**	**30**	**19**	**17,9**

Semestr 3

Kursy/grupy kursów obowiązkowe **liczba punktów ECTS** **30**

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI3086P	Engineering Graphics 3D (Grafika inżynierska 3D)				2		KMBM _U05, KMBM _K04	30	60	2	2	1,4	T	z		DN	P	K
2.	W05MBM-SI3004L	Electrical Engineering (Elektrotechnika)			1			KMBM _U16, KMBM _K04	15	30	1		0,7	T	z			P	K
3.	W10MBM-SI3085W	Statistics for Engineers (Statystyka inżynierska)	1					KMBM _W01	15	30	1		0,6	T	z				PD
4.	W10MBM-SI3085P	Statistics for Engineers (Statystyka inżynierska)				1		KMBM _U01, KMBM _K04, KMBM_K12	15	30	1		0,7	T	z			P	PD
5.	W10MBM-SI3087W	Fluid Mechanics (Mechanika płynów)	2					KMBM _W08, KMBM _W02	30	60	2	2	1,2	T	z		DN		K
6.	W10MBM-SI3087C	Fluid Mechanics (Mechanika płynów)		1				KMBM _U15, KMBM _U02	15	30	1	1	0,7	T	z		DN	P	K
7.	W10MBM-SI3088W	Materials Science (Materiałoznawstwo)	2					KMBM _W07	30	90	3	3	1,8	T	E		DN		PD
8.	W10MBM-SI3088L	Materials Science (Materiałoznawstwo)			1			KMBM _U06	15	60	2	2	1,4	T	z		DN	P	PD
9.	W10MBM-SI3089W	Mechanics II (Mechanika II)	2					KMBM _W08	30	60	2	2	1,2	T	E		DN		PD
10.	W10MBM-SI3089C	Mechanics II (Mechanika II)		2				KMBM _U07	30	60	2	2	1,4	T	z		DN	P	PD
11.	W10MBM-SI3090W	Polymers I (Tworzywa sztuczne)	2					KMBM _W07, KMBM_W20	30	60	2	2	1,2	T	z		DN		K
12.	W10MBM-SI3090L	Polymers I (Tworzywa sztuczne)			1			KMBM _U06, KMBM_U20, KMBM _K09	15	30	1	1	0,7	T	z		DN	P	K
13.	W10MBM-SI3091W	Chipless Processes -Casting (Techniki wytwarzania - odlewnictwo)	1					KMBM _W20	15	60	2	2	1,2	T	z		DN		K
14.	W10MBM-SI3091L	Chipless Processes -Casting (Techniki wytwarzania - odlewnictwo)			1			KMBM _U20, KMBM _K01, KMBM _K04, KMBM _K06	15	30	1	1	0,7	T	z		DN	P	K
15.	W10MBM-SI3092W	Fundamentals of Materials Strength (Podstawy wytrzymałości materiałów)	2					KMBM _W09	30	60	2	2	1,2	T	z		DN		PD
16.	W10MBM-SI3092C	Fundamentals of Materials Strength (Podstawy wytrzymałości materiałów)		1				KMBM _U08	15	30	1	1	0,7	T	z		DN	P	PD
17.	W10MBM-SI3084P	Programming in MATLAB (Informatyka podstawy programowania Matlab)				2		KMBM _U17, KMBM _K04	30	60	2		1,4	T	z			P	K
18.	W10MBM-SI3093W	Ordinary Differential Equations (Równania różniczkowe zwyczajne)	1					KMBM _W01	15	30	1		0,6	T	z				PD
19.	W10MBM-SI3093C	Ordinary Differential Equations (Równania różniczkowe zwyczajne)		1				KMBM _U01, KMBM_K03, KMBM_K04, KMBM_K12	15	30	1		0,7	T	z			P	PD
		Razem	**13**	**5**	**4**	**5**	**0**		**405**	**900**	**30**	**23**	**19,5**						

Kursy/grupy kursów wybieralne (np. nazwa specjalności) (minimum …… godzin w semestrze, ……. punktów ECTS)

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
		Razem	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**						

Razem w semestrze

Łączna liczba godzin				
w	ć	l	p	s
13	**5**	**4**	**5**	**0**

Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN5	Liczba punktów ECTS zajęć BU1
405	**900**	**30**	**23**	**19,5**

Semestr 4

Kursy/grupy kursów obowiązkowe **liczba punktów ECTS 28**

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI3097W	Fundamentals of Machine Design I (Podstawy konstrukcji maszyn I)	2					KMBM _W13	30	90	3	3	1,8	T	E		DN		K
2.	W10MBM-SI3097L	Fundamentals of Machine Design I (Podstawy konstrukcji maszyn I)			1			KMBM _U18, KMBM _U08, KMBM _U23, KMBM _K10	15	60	2	2	1,4	T	z		DN	P	K
3.	W10MBM-SI3097P	Fundamentals of Machine Design I (Podstawy konstrukcji maszyn I)				2		KMBM _U18, KMBM _U08, KMBM _U23, KMBM _K10	30	60	2	2	1,4	T	z		DN	P	K
4.	W10MBM-SI3098W	Theory of Mechanisms and Manipulators E (Teoria mechanizmów i manipulatorów)	2					KMBM _W15, KMBM_W08	30	60	2	2	1,2	T	E		DN		K
5.	W10MBM-SI3098P	Theory of Mechanisms and Manipulators E (Teoria mechanizmów i manipulatorów)				2		KMBM _U07, KMBM_U14, KMBM _K04	30	90	3	3	2,1	T	z		DN	P	K
6.	W10MBM-SI3100W	Chipless Processes -Plastic Forming (Technki wytwarzania-przeróbka plastyczna)	1					KMBM _W20	15	60	2	2	1,2	T	z		DN		K
7.	W10MBM-SI3100L	Chipless Processes -Plastic Forming (Technki wytwarzania-przeróbka plastyczna)			1			KMBM _U20, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
8.	W10MBM-SI3101W	Chipless Processes -Welding Metallurgy (Techniki wytwarzania-spawalnictwo)	1					KMBM _W20	15	60	2	2	1,2	T	z		DN		K
9.	W10MBM-SI3101L	Chipless Processes -Welding Metallurgy (Techniki wytwarzania-spawalnictwo)			1			KMBM _U20, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
10.	W10MBM-SI3099W	Geometric Metrology (Metrologia wielkości geometrycznych)	1					KMBM _W10	15	30	1	1	0,6	T	z		DN		PD
11.	W10MBM-SI3099L	Geometric Metrology (Metrologia wielkości geometrycznych)			1			KMBM _U09	15	30	1	1	0,7	T	z		DN	P	PD
12.	W10MBM-SI3096W	Drive Systems (Układy napędowe pojazdów)	1					KMBM _W14	15	30	1	1	0,6	T	z		DN		K
13.	W10MBM-SI3096L	Drive Systems (Układy napędowe pojazdów)			1			KMBM _U27, KMBM _U19, KMBM _K02, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
14.	W10MBM-SI3102W	Strength of Materials (Wytrzymałość materiałów)	2					KMBM _W09	30	60	2	2	1,2	T	E		DN		PD
15.	W10MBM-SI3102C	Strength of Materials (Wytrzymałość materiałów)		1				KMBM _U08, KMBM_U07, KMBM _K01, KMBM _K03	15	60	2	2	1,4	T	z		DN	P	PD
16.	W10MBM-SI3094L	Fundamentals of Materials Strength (Podstawy wytrzymałości materiałów)			1			KMBM _U08	15	30	1	1	0,7	T	z		DN	P	PD
17.	W10MBM-SI3095L	Industrial Metrology (Metrologia przemysłowa)			1			KMBM _U09, KMBM_U13, KMBM _K01, KMBM _K03	15	30	1	1	0,7	T	z		DN	P	K
		Razem	**10**	**1**	**7**	**4**	**0**		**330**	**840**	**28**	**28**	**18,3**						

Kursy/grupy kursów wybieralne (minimum 90 godzin w semestrze, 2 punkty ECTS)

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	SJO-SI0001	Foreign Language A1/A2/B1/B2.1/C1.1 (Języki obce)		4				KMBM_U11, KMBM_U24,KMBM_U28, KMBM_U29, KMBM_K06	60	60	2		2	T	z	O		P	KO
2.	SWF-S00001	Sport (Zajęcia sportowe)		2				KMBM _K07	30	0	0		0	T	z	O		P	KO
		Razem	**0**	**6**	**0**	**0**	**0**		**90**	**60**	**2**	**0**	**2**						

Razem w semestrze

Łączna liczba godzin				
w	ć	l	p	s
10	**7**	**7**	**4**	**0**

Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN5	Liczba punktów ECTS zajęć BU1
420	**900**	**30**	**28**	**20,3**

Semestr 5

Kursy/grupy kursów obowiązkowe **liczba punktów ECTS 18**

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI3106W	Hydraulic, Hydrotronic and Pneumatic Systems (Hydrostatyczne układy napędowe)	1					KMBM _W13	15	30	1	1	0,6	T	z		DN		K
2.	W10MBM-SI3106L	Hydraulic, Hydrotronic and Pneumatic Systems (Hydrostatyczne układy napędowe)			1			KMBM _U14, KMBM_K09	15	30	1	1	0,7	T	z		DN	P	K
3.	W10MBM-SI3107W	Finite Elements Method (Metoda elementów skończonych)	1					KMBM _W20, KMBM _W13, KMBM_W09	15	30	1	1	0,6	T	z		DN		K
4.	W10MBM-SI3107P	Finite Elements Method (Metoda elementów skończonych)				2		KMBM _U17, KMBM _U08, KMBM_K02	30	60	2	2	1,4	T	z		DN	P	K
5.	W10MBM-SI3108W	Fundamentals of Machine Design II (Podstawy konstrukcji maszyn II)	2					KMBM _W13	30	60	2	2	1,2	T	E		DN		K
6.	W10MBM-SI3108P	Fundamentals of Machine Design II (Podstawy konstrukcji maszyn II)				2		KMBM _U18, KMBM _U08, KMBM _K02, KMBM _K03, KMBM _K05, KMBM _K11	30	90	3	3	2,1	T	z		DN	P	K
7.	W10MBM-SI3109W	Fundamentals of Automatic Control (Podstawy automatyki)	2					KMBM _W01, KMBM _W12	30	60	2	2	1,2	T	E		DN		K
8.	W10MBM-SI3109L	Fundamentals of Automatic Control (Podstawy automatyki)			2			KMBM _U19, KMBM_K05	30	60	2	2	1,4	T	z		DN	P	K
9.	W10MBM-SI3110W	Manufacturing Processes - Machining (Techki wytwarzania-obróbka ubytkowa)	3					KMBM _W20, KMBM _W13, KMBM_W09	45	60	2	2	1,2	T	E		DN		K
10.	W10MBM-SI3110L	Manufacturing Processes - Machining (Techki wytwarzania-obróbka ubytkowa)			2			KMBM _U20, KMBM _U17, KMBM _K04	30	60	2	2	1,4	T	z		DN	P	K
		Razem	**9**	**0**	**5**	**4**	**0**		**270**	**540**	**18**	**18**	**11,8**						

Kursy/grupy kursów wybieralne (minimum 150 godzin w semestrze, 12 punktów ECTS)

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	SJO-SI0002	Foreign Language B2.2/C1.2 (Języki obce)		4				KMBM_U11, KMBM_U24,KMBM_U28, KMBM_U29, KMBM_K06	60	90	3		2,5	T	z	O		P	KO
2.	W10MBM-SI3104W	Vehicle Engineering (Budowa pojazdów samochodowych)	2					KMBM _W13	30	90	3	3	1,8	T	z		DN		S
3.	W10MBM-SI3105W	Trybology (Podstawy tribologii)	1					KMBM _W07, KMBM_W20	15	60	2	2	1,2	T	z		DN		S
4.	W10MBM-SI3105L	Trybology (Podstawy tribologii)			1			KMBM _U01, KMBM _U03, KMBM _K02, KMBM _K03, KMBM _K04	15	60	2	2	1,4	T	z		DN	P	S
5.	W10MBM-SI3103P	Computer Aided Machine Design I (Modelowanie komputerowe w projektowaniu)				1		KMBM_U08, KMBM _U14, KMBM _U17, KMBM_U18, KMBM_U27, KMBM _K04, KMBM _K05	15	30	1	1	0,7	T	z		DN	P	S

6.	**MBM-SI5W-MEC1**	**Selectable Courses (Blok wybieralny)**				**1**		KMBM_U17, KMBM_K04	15	30	1	1	0,7	T	z		DN	P	S
	W10MBM-SI3130P	FEM analysis of strongly nonlinear applications in the MSC.MARC package				1													
	W10MBM-SI3131P	3D Engineering Graphics - SolidWorks				1													
	W10MBM-SI3132P	Dimensional and shape inspection with GOM Inspect and Solidworks				1													
	W10MBM-SI3133P	Computer-aided manufacturing in the CAD-CAM				1													
	W10MBM-SI3134P	Solid and surface modeling in CATIA				1													
	W10MBM-SI3135P	Numerical modelling				1													
	W10MBM-SI3136P	Engineering calculations with usage of spreadsheet				1													
	W10MBM-SI3137P	Geometry modelling and drawing creation with PTC Creo Parametric (formerly Pro/Engineer)				1													
	W10MBM-SI3138P	Planning high speed machining with Inventor HSM				1													
	W10MBM-SI3139P	Designing injection moulding and die casting tools in Solidworks				1													
	W10MBM-SI3140P	Computer Aided Design of heavy machinery assemblies (Inventor, AutoCAD)				1													
	W10MBM-SI3141P	Solving mechanics problems using Abaqus				1													
	W10MBM-SI3142P	Design techniques in solidworks				1													
	W10MBM-SI3143P	Creating technical drawings in Solidworks				1													
	W10MBM-SI3144P	Advanced functions and programming in Microsoft Excel				1													
	W10MBM-SI3145P	Advanced methods of modeling and analysis in CAD / FEM systems				1													
	W10MBM-SI3146P	Managing configurations and building parameterized libraries with Solidworks and Microsoft Excel				1													
	W10MBM-SI3147P	Advanced Computer Aided Engineering in the Catia system				1													
	W10MBM-SI3148P	Computer analysis of measurements data				1													
		Razem	**3**	**4**	**1**	**2**	**0**		**150**	**360**	**12**	**9**	**8,3**						

Razem w semestrze

Łączna liczba godzin				
w	ć	l	p	s
12	**4**	**6**	**6**	**0**

Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN5	Liczba punktów ECTS zajęć BU1
420	**900**	**30**	**27**	**20,1**

Semestr 6

Kursy/grupy kursów obowiązkowe **liczba punktów ECTS 6**

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI3116W	Safety of machines and technological processes (Bezpieczeństwo maszyn i procesów technologicznych)	1					KMBM _W21	15	60	2	2	1,2	T	E		DN		K
2.	W10MBM-SI3116S	Safety of machines and technological processes (Bezpieczeństwo maszyn i procesów technologicznych)					1	KMBM _U21, KMBM_U26	15	30	1	1	0,7	T	z		DN	P	K
3.	W10MBM-SI3117W	Manufacturing Systems CNC (Maszyny technologiczne CNC i roboty)	1					KMBM _W20	15	30	1	1	0,6	T	z		DN		K
4.	W10MBM-SI3117L	Manufacturing Systems CNC (Maszyny technologiczne CNC i roboty)			1			KMBM _U20, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
5.	W10MBM-SI3117P	Manufacturing Systems CNC (Maszyny technologiczne CNC i roboty)				1		KMBM _U20, KMBM _K04	15	30	1	1	0,7	T	z		DN	P	K
		Razem	**2**	**0**	**1**	**1**	**1**		**75**	**180**	**6**	**6**	**3,9**						

Kursy/grupy kursów wybieralne (minimum 270 godzin w semestrze, 24 punkty ECTS)

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI3119	Professional Training (praktyka)						KMBM_U30, KMBM_U25, KMBM_U23, KMBM_K03, KMBM_K04, KMBM_K05	0	90	3	3	3	T	z		DN	P	K
2.	W10MBM-SI3118P	Introduction to diploma dissertation (Wstęp do pracy dyplomowej)				1		KMBM _U01, KMBM _U02, KMBM _U22, KMBM _U25, KMBM _U28, KMBM _U31, KMBM _K03, KMBM _K04, KMBM _K05	15	90	3		2,1	T	z			P	S
3.	W10MBM-SI3112W	Offroad Vehicles Engineering (Inżynieria pojazdów przemysłowych)	2					KMBM _W01, KMBM _W14	30	60	2	2	1,2	T	z		DN		S
4.	W10MBM-SI3112L	Offroad Vehicles Engineering (Inżynieria pojazdów przemysłowych)			2			KMBM _U01, KMBM_U27	30	60	2	2	1,4	T	z		DN	P	S
5.	W10MBM-SI3112P	Offroad Vehicles Engineering (Inżynieria pojazdów przemysłowych)				1		KMBM _U01, KMBM_U27, KMBM _K01, KMBM _K04, KMBM _K10	15	30	1	1	0,7	T	z		DN	P	S
6.	W10MBM-SI3113W	Hydraulic Drive Systems (Napęd hydrauliczny)	2					KMBM_W14	30	60	2	2	1,2	T	E		DN		S
7.	W10MBM-SI3113L	Hydraulic Drive Systems (Napęd hydrauliczny)			2			KMBM_U14, KMBM _K04, KMBM _K09	30	60	2	2	1,4	T	z		DN	P	S
8.	W10MBM-SI3113P	Hydraulic Drive Systems (Napęd hydrauliczny)				1		KMBM_U14, KMBM _K04, KMBM _K09	15	30	1	1	0,7	T	z		DN	P	S
9.	W10MBM-SI3114W	Internal Combustion Engines (Silniki spalinowe)	1					KMBM _W13, KMBM _W14	15	30	1	1	0,6	T	z		DN		S
10.	W10MBM-SI3114L	Internal Combustion Engines (Silniki spalinowe)			1			KMBM _U27, KMBM _K01, KMBM _K02	15	30	1	1	0,7	T	z		DN	P	S
11.	W10MBM-SI3115W	Carrying Structures (Ustroje nośne)	1					KMBM _W13, KMBM _W14	15	30	1	1	0,6	T	z		DN		S
12.	W10MBM-SI3115P	Carrying Structures (Ustroje nośne)				2		KMBM_U18, KMBM_U14, KMBM _K04, KMBM _K05	30	60	2	2	1,4	T	z		DN	P	S
13.	W10MBM-SI3111P	Computer Aided Machine Design II (Modelowanie komputerowe w projektowaniu)				2		KMBM_U08, KMBM _U14, KMBM _U17, KMBM_U18, KMBM_U27, KMBM _K04, KMBM _K05	30	90	3	3	2,1	T	z		DN	P	S
		Razem	**6**	**0**	**5**	**7**	**0**		**270**	**720**	**24**	**21**	**17,1**						

Razem w semestrze

Łączna liczba godzin					Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć	Liczba punktów ECTS zajęć BU1
w	ć	l	p	s					
8	**0**	**6**	**8**	**1**	**345**	**900**	**30**	**27**	**21**

Semestr 7

Kursy/grupy kursów obowiązkowe **liczba punktów ECTS 6**

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI3124W	Fundamentals of Exploitation and Repair (Podstawy eksploatacji i remontów maszyn)	2					KMBM _W20, KMBM _W21	30	60	2	2	1,2	T	z		DN		K
2.	W10MBM-SI3124L	Fundamentals of Exploitation and Repair (Podstawy eksploatacji i remontów maszyn)			1			KMBM _U21, KMBM_U27, KMBM _K02, KMBM _K05, KMBM _K10, KMBM _K11	15	30	1	1	0,7	T	z		DN	P	K
3.	W10MBM-SI3125W	Management in production (Zarządzanie w produkcji)	1					KMBM _W16	15	30	1		0,6	T	z				KO
4.	W10MBM-SI3121W	Production System Organisation (Podstawy organizacji produkcji)	2					KMBM _W16	30	60	2		1,2	T	z				K
		Razem	**5**	**0**	**1**	**0**	**0**		**90**	**180**	**6**	**3**	**3,7**						

Kursy/grupy kursów wybieralne (minimum 135 godzin w semestrze, 24 punkty ECTS)

Lp.	Kod kursu / grupy kursów	Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol efektu uczenia się	Liczba godzin		Liczba pkt. ECTS			Forma[2] kursu/ grupy kursów	Sposób[3] zaliczenia	Kurs/grupa kursów			
			w	ć	l	p	s		ZZU	CNPS	łączna	zajęć DN[5]	zajęć BU[1]			ogólnouczelniany[4]	zw. z dział. nauk[5]	o char. prakt.[6]	rodzaj[7]
1.	W10MBM-SI3126S	Thesis, Seminar (Seminarium dyplomowe)					1	KMBM _U22, KMBM _U28, KMBM_K01, KMBM _K02, KMBM _K05	15	30	1		0,7	T	z			P	S
2.	W10MBM-SI3127D	Thesis: Final Engineering project (praca dyplomowa)				1		KMBM _U22, KMBM _U28, KMBM _U29, KMBM_U30, KMBM_U31, KMBM _K01, KMBM _K02, KMBM _K03, KMBM _K04, KMBM _K05, KMBM _K06, KMBM _K08, KMBM _K09, KMBM _K10,	15	360	12	12	8,4	T	z		DN	P	S
3.	W10MBM-SI3122W	Polymers in Engineering (Tworzywa sztuczne konstrukcyjne)	2					KMBM _W20	30	90	3	3	1,8	T	z		DN		S
4.	W10MBM-SI3123W	Vehicles Loading Modelling (Modelowanie obciążeń pojazdów samochodowych)	1					KMBM _W20, KMBM_W21	15	60	2	2	1,2	T	z		DN		S
5.	W10MBM-SI3123P	Vehicles Loading Modelling (Modelowanie obciążeń pojazdów samochodowych)				1		KMBM _U18, KMBM _K01, KMBM _K05, KMBM _K09	15	60	2	2	1,4	T	z		DN	P	S
6.	W10MBM-SI3120W	Legal aspects of engineering activities (Uwarunkowania prawne działalności inżyniera)	1					KMBM _W18, KMBM _K01, KMBM _K05, KMBM _K09	15	30	1	1	0,6	T	z		DN		S
7.	W10MBM-SI3120P	Legal aspects of engineering activities (Uwarunkowania prawne działalności inżyniera)				1		KMBM _U25, KMBM _U26, KMBM _K01, KMBM _K05, KMBM _K09	15	30	1	1	0,7	T	z		DN	P	S
8.	**MBM-SI7W-MEC1**	**Selectable Courses**	**1**						15	60	2	2	1,2	T	z		DN		S
	W10MBM-SI3149W	Biomedical Engineering	1					KMBM _W09, KMBM _W08											
	W10MBM-SI3150W	Technique in Medicine	1					KMBM _W09, KMBM _W08, KMBM _K01, KMBM _K02, KMBM _K06, KMBM _K08											
		Razem	**5**	**0**	**0**	**3**	**1**		**135**	**720**	**24**	**23**	**16**						

Razem w semestrze

Łączna liczba godzin				
w	ć	l	p	s
10	**0**	**1**	**3**	**1**

Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Łączna liczba punktów ECTS zajęć DN5	Liczba punktów ECTS zajęć BU1
225	**900**	**30**	**26**	**19,7**

2. Zestaw egzaminów w układzie semestralnym

Kod kursu/grupy kursów	Nazwy kursów/ grup kursów kończących się egzaminem	Semestr
W13MBM-SI3004W	Linear Algebra with Analytic Geometry B	1
W13MBM-SI3005W	Mathematical Analysis 1A (Analiza matematyczna 1A)	
W11MBM-SI3002W	Physics 1A (Fizyka 1A)	
W13MBM-SI3006W	Elements of Mathematical Analysis E (Elementy analizy matematycznej 2)	2
W10MBM-SI3088W	Materials Science (Materiałoznawstwo)	3
W10MBM-SI3089W	Mechanics II (Mechanika II)	
W10MBM-SI3097W	Fundamentals of Machine Design I (Podstawy konstrukcji maszyn I)	4
W10MBM-SI3098W	Theory of Mechanisms and Manipulators E (Teoria mechanizmów i manipulatorów)	
W10MBM-SI3102W	Strength of Materials (Wytrzymałość materiałów)	
W10MBM-SI3108W	Fundamentals of Machine Design II (Podstawy konstrukcji maszyn II)	5
W10MBM-SI3109W	Fundamentals of Automatic Control (Podstawy automatyki)	
W10MBM-SI3110W	Manufacturing Processes - Machining (Techki wytwarzania-obróbka ubytkowa)	
W10MBM-SI3116W	Safety of machines and technological processes (Bezpieczeństwo maszyn i procesów technologicznych)	6
W10MBM-SI3113W	Hydraulic Drive Systems (Napęd hydrauliczny)	

3. Liczby dopuszczalnego deficytu punktów ECTS po poszczególnych semestrach

Semestr	Dopuszczalny deficyt punktów ECTS po semestrze
1	13
2	13
3	10
4	10
5	7
6	0
7	0

[1]BU – liczba punktów ECTS przypisanych zajęciom wymagających bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia

[2]Tradycyjna – T, zdalna – Z

[3]Egzamin – E, zaliczenie na ocenę – Z. W grupie kursów po literze E lub Z wpisać w nawiasie formę kursu końcowego (w, c, l, p, s)

[4]Kurs/ grupa kursów Ogólnouczelniany – O

[5]Kurs/ grupa kursów związany/-na z prowadzoną działalnością naukową – DN

[6] Kurs / grupa kursów o charakterze praktycznym – P. W grupie kursów w nawiasie wpisać liczbę punktów ECTS dla kursów o charakterze praktycznym

[7] KO - kształcenia ogólnego, PD – podstawowy, K – kierunkowy, S – specjalnościowy

Opinia właściwego organu Samorządu Studenckiego

31.03.2023r.
....
Data

SAMORZĄD STUDENCKI
Paulina Osuchowska
Wydziału Mechanicznego
....
Imię, nazwisko i podpis przedstawiciela studentów

31.03.2023r.
....
Data

DZIEKAN
WYDZIAŁU MECHANICZNEGO
prof. dr hab. inż. CELINA PEZOWICZ
....
Podpis Dziekana Wydziału / Dyrektora Filii

[1]BU – liczba punktów ECTS przypisanych zajęciom wymagających bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia
[2]Tradycyjna – T, zdalna – Z
[3]Egzamin – E, zaliczenie na ocenę – Z. W grupie kursów po literze E lub Z wpisać w nawiasie formę kursu końcowego (w, c, l, p, s)
[4]Kurs/ grupa kursów Ogólnouczelniany – O
[5]Kurs/ grupa kursów związany/-na z prowadzoną działalnością naukową – DN
[6] Kurs / grupa kursów o charakterze praktycznym – P. W grupie kursów w nawiasie wpisać liczbę punktów ECTS dla kursów o charakterze praktycznym
[7] KO - kształcenia ogólnego, PD – podstawowy, K – kierunkowy, S – specjalnościowy

Zał. 2.1

RAMOWY PROGRAM PRAKTYKI ZAWODOWEJ

studia inżynierskie - I stopień stacjonarne

kierunki studiów: *Mechanika i Budowa Maszyn*

1. Czas trwania praktyki:

Minimalny czas trwania praktyki wynosi **4 tygodnie** (20 dni roboczych)

Jej realizacja powinna nastąpić w okresie przerwy semestralnej letniej (miesiące: lipiec, sierpień, wrzesień), po IV semestrze studiów.

2. Profil praktyki

Praktyka o charakterze ogólnomechanicznym z elementami charakterystycznymi dla danego kierunku studiów.

3. Cel praktyki:

Celem praktyki jest zdobycie doświadczenia przemysłowego w zakresie ogólnomechanicznym (zapoznanie się z podstawowym wyposażeniem technicznym i technologicznym zakładów o profilu mechanicznym) oraz kierunkowym (zapoznanie się z praca wyższego dozoru technicznego zakładu w obszarze związanym z kierunkiem studiów).

4. Sposób realizacji praktyki:

Student, po zapoznaniu go przez wytypowanych pracowników z organizacja zakładu, jego profilem produkcji i wyposażeniem technicznym powinien mieć możliwość obserwacji pracy, ew. obsługi maszyn i procesów technologicznych realizowanych w zakładzie oraz zapoznać się z praca kadry inżynierskiej.

5. Przebieg praktyki:

Sprawy organizacyjne (spotkanie z zakładowym opiekunem praktyki, szczegółowe omówienie programu praktyki, szkolenie BHP).

Zapoznanie studenta z profilem produkcji, organizacją i wyposażeniem technicznym zakładu.

Wykonywanie przez studenta prac leżących w zakresie obowiązków inżyniera, ustalonych przez zakładowego opiekuna praktyki, pod katem specjalizacji studenta.

6. Zaliczenie praktyki:

Student zobowiązany jest sporządzić sprawozdanie z praktyki.

Podstawa zaliczenia praktyki jest obecność studenta na praktyce (dopuszcza się 15% nieobecności usprawiedliwionej przypadkami losowymi), wykonywanie przez studenta poleceń zakładowego opiekuna praktyk i pozytywna opinia końcowa z zakładu pracy.

Praktykę zalicza opiekun uczelniany d/s praktyk, na podstawie sprawozdania sporządzonego przez studenta, pisemnej opinii zakładowego opiekuna praktyk oraz rozmowy ze studentem przy zaliczaniu praktyki na uczelni.

studia: I stopnia STACJONARNE kierunek: MECHANIKA i BUDOWA MASZYN (W10-MBMP-000P-OSIW7) specjalność: KONSTRUKCJA MASZYN, URZĄDZEŃ i POJAZDÓW

Format of each cell: course name
course code
form of class and hours (ECTS points in brackets). Column headers: W, C, L, P, S and one unlabelled column (shown here as "–").

etap	1I-MBM-000	2I-MBM-000	3I-MBM-000	4I-MBM-000	5I-MBM-KMP	6I-MBM-KMP	7I-MBM-KMP
		Podstawy zarządzania W10MBM-SI0061 W 15 (1)					
		Maszynoznawstwo W10MBM-SI0067 W 15 (1)					
		Technologia materiałów inżynierskich W10MBM-SI0068 W 15 (2), L 15 (2)	Grafika inżynierska 3D W10MBM-SI0074 P 30 (2)	Podstawy wytrzymałości materiałów W10MBM-SI0105 L 15 (1)			
	Ergonomia i BHP W10MBM-SI0062 W 15 (1)	Termodynamika techniczna W10MBM-SI0069 W 30 (2), L 15 (2)	Mechanika płynów W10MBM-SI0075 W 30 (2), C 15 (1)	Metrologia przemysłowa W10MBM-SI0084 L 15 (1)	Modelowanie komputerowe w projektowaniu I W10MBM-SI1011 P 15 (1)		
	Podstawy metrologii W10MBM-SI0063 W 15 (1)	Ekologia W10MBM-SI0070 W 15 (1)	Materiałoznawstwo E W10MBM-SI0076 W 30 (3), L 15 (2)	Podstawy konstrukcji maszyn I E W10MBM-SI0085 W 30 (3), L 15 (2), P 30 (2)	Budowa pojazdów samochodowych W10MBM-SI1012 W 30 (3)	Modelowanie komputerowe w projektowaniu II W10MBM-SI1014 P 30 (3)	Modelowanie obciążeń pojazdów samochodowych W10MBM-SI1020 W 15 (2), P 15 (2)
	Technologie informacyjne W10MBM-SI0064 W 30 (2)	Elektrotechnika W05MBM-SI0003 W 30 (2)	Równania różniczkowe zwyczajne W10MBM-SI0077 W 15 (1), C 15 (1)	Teoria mechanizmów i manipulatorów E W10MBM-SI0086 W 30 (2), P 30 (3)	Podstawy tribologii W10MBM-SI1013 W 15 (2), L 15 (2)	Ustroje nośne W10MBM-SI1015 W 15 (1), P 30 (2)	Uwarunkowania prawne działalności inżyniera W10MBM-SI1021 W 15 (1), P 15 (1)
	Grafika inżynierska - geometria wykreślna W10MBM-SI0065 W 15 (1), C 30 (2)	Elektronika W12MBM-SI0002 W 30 (2)	Elektrotechnika W05MBM-SI0004 L 15 (1)	Techniki wytwarzania - spawalnictwo W10MBM-SI0087 W 15 (2), L 15 (1)	BLOK KURSÓW: PROGRAMOWANIE, MODELOWANIE NUMERYCZNE MBM-SI5W-0001 P 15 (1)	Inżynieria pojazdów przemysłowych W10MBM-SI1016 W 30 (2), L 30 (2), P 15 (1)	Projektowanie elementów z tworzyw sztucznych W10MBM-SI1022 W 30 (3)
	Chemia W10MBM-SI0066 W 30 (2)	Grafika inżynierska - zapis konstrukcji W10MBM-SI0071 W 15 (1), P 30 (2)	Tworzywa sztuczne W10MBM-SI0078 W 30 (2), L 15 (1)	Techniki wytwarzania - przeróbka plastyczna W10MBM-SI0088 W 15 (2), L 15 (1)	Hydrostatyczne układy napędowe W10MBM-SI0092 W 15 (1), L 15 (1)	Napęd hydrauliczny E W10MBM-SI1017 W 30 (2), L 30 (2), P 15 (1)	BLOK WYBIERALNY MBM-SI7W-KMP2 W 15 (2)
	Algebra liniowa z gemetrią analityczną B E W13MBM-SI0004 W 30 (2), C 15 (2)	Podstawy materiałoznawstwa W10MBM-SI0072 W 30 (2), L 15 (1)	Informatyka podstawy programowania (Matlab) W10MBM-SI0079 P 30 (2)	Wytrzymałość materiałów E W10MBM-SI0089 W 30 (2), C 15 (2)	Metoda elementów skończonych W10MBM-SI0093 W 15 (1), P 30 (2)	Silniki spalinowe W10MBM-SI1018 W 15 (1), L 15 (1)	Podstawy organizacji produkcji W10MBM-SI0100 W 30 (2)
	Analiza matematyczna 1A E W13MBM-SI0005 W 30 (5), C 30 (3)	Mechanika I W10MBM-SI0073 W 30 (2), C 30 (2)	Techniki wytwarzania - odlewnictwo W10MBM-SI0080 W 15 (2), L 15 (1)	Układy napędowe pojazdów W10MBM-SI0090 W 15 (1), L 15 (1)	Podstawy konstrukcji maszyn II E W10MBM-SI0094 W 30 (2), P 30 (3)	Bezpieczeństwo maszyn i procesów technologicznych E W10MBM-SI0097 W 15 (2), S 15 (1)	Podstawy eksploatacji i remontów maszyn W10MBM-SI0101 W 30 (2), L 15 (1)
	Fizyka 1A E W11MBM-SI0002 W 30 (3), C 15 (2)	Elementy analizy matematycznej 2 E W13MBM-SI0006 W 15 (2), C 15 (2)	Podstawy wytrzymałości materiałów W10MBM-SI0081 W 30 (2), C 15 (1)	Metrologia wielkości geometrycznych W10MBM-SI0091 W 15 (1), L 15 (1)	Podstawy automatyki E W10MBM-SI0095 W 30 (2), L 30 (2)	Maszyny technologiczne CNC i roboty W10MBM-SI0098 W 15 (1), L 15 (1), P 15 (1)	Zarządzanie w produkcji W10MBM-SI0102 W 15 (1)
	Laboratorium podstaw fizyki W11MBM-SI0003 L 15 (2)	Zajęcia sportowe SWF-S00001 – 30 (0)	Statystyka inżynierska W10MBM-SI0082 W 15 (1), P 15 (1)	Zajęcia sportowe SWF-S00001 – 30 (0)	Techniki wytwarzania - obróbka ubytkowa E W10MBM-SI0096 W 45 (2), L 30 (2)	Wstęp do pracy dyplomowej W10MBM-SI1019 – 15 (3)	Seminarium dyplomowe W10MBM-SI1023 S 15 (1)
	Blok humanistyczny MBM-SI1W-0001 W 30 (2)	Blok humanistyczny MBM-SI2W-0001 W 15 (1)	Mechanika II E W10MBM-SI0083 W 30 (2), C 30 (2)	Języki obce A1/A2/B1/B2.1/C1.1 SJO-SI0001 C 60 (2)	Języki obce B2.2/C1.2 SJO-SI0002 C 60 (3)	PRAKTYKA W10MBM-SI0099 – (3)	PRACA DYPLOMOWA W10MBM-SI1024 – 15 (12)

sem.	ECTS		W	C	L	P	S	–
sem. 1	30	ECTS	19	9	2	0	0	0
	330	l. godz.	225	90	15	0	0	0
sem. 2	30	ECTS	19	4	5	2	0	0
	405	l. godz.	255	45	45	30	0	30
sem. 3	30	ECTS	15	5	5	5	0	0
	405	l. godz.	195	75	60	75	0	0
sem. 4	30	ECTS	13	4	8	5	0	0
	420	l. godz.	150	75	105	60	0	30
sem. 5	30	ECTS	13	3	7	7	0	0
	420	l. godz.	180	60	90	90	0	0
sem. 6	30	ECTS	9	0	6	8	1	6
	345	l. godz.	120	0	90	105	15	15
sem. 7	30	ECTS	13	0	1	3	1	12
	225	l. godz.	150	0	15	30	15	15

razem

W	C	L	P	S	BK
1275	345	420	390	30	90
2550					

ECTS	210

program obowiązuje od roku akad. 2023/2024

Blok humanistyczny							Blok humanistyczny						
MBM-SI1W-0001							MBM-SI2W-0001						
Wstęp do filozofii							Ochrona własności intelektualnej						
2							1						
W08MBM-SI0002	30						W10MBM-SI0104	15					
Technika wojskowa w konfliktach zbrojnych							Prawo wynalazcze i autorskie						
2							1						
W10MBM-SI0103	30						W08MBM-SI0003	15					

Blok					
MBM-SI5W-0001					
BLOK KURSÓW: PROGRAMOWANIE, MODELOWANIE NUMERYCZNE					
1					
				15	

W10MBM-SI0106	Analiza MES w zastosowaniach silnie nieliniowych w pakiecie MSC.MARC
W10MBM-SI0107	Grafika inżynierska 3D-SolidWorks
W10MBM-SI0108	Inspekcja wymiarowo-kształtowa 3D z wykorzystaniem programów GOM Inspect i Solidworks
W10MBM-SI0109	Komputerowo wspomagane wytwarzanie w systemie CAD-CAM-CATIA V5
W10MBM-SI0110	Modelowanie bryłowe i powierzchniowe w systemie CATIA
W10MBM-SI0111	Modelowanie numeryczne
W10MBM-SI0112	Obliczenia inżynierskie z użyciem arkusza kalkulacyjnego
W10MBM-SI0113	Podstawy modelowania geometrii i generowanie dokumentacji z wykorzystaniem oprogramowanie PTC Creo Parametric
W10MBM-SI0114	Programowanie obróbki szybkościowej w programie Inventor HSM
W10MBM-SI0115	Projektowanie form wtryskowych i odlewniczych w programie Solidworks
W10MBM-SI0116	Projektowanie zespołów maszyn roboczych w systemach CAD (Inventor, AutoCAD)
W10MBM-SI0117	Rozwiązywanie zagadanień mechaniki w systemie ABAQUS
W10MBM-SI0118	Techniki projektowania - SolidWorks
W10MBM-SI0119	Tworzenie dokumentacji technicznej w programie Solidworks
W10MBM-SI0120	Zaawansowane funkcje i programowanie w Microsoft Excel
W10MBM-SI0121	Zaawansowane metody modelowania i analizy w systemach CAD/FEM
W10MBM-SI0122	Zarządzanie konfiguracjami i budowanie sparametryzowanych bibliotej danych CAD z wykorzystaniem programów Solidworks i Microsoft Excel
W10MBM-SI0123	Zaawansowane wspomaganie wytwarzania w systemie CATIA
W10MBM-SI0124	Komputerowa analiza danych pomiarowych

Blok wybieralny						
MBM-SI7W-KMP2						
Biomechanika inżynierska						
2						
W10MBM-SI1025	15					
Technika w medycynie						
2						
W10MBM-SI1026	15					

studia: I stopnia STACJONARNE kierunek: MECHANIKA i BUDOWA MASZYN (W10-MBMP-000P-OSIW7) specjalność: TECHNOLOGIE I SYSTEMY WYTWÓRCZE

etap

1I-MBM-000 (sem. 1)

Kurs	ECTS	Kod	W	C	L	P	S	
Ergonomia i BHP	1	W10MBM-SI0062	15					
Podstawy metrologii	1	W10MBM-SI0063	15					
Technologie informacyjne	2	W10MBM-SI0064	30					
Grafika inżynierska - geometria wykreślna	1 2	W10MBM-SI0065	15	30				
Chemia	2	W10MBM-SI0066	30					
Algebra liniowa z gemetrią analityczną B E	2 2	W13MBM-SI0004	30	15				
Analiza matematyczna 1A E	5 3	W13MBM-SI0005	30	30				
Fizyka 1A E	3 2	W11MBM-SI0002	30	15				
Laboratorium podstaw fizyki	2	W11MBM-SI0003			15			
Blok humanistyczny	2	MBM-SI1W-0001	30					
30	ECTS		19	9	2	0	0	0
330	l. godz.		225	90	15	0	0	0

2I-MBM-000 (sem. 2)

Kurs	ECTS	Kod	W	C	L	P	S	
Podstawy zarządzania	1	W10MBM-SI0061	15					
Maszynoznawstwo	1	W10MBM-SI0067	15					
Technologia materiałów inżynierskich	2 2	W10MBM-SI0068	15		15			
Termodynamika techniczna	2 2	W10MBM-SI0069	30		15			
Ekologia	1	W10MBM-SI0070	15					
Elektrotechnika	2	W05MBM-SI0003	30					
Elektronika	2	W12MBM-SI0002	30					
Grafika inżynierska - zapis konstrukcji	1 2	W10MBM-SI0071	15			30		
Podstawy materiałoznawstwa	2 1	W10MBM-SI0072	30		15			
Mechanika I	2 2	W10MBM-SI0073	30	30				
Elementy analizy matematycznej 2 E	2 2	W13MBM-SI0006	15	15				
Zajęcia sportowe	0	SWF-S00001						30
Blok humanistyczny	1	MBM-SI2W-0001	15					
30	ECTS		19	4	5	2	0	0
405	l. godz.		255	45	45	30	0	30

3I-MBM-000 (sem. 3)

Kurs	ECTS	Kod	W	C	L	P	S	
Grafika inżynierska 3D	2	W10MBM-SI0074				30		
Mechanika płynów	2 1	W10MBM-SI0075	30	15				
Materiałoznawstwo E	3 2	W10MBM-SI0076	30		15			
Równania różniczkowe zwyczajne	1 1	W10MBM-SI0077	15	15				
Elektrotechnika	1	W05MBM-SI0004			15			
Tworzywa sztuczne	2 1	W10MBM-SI0078	30		15			
Informatyka podstawy programowania (Matlab)	2	W10MBM-SI0079				30		
Techniki wytwarzania - odlewnictwo	2 1	W10MBM-SI0080	15		15			
Podstawy wytrzymałości materiałów	2 1	W10MBM-SI0081	30	15				
Statystyka inżynierska	1 1	W10MBM-SI0082	15			15		
Mechanika II E	2 2	W10MBM-SI0083	30	30				
30	ECTS		15	5	5	5	0	0
405	l. godz.		195	75	60	75	0	0

4I-MBM-000 (sem. 4)

Kurs	ECTS	Kod	W	C	L	P	S	
Podstawy wytrzymałości materiałów	1	W10MBM-SI0105			15			
Metrologia przemysłowa	1	W10MBM-SI0084			15			
Podstawy konstrukcji maszyn I E	3 2 2	W10MBM-SI0085	30		15	30		
Teoria mechanizmów i manipulatorów E	2 3	W10MBM-SI0086	30			30		
Techniki wytwarzania - spawalnictwo	2 1	W10MBM-SI0087	15		15			
Techniki wytwarzania - przeróbka plastyczna	2 1	W10MBM-SI0088	15		15			
Wytrzymałość materiałów E	2 2	W10MBM-SI0089	30	15				
Układy napędowe pojazdów	1 1	W10MBM-SI0090	15		15			
Metrologia wielkości geometrycznych	1 1	W10MBM-SI0091	15		15			
Zajęcia sportowe	0	SWF-S00001						30
Języki obce A1/A2/B1/B2.1/C1.1	2	SJO-SI0001		60				
30	ECTS		13	4	8	5	0	0
420	l. godz.		150	75	105	60	0	30

5I-MBM-TSW (sem. 5)

Kurs	ECTS	Kod	W	C	L	P	S	
Projektowanie procesów wytwarzania – obróbka bezubytkowa I	1	W10MBM-SI2013				15		
Komputerowa symulacja procesów odlewania	2 1	W10MBM-SI2014	15			15		
Technologie spajania	2 2	W10MBM-SI2015	30		15			
BLOK KURSÓW: PROGRAMOWANIE, MODELOWANIE NUMERYCZNE	1	MBM-SI5W-0001				15		
Hydrostatyczne układy napędowe	1 1	W10MBM-SI0092	15		15			
Metoda elementów skończonych	1 2	W10MBM-SI0093	15			30		
Podstawy konstrukcji maszyn II E	2 3	W10MBM-SI0094	30			30		
Podstawy automatyki E	2 2	W10MBM-SI0095	30		30			
Techniki wytwarzania - obróbka ubytkowa E	2 2	W10MBM-SI0096	45		30			
Języki obce B2.2/C1.2	3	SJO-SI0002		60				
30	ECTS		12	3	7	8	0	0
435	l. godz.		180	60	90	105	0	0

6I-MBM-TSW (sem. 6)

Kurs	ECTS	Kod	W	C	L	P	S	
Projektowanie procesów wytwarzania – obróbka bezubytkowa II	3	W10MBM-SI2016				30		
Komputerowa symulacja procesów kształtowania plastycznego	2 1	W10MBM-SI2017	15			15		
Narzędzia skrawające	1 1	W10MBM-SI2018	15		15			
Planowanie wytwarzania CAD/CAM	1 2	W10MBM-SI2019	15		30			
Projektowanie procesów technologicznych	2 2	W10MBM-SI2020	15			30		
Technologia i materiały stosowane w wytwarzaniu konstrukcji lekkich	1 1 1	W10MBM-SI2021	15		15	15		
Bezpieczeństwo maszyn i procesów technologicznych E	2 1	W10MBM-SI0097	15				15	
Maszyny technologiczne CNC i roboty	1 1 1	W10MBM-SI0098	15		15	15		
Wstęp do pracy dyplomowej	3	W10MBM-SI2022						15
PRAKTYKA	3	W10MBM-SI0099						
30	ECTS		10	0	5	8	1	6
315	l. godz.		105	0	75	105	15	15

7I-MBM-TSW (sem. 7)

Kurs	ECTS	Kod	W	C	L	P	S	
Utrzymanie ruchu maszyn i urządzeń wytwórczych	1	W10MBM-SI2023	15					
Technologie przyrostowe w budowie maszyn	1 1	W10MBM-SI2024	15		15			
BLOK WYBIERALNY	2	MBM-SI7W-TSW2	15					
Technologie laserowe w wytwarzaniu	1 2	W10MBM-SI2025	15		15			
Technologie wytwarzania wyrobów z tworzyw sztucznych	2 1	W10MBM-SI2026	15		15			
Podstawy organizacji produkcji	2	W10MBM-SI0100	30					
Podstawy eksploatacji i remontów maszyn	2 1	W10MBM-SI0101	30		15			
Zarządzanie w produkcji	1	W10MBM-SI0102	15					
Seminarium dyplomowe	1	W10MBM-SI2027					15	
PRACA DYPLOMOWA	12	W10MBM-SI2028						15
30	ECTS		12	0	5	0	1	12
240	l. godz.		150	0	60	0	15	15

razem

W	C	L	P	S	BK
1260	345	450	375	30	90
2550					

ECTS	210

program obowiązuje od roku akad. 2023/2024

Blok humanistyczny		Blok humanistyczny	
MBM-SI1W-0001		MBM-SI2W-0001	
Wstęp do filozofii 2		Ochrona własności intelektualnej 1	
W08MBM-SI0002	30	W10MBM-SI0104	15
Technika wojskowa w konfliktach zbrojnych 2		Prawo wynalazcze i autorskie 1	
W10MBM-SI0103	30	W08MBM-SI0003	15

Blok
MBM-SI5W-0001
BLOK KURSÓW: PROGRAMOWANIE, MODELOWANIE NUMERYCZNE 1
15

Blok wybieralny	
MBM-SI7W-TSW2	
Metrologia w procesach wytwarzania 2	
W10MBM-SI2029	15
Badanie jakości wyrobów 2	
W10MBM-SI2030	15

W10MBM-SI0106	Analiza MES w zastosowaniach silnie nieliniowych w pakiecie MSC.MARC
W10MBM-SI0107	Grafika inżynierska 3D-SolidWorks
W10MBM-SI0108	Inspekcja wymiarowo-kształtowa 3D z wykorzystaniem programów GOM Inspect i Solidworks
W10MBM-SI0109	Komputerowo wspomagane wytwarzanie w systemie CAD-CAM-CATIA V5
W10MBM-SI0110	Modelowanie bryłowe i powierzchniowe w systemie CATIA
W10MBM-SI0111	Modelowanie numeryczne
W10MBM-SI0112	Obliczenia inżynierskie z użyciem arkusza kalkulacyjnego
W10MBM-SI0113	Podstawy modelowania geometrii i generowanie dokumentacji z wykorzystaniem oprogramowanie PTC Creo Parametric
W10MBM-SI0114	Programowanie obróbki szybkościowej w programie Inventor HSM
W10MBM-SI0115	Projektowanie form wtryskowych i odlewniczych w programie Solidworks
W10MBM-SI0116	Projektowanie zespołów maszyn roboczych w systemach CAD (Inventor, AutoCAD)
W10MBM-SI0117	Rozwiązywanie zagadnień mechaniki w systemie ABAQUS
W10MBM-SI0118	Techniki projektowania - SolidWorks
W10MBM-SI0119	Tworzenie dokumentacji technicznej w programie Solidworks
W10MBM-SI0120	Zaawansowane funkcje i programowanie w Microsoft Excel
W10MBM-SI0121	Zaawansowane metody modelowania i analizy w systemach CAD/FEM
W10MBM-SI0122	Zarządzanie konfiguracjami i budowanie sparametryzowanych bibliotej danych CAD z wykorzystaniem programów Solidworks i Microsoft Excel
W10MBM-SI0123	Zaawansowane wspomaganie wytwarzania w systemie CATIA
W10MBM-SI0124	Komputerowa analiza danych pomiarowych

I LEVEL REGULAR STUDIES MECHANICS and MACHINE BUILDING (W10-MBMP-000A-OSIW7) specjalność: MECHANICAL ENGINEERING DESIGN

etap	1I-MBM-MEC (W C L P S)	2I-MBM-MEC (W C L P S)	3I-MBM-MEC (W C L P S)	4I-MBM-MEC (W C L P S)	5I-MBM-MEC (W C L P S)	6I-MBM-MEC (W C L P S)	7I-MBM-MEC (W C L P S)
		Essential of Management (Podstawy zarządzania) W10MBM-SI3071 W 15 [1]					
		Block of humanistic courses MBM-SI2W-MEC1 W 15 [1]					
		Theory of Machines (Maszynoznawstwo) W10MBM-SI3077 W 15 [1]	**Programming in MATLAB** (Informatyka podst.program. Matlab) W10MBM-SI3084 P 30 [2]	**Fundamentals of Materials Strength** (Podstawy wytrzymałości materiałów) W10MBM-SI3094 L 15 [1]			
	Ergonomy and Safety (Ergonomia i BHP) W10MBM-SI3072 W 15 [1]	**Engineering Graphics: Engineering Drawing** (Grafika inż.-zapis konstr.) W10MBM-SI3078 W 15 [1], P 30 [2]	**Statistics for Engineers** (Statystyka inżynierska) W10MBM-SI3085 W 15 [1], P 15 [1]	**Industrial Metrology** (Metrologia przemysłowa) W10MBM-SI3095 L 15 [1]	**Computer Aided Machine Design I** (Modelowanie komputerowe w projektowaniu) W10MBM-SI3103 P 15 [1]		
	Fundamentals of metrology (Podstawy metrologii) W10MBM-SI3073 W 15 [1]	**Engineering Materials Technology** (Technol.materiałów inż.) W10MBM-SI3079 W 15 [2], L 15 [2]	**Engineering Graphics 3D** (Grafika inżynierska 3D) W10MBM-SI3086 P 30 [2]	**Drive Systems** (Układy napędowe pojazdów) W10MBM-SI3096 W 15 [1], L 15 [1]	**Vehicle Engineering** (Budowa pojazdów samochodowych) W10MBM-SI3104 W 30 [3]	**Computer Aided Machine Design II** (Modelowanie komputerowe w projektowaniu) W10MBM-SI3111 P 30 [3]	**Legal aspects of engineering activities** (Uwarunkowania prawne działalności inżyniera) W10MBM-SI3120 W 15 [1], P 15 [1]
	Engineering Graphics: Descriptive Geometry (Grafika inż.-geom.wykr.) W10MBM-SI3074 W 15 [1], C 30 [2]	**Thermodynamics** (Termodynamika techniczna) W10MBM-SI3080 W 30 [2], L 15 [2]	**Fluid Mechanics** (Mechanika płynów) W10MBM-SI3087 W 30 [2], C 15 [1]	**Fundamentals of Machine Design I E** (Podstawy konstrukcji maszyn I) W10MBM-SI3097 W 30 [3], L 15 [2], P 30 [2]	**Trybology** (Podstawy tribologii) W10MBM-SI3105 W 15 [2], L 15 [2]	**Offroad Vehicles Engineering** (Inżynieria pojazdów przemysłowych) W10MBM-SI3112 W 30 [2], L 30 [2], P 15 [1]	**Production System Organisation** (Podstawy organizacji produkcji) W10MBM-SI3121 W 30 [2]
	Information Technologies (Technologie informacyjne) W10MBM-SI3075 W 30 [2]	**Fundamentals of Materials Science** (Podstawy materiałoznawstwa) W10MBM-SI3081 W 30 [2], L 15 [1]	**Materials Science E** (Materiałoznawstwo II) W10MBM-SI3088 W 30 [3], L 15 [2]	**Theory of Mechanisms and Manipulators E** (Teoria mech.i manip.) W10MBM-SI3098 W 30 [2], P 30 [3]	**Hydraulic, Hydrotronic and Pneumatic Systems** (Hydros. ukł.nap.) W10MBM-SI3106 W 15 [1], L 15 [1]	**Hydraulic Drive Systems E** (Napęd hydrauliczny) W10MBM-SI3113 W 30 [2], L 30 [2], P 15 [1]	**Polymers in Engineering** (Tworzywa sztuczne konstrukcyjne) W10MBM-SI3122 W 30 [3]
	Chemistry (Chemia) W10MBM-SI3076 W 30 [2]	**Mechanics I** (Mechanika I) W10MBM-SI3082 W 30 [2], C 30 [2]	**Mechanics II E** (Mechanika II) W10MBM-SI3089 W 30 [2], C 30 [2]	**Geometric Metrology** (Metrologia wielkości geometrycznych) W10MBM-SI3099 W 15 [1], L 15 [1]	**Finite Elements Method** (Metoda elementów skończonych) W10MBM-SI3107 W 15 [1], P 30 [2]	**Internal Combustion Engines** (Silniki spalinowe) W10MBM-SI3114 W 15 [1], L 15 [1]	**Vehicles Loading Modelling** (Modelowanie obciążeń pojaz. samoch.) W10MBM-SI3123 W 15 [2], P 15 [2]
	Linear Algebra with Analytic Geometry B E (Algebra liniowa z geometria analityczna B) W13MBM-SI3004 W 30 [2], C 15 [2]	**Ecology** (Ekologia) W10MBM-SI3083 W 15 [1]	**Polymers I** (Tworzywa sztuczne) W10MBM-SI3090 W 30 [2], L 15 [1]	**Chipless Processes -Plastic Forming** (Techn.wytw.-przerób.plast.) W10MBM-SI3100 W 15 [2], L 15 [1]	**Fundamentals of Machine Design II E** (Podstawy konstrukcji maszyn II) W10MBM-SI3108 W 30 [2], P 30 [3]	**Carrying Structures** (Ustroje nośne) W10MBM-SI3115 W 15 [1], P 30 [2]	**Selectable Courses** MBM-SI7W-MEC1 W 15 [2]
	Mathematical Analysis 1A E (Analiza matematyczna 1A) W13MBM-SI3005 W 30 [5], C 30 [3]	**Electrical Engineering** (Elektrotechnika) W05MBM-SI3003 W 30 [2]	**Electrical Engineering** (Elektrotechnika) W05MBM-SI3004 L 15 [1]	**Chipless Processes -Welding Metallurgy** (Techniki wytw.-spaw.) W10MBM-SI3101 W 15 [2], L 15 [1]	**Selectable Courses** (Blok wybieralny) MBM-SI5W-MEC1 P 15 [1]	**Safety of machines and technological processes E** (Bezpiecz.masz.i proc.technol.) W10MBM-SI3116 W 15 [2], S 15 [1]	**Fundamentals of Exploitation and Repair** (Podst.eksploat. i remon. masz.) W10MBM-SI3124 W 30 [2], L 15 [1]
	Physics 1A E (Fizyka 1A) W11MBM-SI3002 W 30 [3], C 15 [2]	**Elements of Mathematical Analysis E** (Elementy analizy matematycznej 2) W13MBM-SI3006 W 15 [2], C 15 [2]	**Chipless Processes -Casting** (Techniki wytwarzania - odlewnictwo) W10MBM-SI3091 W 15 [2], L 15 [1]	**Strength of Materials E** (Wytrzymałość materiałów) W10MBM-SI3102 W 30 [2], C 15 [2]	**Fundamentals of Automatic Control E** (Podstawy automatyki) W10MBM-SI3109 W 30 [2], L 30 [2]	**Manufacturing Systems CNC** (Maszyny technologiczne CNC i roboty) W10MBM-SI3117 W 15 [1], L 15 [1], P 15 [1]	**Management in production** (Zarządzanie w produkcji) W10MBM-SI3125 W 15 [1]
	Basic physics laboratory (Laboratorium podstaw fizyki) W11MBM-SI3003 L 15 [2]	**Electronics** (Elektronika) W12MBM-SI3002 W 30 [2]	**Fundamentals of Materials Strength** (Podstawy wytrzymałości materiałów) W10MBM-SI3092 W 30 [2], C 15 [1]	**Sport** (Zajęcia sportowe) SWF-S00001 inne 30 [0]	**Manufacturing Processes - Machining E** (Tech.wytw.-obr.ubyt.) W10MBM-SI3110 W 45 [2], L 30 [2]	**Introduction to diploma dissertation** (Wstęp do pracy dyplomowej) W10MBM-SI3118 inne 15 [3]	**Thesis, Seminar** (Seminarium dyplomowe) W10MBM-SI3126 S 15 [1]
	Block of humanistic courses MBM-SI1W-MEC1 W 30 [2]	**Sport** (Zajęcia sportowe) SWF-S00001 inne 30 [0]	**Ordinary Differential Equations** (Równania różniczkowe zwyczajne) W10MBM-SI3093 W 15 [1], C 15 [1]	**Foreign Language A1/A2/B1/B2.1/C1.1** (Języki obce) SJO-SI0001 C 60 [2]	**Foreign Language B2.2/C1.2** (Języki obce) SJO-SI0002 C 60 [3]	**Professional Training** (praktyka) W10MBM-SI3119 [3]	**Thesis: Final Engineering project** (praca dyplomowa) W10MBM-SI3127 inne 15 [12]

sem.	ECTS		W	C	L	P	S	inne
sem. 1	30	ECTS	19	9	2	0	0	0
	330	l. godz.	225	90	15	0	0	0
sem. 2	30	ECTS	19	4	5	2	0	0
	405	l. godz.	255	45	45	30	0	30
sem. 3	30	ECTS	15	5	5	5	0	0
	405	l. godz.	195	75	60	75	0	0
sem. 4	30	ECTS	13	4	8	5	0	0
	420	l. godz.	150	75	105	60	0	30
sem. 5	30	ECTS	13	3	7	7	0	0
	420	l. godz.	180	60	90	90	0	0
sem. 6	30	ECTS	9	0	6	8	1	6
	345	l. godz.	120	0	90	105	15	15
sem. 7	30	ECTS	13	0	1	3	1	12
	225	l. godz.	150	0	15	30	15	15

razem	W	C	L	P	S	inne
	1275	345	420	390	30	90
	2550					

ECTS	210

program obowiązuje od roku akad. 2023/2024

Block of humanistic courses		Block of humanistic courses	
MBM-SI1W-MEC1		MBM-SI2W-MEC1	
Introduction to Philosophy (Wstęp do filozofii) 2		**Intellectual Property Law (Ochrona własności intelektualnej)** 1	
W08MBM-SI3002	30	W10MBM-SI3129	15
Military technology in armed conflicts 2		**Patent and copyright** 1	
W10MBM-SI3128	30	W08MBM-SI3003	15

Selectable Courses	
MBM-SI7W-MEC1	
Biomedical Engineering 2	
W10MBM-SI3149	15
Technique in Medicine 2	
W10MBM-SI3150	15

Selectable Courses	
MBM-SI5W-MEC1	
W10MBM-SI3130	FEM analysis of strongly nonlinear applications in the MSC.MARC package
W10MBM-SI3131	3D Engineering Graphics - SolidWorks
W10MBM-SI3132	Dimensional and shape inspection with GOM Inspect and Solidw
W10MBM-SI3133	Computer-aided manufacturing in the CAD-CAM
W10MBM-SI3134	Solid and surface modeling in CATIA
W10MBM-SI3135	Numerical modelling
W10MBM-SI3136	Engineering calculations with usage of spreadsheet
W10MBM-SI3137	Geometry modelling and drawing creation with PTC Creo Parametric (formerly Pro/Engineer)
W10MBM-SI3138	Planning high speed machining with Inventor HSM
W10MBM-SI3139	Designing injection moulding and die casting tools in Solidworks
W10MBM-SI3140	Computer Aided Design of heavy machinery assemblies (Inventor, AutoCAD)
W10MBM-SI3141	Solving mechanics problems using Abaqus
W10MBM-SI3142	Design techniques in solidworks
W10MBM-SI3143	Creating technical drawings in Solidworks
W10MBM-SI3144	Advanced functions and programming in Microsoft Excel
W10MBM-SI3145	Advanced methods of modeling and analysis in CAD / FEM systems
W10MBM-SI3146	Managing configurations and building parameterized libraries with Solidworks and Microsoft Excel
W10MBM-SI3147	Advanced Computer Aided Engineering in the Catia system
W10MBM-SI3148	Computer analysis of measurements data

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Elektrotechnika**
Name of subject in English: **Electrical engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W05MBM-SI0003**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student knows and understands basic principles of physics, especially electrostatics and electromagnetism.
2. Student is able to compute differential and integral calculus.
3. Student is able to obtain information from literature.

SUBJECT OBJECTIVES

C1. Basic knowledge about electrical circuits and electromagnetic phenomena.
C2. Knowledge about construction and work of the electrical machines and devices.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Student knows basic laws of the theory of electric circuits and electromagnetism and their application in electrical machines and devices.
PEU_W02 - Student knows principle of operation, construction and purpose of transformers.
PEU_W03 - Student knows construction, principle of operation and characteristics of electrical machines.

II. Relating to skills:

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Requirements and literature. Basic principles of electrical engineering.	2
Lec2	Principles of circuit theory. DC circuits. Power and work.	2
Lec3	Electromagnetism - basic quantities, magnetic properties, magnetic circuits.	2
Lec4	Alternating current circuits. Electromagnetic induction phenomenon. Self and mutual inductance.	2
Lec5	R, L, C elements in AC circuits.	2
Lec6	Resonance circuits, real power, reactive power, power factor correction.	2
Lec7	Three-phase AC circuits. Three-phase voltage generation. Wye and delta connections. Power measurements in three-phase systems.	2
Lec8	Transformers and chokes - construction, principle of operation and work analysis.	2
Lec9	Types of transformers and their applications, autotransformers, current transformers, voltage transformers.	2
Lec10	Induction motors- construction, principle of operation.	2
Lec11	Types of induction motor works, load characteristics. Starting, braking, change of rotational speed. Applications of induction motors.	2
Lec12	Synchronous machines - construction, principles of operation, characteristics, electromagnetic torque, applications.	2
Lec13	DC commutator machines - construction, principle of operation, types of motors, characteristics, start-up, change of rotational speed, applications.	2
Lec14	Brushless DC motors (BLDC motors): construcion, principle of operation, electromagnetic torque, change of rotational speed, characteristics, applications.	2
Lec15	Test.	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. multimedia presentation N3. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01-PEU_W03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE P. Hempowicz, R. Kiełsznia, Elektrotechnika i elektronika dla nieelektryków.WNT. Elektrotechnika dla nieelektryków. Ćwiczenia laboratoryjne, Zbiór zadań, skrypt P.Wr. pod redakcją P. Zielińskiego (2000). SECONDARY LITERATURE Elektrotechnika, skrypt P.Wr. pod redakcją P. Zielińskiego (1990).

SUBJECT SUPERVISOR
dr hab. inż. Marek Ciurys email: marek.ciurys@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Elektrotechnika**
Name of subject in English: **Electrical engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W05MBM-SI0004**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			15		
Number of hours of total student workload (CNPS)			30		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)			0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student knows and understands basic principles of physics, especially electrostatics and electromagnetism.
2. Student is able to compute differential and integral calculus.
3. Student is able to obtain information from literature.

SUBJECT OBJECTIVES

C1. Ability for team work and measurements of electrical machines and devices.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:
PEU_U01 - Student is able to connect measurement circuit and make measurements of basic electrical quantities.
PEU_U02 - Student is able to make simple laboratory measurements of electrical machines.
PEU_U03 - Student is able to determine characteristics of electrical motors and transformers.

III. Relating to social competences:
PEU_K01 - Student is aware of the responsibility for their own work and is ready to comply with the rules of teamwork and to take responsibility for jointly implemented tasks.

PROGRAM CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Introduction, discussion of safety regulations and internal regulations of the laboratory. Presentation of the course credit rules. Familiarization with laboratory stands.	1
Lab2	Completion of six of the following laboratory exercises: 1. Power measurements in three-phase AC systems. 2. Tests of alternating current circuits containing elements R, L, C. 3. Transformer tests. 4. Testing of an induction motor. 5. Testing of an induction motor powered by a frequency converter. 6. Power factor improvement - reactive power compensation. 7. Testing of a DC shunt motor. 8. Testing of a DC series motor. 9. Testing of a synchronous motor.	12
Lab3	Crediting.	2
		Total hours: 15

TEACHING TOOLS USED

N1. laboratory experiment
N2. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Laboratory reports.
F2	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Checking preparation for laboratory exercises.
F3	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Activity in class.
P = 0,4*F1+0,3*F2+0,3*F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

P. Hempowicz, R. Kiełsznia, Elektrotechnika i elektronika dla nieelektryków.WNT.

Elektrotechnika dla nieelektryków. Ćwiczenia laboratoryjne, Zbiór zadań, skrypt P.Wr. pod redakcją P. Zielińskiego (2000).

SECONDARY LITERATURE

Elektrotechnika, skrypt P.Wr. pod redakcją P. Zielińskiego (1990).

E. Koziej, B. Sochoń: Elektrotechnika i elektronika. PWN 1986

SUBJECT SUPERVISOR

dr hab. inż. Marek Ciurys email: marek.ciurys@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020 Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Electrical Engineering (Elektrotechnika)**
Name of subject in English: **Electrical Engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W05MBM-SI3003**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student knows and understands basic principles of physics, especially electrostatics and electromagnetism.
2. Student is able to compute differential and integral calculus.
3. Student is able to obtain information from literature.

SUBJECT OBJECTIVES

C1. Basic knowledge about electrical circuits and electromagnetic phenomena.
C2. Knowledge about construction and work of the electrical machines and devices.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Student knows basic laws of the theory of electric circuits and electromagnetism and their application in electrical machines and devices.
PEU_W02 - Student knows principle of operation, construction and purpose of transformers.
PEU_W03 - Student knows construction, principle of operation and characteristics of electrical machines.

II. Relating to skills:

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Requirements and literature. Basic principles of electrical engineering.	2
Lec2	Principles of circuit theory. DC circuits. Power and work.	2
Lec3	Electromagnetism - basic quantities, magnetic properties, magnetic circuits.	2
Lec4	Alternating current circuits. Electromagnetic induction phenomenon. Self and mutual inductance.	2
Lec5	R, L, C elements in AC circuits.	2
Lec6	Resonance circuits, real power, reactive power, power factor correction.	2
Lec7	Three-phase AC circuits. Three-phase voltage generation. Wye and delta connections. Power measurements in three-phase systems.	2
Lec8	Transformers and chokes - construction, principle of operation and work analysis.	2
Lec9	Types of transformers and their applications, autotransformers, current transformers, voltage transformers.	2
Lec10	Induction motors - construction, principle of operation.	2
Lec11	Types of induction motor works, load characteristics. Starting, braking, change of rotational speed. Applications of induction motors.	2
Lec12	Synchronous machines - construction, principle of operation, characteristics, electromagnetic torque, applications.	2
Lec13	DC commutator machines - construction, principle of operation, types of motors, characteristics, start-up, change of rotational speed, applications.	2
Lec14	Brushless DC motors (BLDC motors): construcion, principle of operation, electromagnetic torque, change of rotational speed, characteristics, applications.	2
Lec15	Test.	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. multimedia presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01-PEU_W03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE P. Hempowicz, R. Kiełsznia, Elektrotechnika i elektronika dla nieelektryków.WNT. Elektrotechnika dla nieelektryków. Ćwiczenia laboratoryjne, Zbiór zadań, skrypt P.Wr. pod redakcją P. Zielińskiego (2000). SECONDARY LITERATURE Elektrotechnika, skrypt P.Wr. pod redakcją P. Zielińskiego (1990). E. Koziej, B. Sochoń: Elektrotechnika i elektronika. PWN 1986

SUBJECT SUPERVISOR
dr hab. inż. Marek Ciurys email: marek.ciurys@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Electrical Engineering (Elektrotechnika)**
Name of subject in English: **Electrical Engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W05MBM-SI3004**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			15		
Number of hours of total student workload (CNPS)			30		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)			0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student knows and understands basic principles of physics, especially electrostatics and electromagnetism.
2. Student is able to compute differential and integral calculus.
3. Student is able to obtain information from literature.

SUBJECT OBJECTIVES

C1. Ability for team work and measurements of electrical machines and devices.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:
PEU_U01 - Student is able to connect measurement circuit and make measurements of basic electrical quantities.
PEU_U02 - Student is able to make simple laboratory measurements of electrical machines.
PEU_U03 - Student is able to determine characteristics of electrical motors and transformers.

III. Relating to social competences:
PEU_K01 - Student is aware of the responsibility for their own work and is ready to comply with the rules of teamwork and to take responsibility for jointly implemented tasks.

PROGRAM CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Introduction, discussion of safety regulations and internal regulations of the laboratory. Presentation of the course credit rules. Familiarization with laboratory stands.	1
Lab2	Completion of six of the following laboratory exercises: 1. Power measurements in three-phase AC systems. 2. Tests of alternating current circuits containing elements R, L, C. 3. Transformer tests. 4. Testing of an induction motor. 5. Testing of an induction motor powered by a frequency converter. 6. Power factor improvement - reactive power compensation. 7. Testing of a DC shunt motor. 8. Testing of a DC series motor. 9. Testing of a synchronous motor.	12
Lab3	Crediting.	2
		Total hours: 15

TEACHING TOOLS USED

N1. laboratory experiment
N2. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Laboratory reports.
F2	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Checking preparation for laboratory exercises.
F3	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Activity in class.
P = 0,4*F1+0,3*F2+0,3*F3		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE P. Hempowicz, R. Kiełsznia, Elektrotechnika i elektronika dla nieelektryków.WNT. Elektrotechnika dla nieelektryków. Ćwiczenia laboratoryjne, Zbiór zadań, skrypt P.Wr. pod redakcją P. Zielińskiego (2000). SECONDARY LITERATURE Elektrotechnika, skrypt P.Wr. pod redakcją P. Zielińskiego (1990). E. Koziej, B. Sochoń: Elektrotechnika i elektronika. PWN 1986.

SUBJECT SUPERVISOR
dr hab. inż. Marek Ciurys email: marek.ciurys@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Wstęp do filozofii**
Name of subject in English: **Introduction to philosophy**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W08MBM-SI0002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. No prerequisites required.

SUBJECT OBJECTIVES

C1. To help students improve their critical thinking skills.
C2. To acquaint students with basic philosophical issues.
C3. To raise students’ awareness of the social role and responsibility of engineers and researchers.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 **-** Student has the aware of the importance and understanding humanistic aspects and effects of engineering activity; recognizes the effects of the impact of technical activities on the environment, and related to it social responsibility of science and technology;

II. Relating to skills:

III. Relating to social competences:
PEU_K01 **-** Student has the basic knowledge necessary to understand legal, ethical and social, philosophical conditions of activity engineering.
PEU_K02 **-** Student correctly identifies and resolves dilemmas related to the practice of the profession; is aware of the role a graduate of a technical university; understands the need for formulating and providing the public with information and feedback on achievements techniques and other aspects of the engineer's activity; can convey such information and opinions in an understandable way, with different justifications points of view;

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction (plan, aim and pass conditions)	2
Lec2	What is philosophy?	2
Lec3	Philosophy and other fields of knowledge (1)	2
Lec4	Philosophy and other fields of knowledge (2)	2
Lec5	Selected issues in the philosophy of science and technology (1)	2
Lec6	Selected issues in the philosophy of science and technology (2)	2
Lec7	Cognition as a classic problem of philosophy	2
Lec8	Selected topics in ethics	2
Lec9	Selected issues in social philosophy (1)	2
Lec10	Selected issues in social philosophy (2)	2
Lec11	Selected issues in the philosophy of politics	2
Lec12	Elements of argumentation theory	2
Lec13	A question about man	2
Lec14	Test	2
Lec15	Summary and completion of the course	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. multimedia presentation N3. problem discussion

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01	Test, in-class presentation or a written assignment
F2	PEU_K01, PEU_K02	In-class activity
P = (2*F!+F2)/3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Blackburn S., Oksfordzki słownik filozoficzny, Warszawa 2004;
[2] Chalmers A., Czym jest to, co zwiemy nauką, Wrocław 1997;
[3] Grobler A., Metodologia nauk, Kraków 2004;
[4] Fry H., Hello World. Jak być człowiekiem w dobie maszyn?, Warszawa 2019.
[5] Martens E., Schnädelbach H., Filozofia. Podstawowe pytania, Warszawa 1995;
[6] Zuboff S., Wiek kapitalizmu inwigilacji, Warszawa 2020.

SECONDARY LITERATURE
[1] Anzenbacher A., Wprowadzenie do filozofii, Kraków 2000;
[2] Buksiński T., Współczesne filozofie polityki, Poznań 2006;
[3] Stanford Encyclopedia of Philosophy, https://plato.stanford.edu/
[4] Tegmark, M., Życie 3.0. Człowiek w erze sztucznej inteligencji, Warszawa 2019.

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Prawo wynalazcze i autorskie**
Name of subject in English: **Inventive Law and Copyright**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W08MBM-SI0003**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. No prerequisites
3. .

SUBJECT OBJECTIVES

C1. Familiarizing the student with the basic information of law, including the international legal system.
C2. Overview of the basic institutions of law.
C3. Analysis of legal provisions

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - A student has the knowledge necessary to understand the social, economic, legal, ecological and other non-technical aspects of engineering activity

II. Relating to skills:

III. Relating to social competences:
PEU_K01 - A student understands the non-technical aspects of mechanic engineer’s activity, including its social consequences and impact on the environment

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, functions of law.	1
Lec2	Sources of law, subject and object of the law detailing the sources of intellectual property law.	2
Lec3	Fundamentals of industrial property law.	2
Lec4	Fundamentals of copyright law.	2
Lec5	Author's personal rights and their protection.	2
Lec6	Author's property rights and their protection.	2
Lec7	Selected issues of Inventive Law	2
Lec8	summary.	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. multimedia presentation
N3. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement

F1	PEU_W01, PEU_K01	Activity during classes and participation in discussions, Presentation, case study
P = F1		

PRIMARY AND SECONDARY LITERATURE
<u>PRIMARY LITERATURE</u> [1] R. Golat, Prawo autorskie i prawa pokrewne, C.H.Beck, 2010 [2] M. Barczewski, Traktatowa ochrona praw autorskich i praw pokrewnych, Wolters Kluwer Polska,2007 [3] M. Byrska, Wytyczne EWG w sprawie ochrony programów komputerowych a polski projekt prawa autorskiego, ZNUJ PWiOWI 1993 [4] Rejdak Monika, Nowe postępowanie w sprawach własności intelektualnej, lex 2020 komentarz praktyczny <u>SECONDARY LITERATURE</u> [1] J. Barta, R. Markiewicz (red.) Prawo autorskie i prawa pokrewne. Komentarz, Warszawa 2011 [2] P. Slezak, Prawo autorskie. Wzory umów z komentarzem, Wolters Kluwer Polska - LEX, 2012

SUBJECT SUPERVISOR
dr hab. inż. Mirosław Bocian tel.: 320-27-54 email: miroslaw.bocian@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Introduction to philosophy (Wstęp do filozofii)**
Name of subject in English: **Introduction to philosophy**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W08MBM-SI3002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. No prerequisites required.

SUBJECT OBJECTIVES

C1. To help students improve their critical thinking skills.
C2. To acquaint students with basic philosophical issues.
C3. To raise students’ awareness of the social role and responsibility of engineers and researchers.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Student has the aware of the importance and understanding humanistic aspects and effects of engineering activity; recognizes the effects of the impact of technical activities on the environment, and related to it social responsibility of science and technology;

II. Relating to skills:

III. Relating to social competences:
PEU_K01 - Student has the basic knowledge necessary to understand legal, ethical and social, philosophical conditions of activity engineering.
PEU_K02 - Student correctly identifies and resolves dilemmas related to the practice of the profession; is aware of the role a graduate of a technical university; understands the need for formulating and providing the public with information and feedback on achievements techniques and other aspects of the engineer's activity; can convey such information and opinions in an understandable way, with different justifications points of view;

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction (plan, aim and pass conditions)	2
Lec2	What is philosophy?	2
Lec3	Philosophy and other fields of knowledge (1)	2
Lec4	Philosophy and other fields of knowledge (2)	2
Lec5	Selected issues in the philosophy of science and technology (1)	2
Lec6	Selected issues in the philosophy of science and technology (2)	2
Lec7	Cognition as a classic problem of philosophy	2
Lec8	Selected topics in ethics	2
Lec9	Selected issues in social philosophy (1)	2
Lec10	Selected issues in social philosophy (2)	2
Lec11	Selected issues in the philosophy of politics	2
Lec12	Elements of argumentation theory	2
Lec13	A question about man	2
Lec14	Test	2
Lec15	Summary and completion of the course	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. multimedia presentation N3. problem discussion

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01	Test, in-class presentation or a written assignment
F2	PEU_K01, PEU_K02	In-class activity
P = (2*F!+F2)/3		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE [1] Blackburn S., Oksfordzki słownik filozoficzny, Warszawa 2004; [2] Chalmers A., Czym jest to, co zwiemy nauką, Wrocław 1997; [3] Grobler A., Metodologia nauk, Kraków 2004; [4] Fry H., Hello World. Jak być człowiekiem w dobie maszyn?, Warszawa 2019. [5] Martens E., Schnädelbach H., Filozofia. Podstawowe pytania, Warszawa 1995; [6] Zuboff S., Wiek kapitalizmu inwigilacji, Warszawa 2020. SECONDARY LITERATURE [1] Anzenbacher A., Wprowadzenie do filozofii, Kraków 2000; [2] Buksiński T., Współczesne filozofie polityki, Poznań 2006; [3] Stanford Encyclopedia of Philosophy, https://plato.stanford.edu/ [4] Tegmark, M., Życie 3.0. Człowiek w erze sztucznej inteligencji, Warszawa 2019.

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Patent and copyright (Prawo wynalazcze i autorskie)**
Name of subject in English: **Inventive Law and Copyright Law**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W08MBM-SI3003**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. No prerequisites

SUBJECT OBJECTIVES

C1. Familiarizing the student with the basic information of law, including the international legal system.
C2. Overview of the basic institutions of law.
C3. Analysis of legal provisions

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

PEU_W01 - A student has the knowledge necessary to understand the social, economic, legal, ecological and other non-technical aspects of engineering activity

II. Relating to skills:

III. Relating to social competences:

PEU_K01 - A student understands the non-technical aspects of mechanic engineer’s activity, including its social consequences and impact on the environment

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, functions of law.	1
Lec2	Sources of law, subject and object of the law detailing the sources of intellectual property law.	2
Lec3	Fundamentals of industrial property law.	2
Lec4	Fundamentals of copyright law.	2
Lec5	Author's personal rights and their protection.	2
Lec6	Author's property rights and their protection.	2
Lec7	Selected issues of Inventive Law	2
Lec8	summary.	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. multimedia presentation
N3. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement

F1	PEU_W01, PEU_K01	Activity during classes and participation in discussions, Presentation, case study
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE [1] Hazel V.J Mioir, Patent Policy and Innovation: Do Legal Rules Deliver Effective Economic Outcomes? 2013 [2] I Toshiko Takenaka, ntellectual Property in Common Law and Civil Law, 2013 [3] David Booton, Form in Intellectual Property Law, 2017. SECONDARY LITERATURE

SUBJECT SUPERVISOR
dr hab. inż. Mirosław Bocian tel.: 320-27-54 email: miroslaw.bocian@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Podstawy zarządzania**
Name of subject in English: **Essentials of Management**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0061**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. No initial requirements.

SUBJECT OBJECTIVES

C1. Acquiring knowledge management process and its elements.
C2. Acquiring knowledge about the nature and mechanisms of building and functioning organizations.
C3. Acquiring knowledge about basic instruments and tools of management, using them in organizations and the analysis of management problems.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Student is able to define the basic mechanisms of functioning of organizations, distinguishes types of organizations, their components and recognizes elements of the environment that affects functioning of respective subsystems in organizations.
PEU_W02 - The student is able to define the management process and its elements and knows the basic management methods and techniques within the each of the management functions of planning, organizing, leading and controlling.
PEU_W03 - The student is able to formulate the scope and areas of organization's impact on the environment depending on the identified decisions made by managers in organizations.

II. Relating to skills:

III. Relating to social competences:
PEU_K01 - The student is aware of the impact of the environment on decisions made in the organization and decisions made in the organization on the environment.
PEU_K02 - The student is aware of the role of planning, organizing, leading and controlling as well as the techniques and tools used in each of these management functions for the efficient and effective functioning of the organization as a whole.
PEU_K03 - The student is aware of the importance of innovation and entrepreneurship for the environment.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organization and its resources. The concept of management. Management process and its elements. Manager and his work.	2
Lec2	Organization's environment and its elements. Influence of environment on organization. Methods of analysis of the environment.	2
Lec3	Planning in organization. Setting goals. Hierarchy of goals. Types of plans. Decision making process. Strategy and strategic management. Marketing and marketing planning.	2
Lec4	The function of organizing. Organizational structures. Human resources management and its elements. Tools and techniques of human resources management.	2
Lec5	The function of leading. Human behaviors in organizations. Leadership and power. Managing styles. Motivating. Selected motivating techniques.	2
Lec6	The function of controlling. Steps and levels of control. Creativity, innovation, knowledge. The concept of innovation and types of innovation.	2
Lec7	Entrepreneurship. The role of entrepreneurship in the economy. Knowledge based economy.	2
Lec8	Test / On-line test	1
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01-W03	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Griffin R.W., Management. 13h Edition, South-Western Cengage Learning, 2022.
2. Coulter M, Robbins S.P., DeCenzo D., Fundamentals of Management. Global Edition. 11th EditionPearson, 2019
3. DuBrin A.J., Essentials Of Management. 10th Edition, South-Western Cengage Learning, 2016.
4. Kinicki A., Williams B.K., Management. A practical introduction. 9h Edition, McGraw-Hill Education, 2019.

SECONDARY LITERATURE

1. McKee A., Management. A Focus On Leaders, Prentice Hall, 2012.
2. Hatch M.J., Cunliffe A.L., Organization Theory. Modern, Symbolic, And Postmodern Perspectives, Oxford University Press, 2013.
3. Bygrave W., Zacharakis A., Entrepreneurship, 4rd Edition, Wiley, 2016.
4. Aulet B., Disciplined Entrepreneurship: 24 Steps to a Successful Startup, Wiley, 2013.
5. Press and portals about management and entrepreneurship.

SUBJECT SUPERVISOR
dr inż. Mateusz Molasy tel.: 713202662 email: mateusz.molasy@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Ergonomia i BHP**
Name of subject in English: **Ergonomics and Safety**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0062**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. has basic knowledge from range of characteristic and properties of hazardous physical agents (electric energy, mechanical vibrations, lighting, electromagnetic field, dusts), chemical and biological agents
2. has systematical knowledge from range of mathematics, physics, chemistry and informatics

SUBJECT OBJECTIVES

C1. Acquirement of basic knowledge in the field of labor law, as well as work accidents and occupational diseases
C2. Acquirement of basic knowledge in the field of ergonomics and biomechanics
C3. Acquirement of basic knowledge in the field of protection before dangerous, harmful and strenuous factors in work environment

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - knows basic regulations and standards of work safety
PEU_W02 - has basic knowledge of ergonomics and consciousness for capability of its practical application in designing and manufacturing of products
PEU_W03 - knows basic threats at work positions and methods of protection before them

II. Relating to skills:

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Occupational health and safety (OHS), work safety regulations and principles	2
Lec2	Accidents at work and occupational diseases	2
Lec3	Estimation of professional risk on work positions	2
Lec4	Ergonomics as an interdisciplinary science	2
Lec5	Biomechanics - science for discovering of threats for employee health, being result of executable work	2
Lec6	Hazardous and harmful agents in work environment - mechanical agents and electric power	2
Lec7	Hazardous and harmful agents in work environment - noise, vibrations and lighting	2
Lec8	Summary, test	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem discussion
N3. tutorials
N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01 - PEU_W03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE Monika Blaszczok - Ergonomics of safe and hygienic work, Silesian University of Technology, Gliwice 2018 SECONDARY LITERATURE B. Rączkowski - Industrial Safety in practice, ODDK, Gdansk 2022

SUBJECT SUPERVISOR
dr inż. Jacek Iwko tel.: 42-54 email: jacek.iwko@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Podstawy metrologii**
Name of subject in English: **Fundamentals of metrology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0063**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of mathematics and physics at secondary school level.

SUBJECT OBJECTIVES

C1. Understanding the essence of measurement to recognize true state and relations between physical quantities
C2. Gaining knowledge of basic metrological concepts, unit system SI, rules of making measurements of physical quantities and basic properties of measurements sensors and apparatus.
C3. Gaining knowledge about signal processing, measurements systems, rules and properties of measurement process.
C4. Gaining basic knowledge about measurement interferences factors.
C5. Gaining basic knowledge about experiment planning and results elaboration and uncertainty analysis.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Has basic knowledge of metrology, understands essence of measurements and knows measurements methods
PEU_W02 - Knows basic properties of measurements apparatus and measurements systems.
PEU_W03 - Has basic knowledge of accuracy and measurement uncertainty.

II. Relating to skills:

III. Relating to social competences:
PEU_K01 - Search for information and its critical analysis
PEU_K02 - Objective evaluation of arguments, the rational explanation of his own point of view using the knowledge of fundamentals of metrology.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Basic concepts of metrology.	1
Lec2	Quantities and units of measurement. Integrated measurement units. SI units, measurement standards, a hierarchical system of measurement standards.	2
Lec3	Measurement method, types and classification. Examples.	2
Lec4	Analog and digital measurement instruments: types, components, I/O elements, A/C converters, microprocessor role; metrological properties; influence of interferences.	4
Lec5	Measurement uncertainty and results elaboration: sources of uncertainty; division and rules of estimation, calculation of A-type uncertainty.	2
Lec6	Calculation of B-type standard uncertainty and enhanced uncertainty with proper trust level. Methods for results elaboration and presentation.	2
Lec7	Test	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01 - PEU_W03	Test
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SECONDARY LITERATURE

SUBJECT SUPERVISOR
dr inż. Marek Kuran tel.: 27-28 email: marek.kuran@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Technologie informacyjne**
Name of subject in English: **Information Technologies**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0064**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge about the functioning of computers taken from high school

SUBJECT OBJECTIVES

C1. Presentation of the history of counting and computers in an accessible way.
C2. Description of the internal structure of computers and basic algorithms for performing calculations on integers and floating point numbers; discussion of the causes and nature of errors arising during arithmetic operations
C3. Presentation of the essence of the algorithm, ways of notating algorithms, presentation of the basic methods of creating algorithms. Discussion of the essence of software errors and the basics of computational complexity of algorithms.
C4. Presentation of basic concepts in the field of intellectual property protection, copyright, patent law and trademarks

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

PEU_W01 - As a result of the course, the student should be able to define the basic concepts related to information and its processing

PEU_W02 - After completing the course, the student should be able to describe and explain algorithms and the basic ways of constructing them, as well as define various causes of errors and ways to remove them.

PEU_W03 - He has elementary knowledge in the field of intellectual property protection and patent law.

II. Relating to skills:

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Syllabus. Requirements. How to pass. Information.	2
Lec2	A brief history of mathematics and the history of the development of computer systems.	2
Lec3	Computer arithmetic	2
Lec4	Non-integer arithmetic; absolute errors	2
Lec5	Computer architecture	2
Lec6	Introduction to algorithms	2
Lec7	Algorithms (part I)	2
Lec8	Method of notation of algorithms (Algorithms part II)	2
Lec9	Turing machine (Algorithms part III)	2
Lec10	Algorithmic methods (Algorithms part IV)	2
Lec11	Can computers be wrong?	1
Lec12	Computational complexity	1
Lec13	Copyright law outline	2
Lec14	Patent law outline	2
Lec15	Trademarks	2
Lec16	Final test	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01-PEU_W03, PEU_K01	final test
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE 1. Harel D., FeldmanY.: Algorithmics: The Spirit of Computing, Addison-Wesley 2. Gleick J.: The Information: A History, a Theory, a Flood, Pantheon Books SECONDARY LITERATURE 1. Rockman H.B., Intellectual Property Law for Engineers, Scientists, and Entrepreneurs, Willey

SUBJECT SUPERVISOR
dr inż. Wojciech Myszka tel.: +48(71)3203269 email: Wojciech.Myszka@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Grafika inżynierska - geometria wykreślna**
Name of subject in English: **Engineering Graphics: Descriptive Geometry**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0065**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	30			
Number of hours of total student workload (CNPS)	30	60			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	1	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has knowledge of the fundamental theorems of Euclidean geometry
2. Student has ability to use of the drawing utensils.
3. Student has ability to draw basic geometric structures, such as division of a line's segment into n equal parts, plotting a regular hexagon

SUBJECT OBJECTIVES

C1. Knowledge of the theoretical and practical basis of the Monge descriptive projection method of the geometric structures on the drawing's plane as the basis for design recording (engineering drawing).
C2. Knowledge in the field of the geometric structures restitution based on Monge's projections.
C3. Preparation for the design recording (engineering drawing) application.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Student has ordered knowledge on geometric structure mapping onto drawing's plane using Monge's projection method and elementary knowledge in the field of axonometry.
PEU_W02 - Student knows an appropriate solution algorithm of mapping of the position and the relationship of the geometric formations in the space, as well as identifying the measures relationship.
PEU_W03 - Student knows the rules for drawing, using Monge's method, showing localization of the element or geometric structure in the space.

II. Relating to skills:
PEU_U01 - Student can practically apply the principles of the Monge's projection method to map the elements and geometric structures (including solids) on the drawing plane.
PEU_U02 - Student can set the size of the dimensions characterized measuring tasks of geometry.
PEU_U03 - Student can provide restitution of the geometric structure on the basis of Monge's projection and submit the result by axonometric projection.

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic definitions and principles of the parallel, rectangular projection by Monge's projection, the mapping of basic geometric elements (points, line, plane).	1
Lec2	Common elements - edges and breakdown points; parallel and perpendicular elements.	2
Lec3	Transformation of the position (rotation, revolved section, increasing of the revolved section) and the reference system transformation (additional projection plane).	2
Lec4	Solids - definitions; solid section as a set of common elements of the solid cutting plane, solid's breakdown points by a straight line.	2
Lec5	Cutting of the solids with projecting planes set - a modification of the initial solid's view, developed views.	2
Lec6	Penetration of the solids - transmission lines definition, the use of auxiliary cutting planes and reference system transformation.	2
Lec7	Projection in the three orthogonal planes; axonometry basis; completion of the missing solid projection - use of the axonometric projection.	2
Lec8	Final test.	2
		Total hours: 15

Form of classes – Classes	Number of hours

Cl1	Information on the drawing utensils and principles of the geometric structures drawing. Projection of a point and straight line, the mapping of a plane using her traces, identification of the basic elements localization in space using two orthogonal projection planes.	2
Cl2	Belonging of the basic geometric elements, completion of the missing projection; particular localization of the geometric elements.	2
Cl3	Edge as common element of two planes. Breakdown point as common element of straight line and plane. Particular cases of a common elements.	2
Cl4	Edge between flat figures (auxiliary projection planes application); breakdown point of the flat figure by straight line. Identification and construction of the parallel and orthogonal relationship between basic geometrical elements.	2
Cl5	Rotation and revolved section of the basic geometrical elements (rotation of a line's segment and plane); application of the localization transformation for measuring tasks (determination of the real size of a line's segment, angle, flat figure).	2
Cl6	Determination of the projections of plane geometrical structures with selected parameters and the desired position in space (increasing of revolved section of a plane figure). Application of the reference system transformation in measuring tasks and identification of the position (angle relative to the projecting plane, distance of the point from the plane, setting the points projections at a set distance from the plane)	2
Cl7	Test K1 (includes classes's 1 - 6 material)	2
Cl8	The mapping of the elementary solids using Monge's projection, points and lin's segments belonging to the solid's walls identification; determination of the cross sections of polyhedra with projection planes.	2
Cl9	Determination of the polyhedra cross sections cutted by arbitrary planes. Determination of the cross section of the solids with surfaces. Solid's breakdown points by lines (use of auxiliary cutting planes containing penetrating straight line) determination.	2
Cl10	Developed view of a polyhedron and solid containing ruled surface. Cutting of the solid with projection planes as a modification of the initial form of solid - cutting of the polyhedron.	2
Cl11	Cutting of a solid of revolution. Polyhedra transmission lines determination.	2
Cl12	Solids (containing surfaces) transmission lines determination.	2
Cl13	Solid mapping onto three orthogonal projectionl planes. Solid modification using projection plane.	2
Cl14	Solid mapping using axonometric projection. Determination of the missing solid projection modified by cutting planes. Relationship between Monge's projection and axonometric projection.	2
Cl15	Test K2 (includes classes's 8 - 14 material)	2
		Total hours: 30

TEACHING TOOLS USED
N1. problem lecture N2. problem exercises N3. self study - preparation for project class N4. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W03	final test
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02	test no. 1, good rating is nedeed (min. 3.0)
F2	PEU_U01, PEU_U02, PEU_U03	test no. 1, good rating is nedeed (min. 3.0)
P = F3		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE [1] Lewandowski Z., Geometria wykreślna, PWN, Warszawa 1980 (i późniejsze wydania), [2] Otto F., Otto E., Podręcznik geometrii wykreślnej, PWN, Warszawa 1998, [3] Zbiór zadań z geometrii wykreślnej, red. Nowakowski T., Oficyna Wyd. Politechniki Wrocławskiej, Wrocław 2001, [4] Bieliński A., Geometria wykreślna, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2005 SECONDARY LITERATURE [1] Szerszeń S., Nauka o rzutach, PWN, Warszawa 1974 (i późniejsze wydania), [2] Przewłocki S., Geometria wykreślna w budownictwie, Wyd. Arkady, Warszawa 1997, [3] Bogaczyk T., Romaszkiewicz-Białas T., 13 wykładów z geometrii wykreślnej, Oficyna Wyd. Politechniki Wrocławskiej, Wrocław 1997, [4] Błach A., Geometria. Przegląd wybranych zagadnień dla uczniów i studentów. Arkady, Warszawa 1998.

SUBJECT SUPERVISOR
dr inż. Marta Kozuń tel.: 320-27-13 email: marta.kozun@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Chemia**
Name of subject in English: **Chemistry**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0066**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. A Range of Chemistry and Physics of Secondary School

SUBJECT OBJECTIVES

C1. Introduction to the divisions of chemistry usable over related courses study (material science, metallurgy, polymers)
C2. Study of basic chemical knowledge allowing for understanding ofchemical rules and physicochemical properties of
technical materials particularly metals, alloys and polymers
C3. Acquired skills of learning through bringing together knowledge from different fields of science, with particular reference to chemistry, physics, material science, ecology.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - The student should have basic chemical knowledge associated with structure of matter, states of matter.
PEU_W02 - The student should have basic inorganic knowledge associated with the structure of metals, alloys, electron conductivity as well as basic organic knowledge associated with fuels and polymers
PEU_W03 - The student should have basic knowledge associated wit optics and nanotechnology

II. Relating to skills:

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	The structure of the atom, the criteria for division and the structure of matter, elements, compounds.	2
Lec2	Periodic table of elements, structure, groups of elements, electron configuration, allotropic varieties, isotopes.	4
Lec3	Mechanisms of chemical bonding (ionic, atomic, metallic), characteristics of exemplary ionic, covalent and metallic materials, the reasons for their properties.	2
Lec4	Characteristics of basic states of matter; analysis of causes and effects of quantities such as pressure, diffusion, density, viscosity, surface tension, wettability; preliminary characterization of amorphous and crystalline structures	4
Lec5	Metals - causes of plasticity, electron and thermal conductivity, gloss and opacity; characteristics of alloys - division criteria, construction, application of basic alloys	4
Lec6	Conductivity - band theory, superconductors, current conduction mechanism in semiconductors "p" and "n"	2
Lec7	Mixtures - partition criteria, characteristics of specific solutions (solubility mechanisms), colloids and suspensions, light scattering mechanism, concentrations	2
Lec8	Elements of crystallography, unit cell, centering, elements of symmetry, structural defects.	4
Lec9	Basics of organic chemistry: hydrocarbons, isomers, natural gas, petroleum - products; introduction to polymers, characteristics of selected polymeric materials	4
Lec10	Qualifying class –test	2
		Total hours: 30

TEACHING TOOLS USED
N1. informative lecture N2. traditional lecture with the use of transparencies and slides N3. tutorials N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01 - PEU_W03	test
P = P		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE Reliable websites, lecture notes SECONDARY LITERATURE thematic studies on the issues presented at the Lecture

SUBJECT SUPERVISOR
dr hab. Marek Jasiorski tel.: 320-32-21 email: marek.jasiorski@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Maszynoznawstwo**
Name of subject in English: **Theory of Machines**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0067**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. A student has knowledge about physical and chemical processes at the high school level.
2. A student has the elementary ability to associate the principles of operation of selected machines and vehicles with the known laws of physics and chemistry.
3. A student is able to use knowledge to analyze the methods of operation of simple mechanical systems.

SUBJECT OBJECTIVES

C1. Learning the general principles of the operation of machines and devices and their role in the modern world.
C2. Acquisition of knowledge and skills in material and functional analysis of the machine's structure. Determining the relationship between the engine, work tool system components, and drive system. Getting acquainted with the EU machinery directive and its requirements.
C3. Acquisition of basic knowledge in the field of relationships between the machine and the technical environment, which are the basis for the machine construction process.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - A student understands the role of machines and devices in modern technology. A student knows the basic principles of operation and construction of working machines and vehicles as well as engines as sources of mechanical energy.
PEU_W02 - As a result of the course a student is aware of the division of machines in terms of their function and construction, while at the same time being able to identify individual components of machines and machine systems.

II. Relating to skills:

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Discussion on the lecture content and final course requirements. The role of technology in the development of civilization.	1
Lec2	The concept of technique and technical system. Matter, energy and information transformation matrix. Machine definitions: classic, functional and EU.	2
Lec3	Analogies between physical environments.	1
Lec4	Machine classification. Examples of machines and machine systems.	2
Lec5	Construction, principles of operation and basic parameters of motors/engines used in machine drives.	2
Lec6	The concept of the drive system. Functions implemented by drive systems of machines and devices and their structure. Examples of load characteristics.	2
Lec7	Typical elements used in the construction of machines.	2
Lec8	Fundamentals of machine control systems, automatic control systems, and the concept of mechatronics systems. Basic definitions and structure of mechatronic systems.	2
Lec9	Written final test.	1
		Total hours: 15

TEACHING TOOLS USED

N1. informative lecture
N2. multimedia presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02	final test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Biały W.: Maszynoznawstwo. WNT, Warszawa 2003.
[2] Chwiej M. Maszynoznawstwo ogólne. PWN, Warszawa 1983 (IV wyd.).
[3] Wołek M.: Maszynoznawstwo ogólne. PWN, Warszawa 1978.
[4] Orlik Z.: Maszynoznawstwo. WSziP, Warszawa 1989.
[5] Gnutek Z., Kordylewski W.: Maszynoznawstwo energetyczne. Wyd. Politechniki Wrocławskiej, Wrocław 2003.
[6] Mille A., Kijewski J., Pawlik K., Szolc T.: Maszynoznawstwo. WSziP, Warszawa 2003.
[7] Olszewska M. (red.): Podstawy mechatroniki. Wyd. REA. Warszawa 2006.
[8] Schmid D. (red.): Mechatronika. Wyd. REA. Warszawa 2002.

SECONDARY LITERATURE

[1]Hryniewicz A.: Energia. Wyzwanie XXI wieku. Wyd. Uniwersytetu Jagielońskiego, Kraków 2002.
[2]Krick E.U.: Wprowadzenie do techniki i projektowania technicznego. WNT, Warszawa 1975.
[3]Szumanowski A.: Czas energii. WKiŁ, Warszawa 1988.
[4]Charles Panati: Niezwykłe dzieje zwykłych rzeczy. Książka i Wiedza, Warszawa 2004.
[5]Encyklopedia Techniki. MUZA SA.
[6] Pritschow G.: Techika sterowania obrabiarkami i robotami przemysłowymi. Oficyna Wyd. Politechniki Wrocławskiej 1993.
[7] Ochoa G., Corey M.: Kalendarium nauki i techniki. Wyd. Zysk i S-ka, Poznań.

SUBJECT SUPERVISOR
dr inż. Tomasz Siwulski tel.: 71 320-28-92 email: tomasz.siwulski@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Technologia materiałów inżynierskich**
Name of subject in English: **Engineering Materials Technology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0068**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of physics and mathematics. He can use basic measuring instruments, e.g. calipers.
2. Ability to analyze information included in laboratory instructions.
3. Ability to work in a team.

SUBJECT OBJECTIVES

C1. Familiarization with metallurgical processes of ore conversion, production of steel and non-ferrous metals.
C2. Familiarization with basic methods of testing of mechanical properties of steel and non-ferrous metals and principles of forming of items with use of powder metallurgy.
C3. Obtaining and reinforcement of social competences connected with a teamwork with a goal to solve problems effectively.
C4. Familiarization with knowledge about basic mechanical properties of engineer materials like: tensile strength, compressive strength, impact strength, hardness by participation in testing of selected materials.
C5. Familiarization with methods of conducting of non-destructive testing like: visual inspection, dye-penetrant examination, magnetic particle testing, radiographic and ultrasonic testing by participation in testing selected parts.
C6. Familiarization with technological tests and forming of items with use of powder metallurgy by participation in an experiment.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - As a result of conducted lecture the student should be able to define the basic physical properties of engineering materials, to quote and to describe the ways of processing of ores the metals, to characterize the metallurgical processes of receiving the metals and the alloys of metals.
PEU_W02 - As a result of conducted laboratory the student should be able to define the mechanical properties of metals and the alloys, to describe the method of tests destructive and non-destructive, to characterize the method of carrying out the technological tests.
PEU_W03 - As a result of conducted classes the student should be able to distinguish basic engineering materials, to characterize their physical and mechanical properties, to identify method investigations of properties of engineering materials.

II. Relating to skills:
PEU_U01 - As a result of the lecture the student should be able to analyze processes metallurgical obtaining metal, compare the properties of engineering materials.
PEU_U02 - As a result of laboratory classes student should be able to carry out in a limited range the basic test of tensile strength, compressive strength, impact tests, hardness tests and technological tests.
PEU_U03 - As a result of the course the student should be able to obtain information from the literature, have the ability to self-learning, carry out measurements, determine the value and to evaluate certainty basic mechanical properties.

III. Relating to social competences:
PEU_K01 - Demonstrates skills needed in teamwork on improving methods of choice of a strategy to optimally solve problems assigned group.
PEU_K02 - Is able objectively evaluate the arguments rationally explain and justify his own point of view using the knowledge of the basics of engineering materials.
PEU_K03 - Respects the customs and rules of the academic community.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters.	1

Lec2	General information about properties of engineer materials. Refractory materials and fuels in pyrometallurgy.	2
Lec3	Metallurgy of iron. Ore treatment, blast furnace process.	2
Lec4	Steel production, influence of admixtures on steel properties.	2
Lec5	Metallurgy of copper. Ore treatment, pyrometallurgical and hydrometallurgical processes of production of copper and its alloys.	2
Lec6	Metallurgy of aluminum. Treatment of ores, production of aluminum oxide and refining of aluminum.	2
Lec7	Metallurgy of zinc. Ore treatment, pyrometallurgical and hydrometallurgical processes of production of zinc and its alloys.	2
Lec8	Production of high melting metals with use of powder metallurgy and methods of production of parts with use of metallic powders.	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Organizational matters, health and safety conditions.	1
Lab2	General information about metals and alloys - alloys fabrication.	2
Lab3	Tensile test of metals.	2
Lab4	Compression test and impact test.	2
Lab5	Hardness measurement of metal alloys.	2
Lab6	Non-destructive tests.	2
Lab7	Technological tests.	2
Lab8	Production of machine elements from metal powders.	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - preparation for laboratory class N3. laboratory experiment N4. report preparation N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement

F1	PEU_W01, PEU_W02, PEU_W03	Final test
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03, PEU_K01-PEU_K03	Oral answers, short tests
P = średnia z F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE 1. Z. Mirski. Technology and engineering materials testing, laboratory. Wrocław University of Technology Publishing House, 2010. 2. Krynicki L., L. Sozański. Technology of metals. Publisher University of Technology, 1994. SECONDARY LITERATURE Supplementary materials for exercises No. 1-5. W10 library (building B4, III floor).

SUBJECT SUPERVISOR
dr inż. Tomasz Wojdat tel.: (71) 320 40 68 email: tomasz.wojdat@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Termodynamika techniczna**
Name of subject in English: **Applied thermodynamics**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0069**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of problems covered by the field of Physics
2. The ability to independently perform laboratory exercises, supported by elementary manual dexterity
3. Awareness of the necessity of group work and the ability to implement it

SUBJECT OBJECTIVES

C1. Based on the laws of thermodynamics, understanding the principles of gas transformations and the possibilities of their use in technology
C2. Knowledge of the basics of the operation of power machines and the ability to determine their efficiency
C3. Knowledge of the basics of compressor operation and the ability to determine their efficiency
C4. Knowledge of the basics of operation of flow machines and the basics of supersonic flow thermodynamics

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Has basic knowledge of physics enabling explanation of facts and phenomena occurring in the natural world and technology
PEU_W02 - Can interpret and analyze the cycles of energy machines

II. Relating to skills:
PEU_U01 - Is able to solve tasks and problems based on acquired knowledge and information obtained from scientific and technical literature in Polish and English, databases and other sources
PEU_U02 - Can carry out calculations of power machines based on variable thermodynamic parameters

III. Relating to social competences:
PEU_K01 - Understands the importance of using mathematical methods in the represented engineering discipline

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic definitions: local parameters, global parameters, specific parameters, pressure, temperature, zero law of thermodynamics	2
Lec2	Perfect gas state equation. The real gas state equation	2
Lec3	Thermodynamic processes. The heat of a process. The work of a process - absolute, technical and useful work	2
Lec4	Heat capacity of the body at constant pressure and constant volume. Change of internal energy. Change of enthalpy.	2
Lec5	Energy balance. The first law of thermodynamics for open and closed systems.	2
Lec6	Polytropic equation. Work and heat of polytropic process. Characteristic transformations – work and heat of characteristic processes	3
Lec7	The second law of thermodynamics. Entropy. Basics of thermodynamic cycles and their efficiency. Carnot cycle.	3
Lec8	Air standard cycles of power machines. The efficiency of air standard cycles	4
Lec9	Reciprocating and rotodynamic compressors, indicator chart and compressor operation.	2
Lec10	Thermodynamics of compressible flows. Energy balance for compressible flows. The first law of thermodynamics for compressible flows	2
Lec11	The flow of gases through nozzles, the Bernoulli equation, dynamic jet action, determination of the local speed of sound	2
Lec12	Basic laws concerning heat transfer by convection, radiation, conduction	2
Lec13	Examination	2
		Total hours: 30

Form of classes – Laboratory	Number of hours

Lab1	Determination of specific heat of gas for polytropic process	2
Lab2	Determination of the correction factor for the adiabatic process	2
Lab3	Determination of volumetric efficiency of the reciprocating compressor	2
Lab4	Study of the adiabatic process of nozzle outflow. Determination of the Bendemann ellipse	2
Lab5	Isothermal process. Practical implementation of Boyle Mariotte's law	3
Lab6	Examination of the heat transfer process through a flat partition at: a) the occurrence of convection and radiation, b) the use of a radiation-attenuating screen	2
Lab7	Isobaric heating using heat regeneration	2
		Total hours: 15

TEACHING TOOLS USED
N1. informative lecture N2. problem lecture N3. self study - self studies and preparation for examination N4. tutorials N5. self study - preparation for laboratory class

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_K01	Examination
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_K01	quiz, report on laboratory exercises
F2	PEU_U01, PEU_U02, PEU_K01	quiz, report on laboratory exercises
F3	PEU_U01, PEU_U02, PEU_K01	quiz, report on laboratory exercises

F4	PEU_U01, PEU_U02, PEU_K01	quiz, report on laboratory exercises
F5	PEU_U01, PEU_U02, PEU_K01	quiz, report on laboratory exercises
F6	PEU_U01, PEU_U02, PEU_K01	quiz, report on laboratory exercises
F7	PEU_U01, PEU_U02, PEU_K01	quiz, report on laboratory exercises
P = (F1+F2+F3+F4+F5+F6+F7)/7		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Szargut, Jan and Termodynamika Techniczna. Wydawnictwo Politechniki Śląskiej. Gliwice, 2009.
[2] Wiśniewski, Stefan. Termodynamika Techniczna. Wydawnictwa Naukowo-Techniczne, 1993.

SECONDARY LITERATURE

[1] Tuliszka, E. and Z. Koszla-Olachowska. Termodynamika Techniczna: Zbiór Zadań : Praca Zbiorowa. Wydaw. Politechniki Poznańskiej, 1980.
[2] Teodorczyk, A. Zbiór Zadań Z Termodynamiki Technicznej. Wydawnictwa Szkolne i Pedagogiczne, 1992.

SUBJECT SUPERVISOR

dr inż. Aleksander Górniak email: aleksander.gorniak@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Ekologia**
Name of subject in English: **Ecology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0070**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has the basic knowledge of chemistry, biology and ecology.
2. Makes use of reference literaturę, exploits available sources, both via the Internet and in print form.

SUBJECT OBJECTIVES

C1. To get the student acquainted with the basic problems of ecology and environmental protection.
C2. To get to know threats resulting from human activity.
C3. Familiarisation with modern solutions serving environmental protection.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Has the basic knowledge of the hazards arising from the industrial activities.
PEU_W02 - Has the knowledge of the international conventions and Polish environmental regulations.
PEU_W03 - Can characterize modern solution for environmental protection.

II. Relating to skills:

III. Relating to social competences:
PEU_K01 - Has the awareness regarding the importance of non-technical impacts of anthropogenic activity.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to the course - Ecological problems of the modern world.	1
Lec2	Conventional energy sources (coal, crude oil and natural gas) and their impact on the environment.	2
Lec3	Renewable energy sources (solar, wind, water, geothermal).	2
Lec4	Ways of energy storage.	1
Lec5	Biomass and biofuels.	1
Lec6	Causes and effects of air pollution (greenhouse effect, ozone hole, smog, acid rain).	2
Lec7	Ecological solutions used in cars (catalyst, DPF, EGR, lambda probe). Zero emission cars.	1
Lec8	Water pollution. Wastewater treatment and water treatment.	2
Lec9	Soil pollution and degradation. Loss of biodiversity.	1
Lec10	Final test	2
		Total hours: 15

TEACHING TOOLS USED

N1. tutorials
N2. multimedia presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01 ÷ PEU_W03	Written final test
F2	PEU_K01	
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE Reliable internet sources SECONDARY LITERATURE

SUBJECT SUPERVISOR
dr hab. Agnieszka Baszczuk tel.: 320-32-21 email: agnieszka.baszczuk@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Grafika inżynierska -zapis konstrukcji**
Name of subject in English: **Engineering Graphics - Engineering Drawing**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0071**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			30	
Number of hours of total student workload (CNPS)	30			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of descriptive geometry.
2. Basic drawing skills and use of computer equipment.
3. The skill to use the Internet digital resources

SUBJECT OBJECTIVES

C1. The acquisition of knowledge and skills in rectangular projection of elements of space on the plane with the use of views and sections, as well as the principles for engineering drawing.
C2. The acquisition of knowledge and skills in the dimensioning and tolerancing of dimensions of machine parts, as well as the identification of their surface features and shape and position tolerances
C3. The acquisition of knowledge and skills in the field of graphic representation of connections of machines and rules for standardization in constructions drawings, as well as elements drawings (manufacturing drawings) and complex systems (assembly drawings) and the principles of schematization.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

PEU_W01 - The student knows and is able to explain the rules of constructions drawings and creating the technical documentation of elements and mechanical components.

PEU_W02 - The student knows how to call the basic parameters characterizing the geometric features of a product and propose how to save these information.

PEU_W03 - The student knows the principles of graphic representation of joint of machine elements and drawing the standard machine elements.

II. Relating to skills:

PEU_U01 - The student is able to draw technical documentation and schematics of technical systems by hand and by computer (CAD).

PEU_U02 - The student is able to read the technical documentation of a machine component and complex technical systems as well as the schematic drawing.

PEU_U03 - The student is able to identify and draw the basic connections of machine parts.

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Rules of technical drawings. Standardization in technical documentation. Orthogonal and axonometric projections. Drawing composition.	2
Lec2	Types of views in the technical drawing. The application of sections, revolved and removed sections. Details presentation.	2
Lec3	Dimensioning. The rules of dimensioning of machine elements. Methods of tolerancing dimensions and fits in drawings.	2
Lec4	Presentation of surface roughness. Form or position tolerances and complex tolerances.	2
Lec5	Drawing of the basic machine joints - separable and inseparable joints. Drawing of the standardized machine elements.	2
Lec6	Types of drawings in the technical documentation. Detail drawings, assembly drawings, general arrangement drawings. Schematic drawings.	2
Lec7	Final test	2
Lec8	Discussion of the final test results and the course summary.	1
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Introduction. Basic principles of drawing using computer technology. Simple drawings using a computer program (CAD): organization of a graphic editor, basic drawing functions (line, circle, arc, etc.)	2

Proj2	Basic techniques of freehand drawing - line, arc, circle, ellipse. Drawings of simple machine elements.	2
Proj3	Views of machine elements based on axonometric drawings. Technical sketch - freehand made. Drawing composition. Computer drawing (editing and modification functions of drawings)	2
Proj4	Views of more complex machine elements. Computer drawing (editing and modification functions - continuation)	2
Proj5	Sections of simple machine elements. Drawing of symmetrical elements (half view and half section).	2
Proj6	Drawing of rotary machine elements (shafts, sleeves). Sections, revolved and removed sections.	2
Proj7	Detail drawings. Dimensioning rules. Tolerances. Surface roughness description.	2
Proj8	Drawing of welded joints and glued joints. Drawing of a frame, body or support element containing parts, that are connected by welding or gluing.	2
Proj9	Thread fits in drawings. Drawing of machine assembly containing a thread fits.	2
Proj10	Final test	2
Proj11	Design exercise - topic overview. The draft sketch of machine assembly as the content of the exercise.	2
Proj12	Design exercise. The general arrangement drawing of the machine assembly.	2
Proj13	Design exercise. Detail drawings of the machine assembly.	2
Proj14	Design exercise. The detail drawings of the machine assembly. Schematic drawing.	2
Proj15	Evaluation of the design exercise. Course grade.	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of multimedia techniques. N2. self study - preparation for project class N3. problem discussion N4. individual solving the drawing exercises with the tutor.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	post-lecture tests (quizzes)
F2	PEU_W01, PEU_W02, PEU_W03	final test

P = 0,1*F1+0,9*F2

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03	final test
F2	PEU_U01- PEU_U03	Assessment of the design exercise
F3	PEU_U01- PEU_U03	Assessment of tasks solved in class
P = 0,6*F1+0,3*F2+0,1*F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Dobrzański T., Rysunek techniczny maszynowy. WNT, Warszawa, 2021.
[2]Rydzanicz I., Zapis konstrukcji. Podstawy. Oficyna Wyd. PWr,Wrocław.
[3]Supporting materials for the lecture - ePortal WUST
[4] Giesecke F.E. et al., Engineering Graphics. Pearson Education Inc. 2004.

SECONDARY LITERATURE

[1] Suseł M., Makowski K.. Grafika inżynierska z zastosowaniem programu AutoCAD, Oficyna Wydawnicza PWr, 2005
[2] Websites for AutoCAD learning eg.
https://autocad-beginners.blogspot.com/2018/01/content-of-autocad-tutorials.html
https://strefainzyniera.pl/index.php/artykul/498/oprogramowanie-cadca

SUBJECT SUPERVISOR

Prof. dr hab. inż. Wojciech Wieleba tel.: +4871 320-27-74 email: wojciech.wieleba@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Podstawy materiałoznawstwa**
Name of subject in English: **Fundamentals of materials science**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0072**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic of physic at the high school level.
2. The basic knowledge of chemistry, ability to use of chemical terminology.
3. The basic knowledge of mathematic, ability of creation and interpretation equations and graphs.

SUBJECT OBJECTIVES

C1. Students' familiarization with criteria of engineering materials types and kinds of such materials.
C2. Knowledge of basic crystallography and cristalline structures properties.
C3. Learning of interpretation and usage of equilibrium phase graphs in planning of properties of engineering materials.
C4. Knowledge of structures and properties of iron-cementite system alloys.
C5. Acknowledgements with state, properties and applications of ceramics, polymers and composites.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Knows groups of engineering materials and criteria of their clasiffication.
PEU_W02 - Knows types of iron alloys, can interprete their microstructures and specify their properties.
PEU_W03 - Can specify the basis properties and fields of usage and kinds of ceramics, polymers and composites.

II. Relating to skills:
PEU_U01 - Ability to interpret microstructures of products after various manufacturing processes and to relate them to properties.
PEU_U02 - -Ability – at the design stage – to select unalloyed steel and cast iron, as well as to consciously select a manufacturing method and chemical composition.

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Mechanical and physical properties of metallic materials. Relationships between the manufacturing process, structure and properties of materials.	2
Lec2	Elements of crystallography, metallic bond, crystal lattices of metals	2
Lec3	Defects of crystalline structures.	2
Lec4	Balance and criteria of balance. Nucleation and crystallization.	2
Lec5	Metal alloys. Structure and types of alloys. Intermetallic phases. Characteristic of phases presented in alloys of metals.	2
Lec6	Pfase equilibrium diagrams of binary systems. Phase rule.	2
Lec7	Iron-cementite equilibrium diagram. Analysis of diagram.	2
Lec8	Influence of carbon content on microstructures and properties of iron alloys.	2
Lec9	Classification and natation rules of non-alloyed steels.	2
Lec10	Classification and natation rules of cast irons.	2
Lec11	Polymers – classification, properties and application	2
Lec12	Ceramics – classification, properties and application.	2
Lec13	Composites – classification, properties and application.	2
Lec14	Test	2
Lec15	Test	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Introduction.The aim and methods of materials investigation. Construction and operation of metallographic microscope.	2

Lab2	Macroscopic investigation of materials and investigation of technological defects.	2
Lab3	Analysis of phase balance diagrams of two-component systems.	2
Lab4	Microstructural investigation of mono- and multiphase alloys at etched and non-etched state.	2
Lab5	Diagram and microstructures of iron-cementite diagram analysis.	2
Lab6	Effect of carbon content on microstructure and properties of steel and steel.	2
Lab7	Cast iron - classification, microstructure in the untreated and digested state, properties, application.	2
Lab8	Laboratory summary.	1
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - self studies and preparation for examination N3. laboratory experiment N4. self study - preparation for laboratory class N5. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	test
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02	quiz
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE [1] Haimann.R; Metaloznawstwo; Wyd.PWr; 2000 [2] Dobrzański.L.A, Materiały inżynierskie i projektowanie materiałowe. Podstawy nauki o materiałach i metaloznawstwo, WNT, 2006 [3] Blicharski M., Wstęp do inżynierii materiałowej, WNT, 2012 [4] Dudziński W., Widanka K., Ćwiczenia laboratoryjne z materiałoznawstwa, Oficyna Wydawnicza PWr, 2012 SECONDARY LITERATURE [1] Dudziński W., Materiały konstrukcyjne w budowie maszyn, Wyd.PWr; 1994 [2] Ashby M. F., Jones D.R.H., Materiały inżynierskie, t. 1 i 2, WNT; 1996

SUBJECT SUPERVISOR
dr hab. inż. Dominika Grygier tel.: 320-38-45 email: dominika.grygier@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Mechanika I**
Name of subject in English: **Mechanics I**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0073**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	30			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	2	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematical analysis (differentiation, integration)
2. Algebra (at secondary level) + linear algebra (matrices, determinants)
3. Euclidean geometry and trigonometry

SUBJECT OBJECTIVES

C1. Solving of practical static and kinematic problems based on the laws of classical mechanics
C2. Implementing of static analysis of strength of machine elements

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - is able to define the basic concepts in mechanics (force, moment of force). He knows the classical mechanics equations in statics. He knows some selected methods of solving trusses, beams and frames
PEU_W02 - has a knowledge of the geometry of the masses (static moments, moments of inertia and deviation)
PEU_W03 - has a knowledge of the basic concepts of particle kinematics and the kinematics of a rigid body (speed, acceleration, number of degrees of freedom, the trajectory and motion equations)

II. Relating to skills:
PEU_U01 - is able to solve typical engineering structures (trusses, beams, frames) under static load: reactions at the supports, the internal forces (as an analytic functions and their graphs)
PEU_U02 - is able to determine the position of center masses, static moments and moments of inertia of basic mechanical systems and the principal axes and moments of inertia in coplanar system
PEU_U03 - can calculate the velocity and acceleration of any points of typical mechanical systems and their components

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Program, requirements, literature. Outline of vector algebra	2
Lec2	Force, moment of force, the main vector and main moment of forces, equilibrium conditions, the axioms of statics. Changing of the moment’s pole	2
Lec3	Concurrent force system. Trusses. Method of separated nodes	2
Lec4	Determination of the reaction forces in the case of coplanar force systems (applying in the beams, trusses, plane frames, etc.)	2
Lec5	Ritter’s method to determining the forces in selected truss members. The reduction of coplanar force system. Culmann’s method.	2
Lec6	The internal forces in statically determinate beams (analytical method)	2
Lec7	Determination of internal forces in the frames	2
Lec8	Centre of masses in discrete and continuous systems. Static moments	2
Lec9	Moments of inertia, parallel and rotational transformation	2
Lec10	Principal axes and moments of inertia in coplanar system	2
Lec11	Particle kinematics (trajectory, velocity, acceleration). Curvilinear motion, tangential and normal acceleration. Kinematics in the natural and polar coordinate system	2
Lec12	The motion of a rigid body. Degrees of freedom. Classification of the motion of a rigid body. Formulas for calculation the velocity and acceleration in the general motion case.	2

Lec13	Kinematics of rigid body rotation. Rotational velocity and acceleration. Plane motion. Methods for determining the velocity of the plane motion (instantaneous center of rotation, centroid)	2
Lec14	Test 1	2
Lec15	Test 2	2
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Basic operations on vectors: analytical and graphical summation, scalar and vector multiplication, etc.	2
Cl2	Determination of forces in the bars of planar systems (trusses) by separated nodes method using equilibrium equations and polygon of forces	2
Cl3	Determination of reaction forces in bearings of any planar systems by analytical methods	2
Cl4	Determination of reaction forces in bearings of spatial systems (one example)	1
Cl5	Determination of forces in freely selected truss rods (by Ritter's method)	1
Cl6	Determination of internal forces in beams	2
Cl7	Determination of internal forces in beams (cont.). Articulated beams.	2
Cl8	Determination of internal forces in frames (simple planar frames at most with one node)	2
Cl9	Determination of mass centres and static moments.	2
Cl10	Determination of the moments of inertia in planar discrete-continuous systems and deviation moments relative to any axis by application Steiner's law.	2
Cl11	Determination of the position of the principal central axis of inertia and values of the principal inertial central moments for planar systems (one example).	2
Cl12	Solving the problems of particle kinematics in the Cartesian coordinate system.	2
Cl13	Solving the kinematic problems of rotation and translatory motion of rigid body.	2
Cl14	Determination of velocity in plane motion of a rigid body. Superposition method and instantaneous center of rotation for velocity.	2
Cl15	Test 1	2
Cl16	Test 2	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. calculation exercises N3. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. B. Gabryszewska, A. Pszonka: "Mechanics", Part 1: Statics, WUT, 1988
2. J. Leyko :"General Mechanics", Part 1 Statics and kinematics, PWN 2022
3. J. Zawadzki, W. Siuta: "General Mechanics", PWN, Warsaw 1971
4. J. Misiak: "General Mechanics. Statics and Kinematics ". Volume I, WNT, Warsaw, 1993
5. C. Witkowski, "Exercises in mechanics." Part I. "Kinematics". WUT. 1999
6. Z. Jaśniewicz , "Exercises in statics “ WUT. 1996
7. J. Nizioł: "Methodology of solving problems in mechanics", PWN 2023

SECONDARY LITERATURE

1. J. Giergiel: "General Mechanics", WNT, Warsaw, 1980
2. B. Skalmierski: "Mechanics" PWN, Warsaw, 1977
3. S. Piasecki, J. Rżysko: "Mechanics" WNT, Warsaw, 1977,
4. W. Siuta: "Engineering Mechanics", WNT, Warsaw, 1968

SUBJECT SUPERVISOR

dr hab. inż. Daniel Lewandowski tel.: 320-28-99 email: daniel.lewandowski@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Grafika inżynierska 3D**
Name of subject in English: **3D Engineering Graphics**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0074**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				60	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Requirement of knowledge of the course "Engineering Graphics - Descriptive Geometry"
2. Requirement of knowledge of the course "Engineering Graphics: Engineering Drawing "
3. Requirement of handling skills of computer hardware

SUBJECT OBJECTIVES

C1. Knowledge and skills in the field of 3D modeling of the machines parts and assemblies
C2. Knowledge and skills in range of machinery and equipment research and analysis on the virtual models (virtual prototyping)
C3. Knowledge and skills in range of technical drawing based on 3D models

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:

PEU_U01 - Students should be able to build 3D models of machine parts
PEU_U02 - Students should be able to build 3D models of the machines parts and assemblies and verify models and their parameters
PEU_U03 - Students should be able to make 2D technical drawing based on a 3D model

III. Relating to social competences:

PEU_K01 - Student gains the skills to take responsibility for their work

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction to solid modeling - basic solid modeling operations, the rules of creation of a 2D sketch, fittings in the sketch (geometric and dimensional fittings)	2
Proj2	Basic solid modeling - Advanced operations on 2D sketches, solid modeling with extrude methods	2
Proj3	Solid Modeling Basics - operations on solids: chamfering, rounding, tilting walls, constructions (point, axis, plane), the creation of the ribs, the holes wizard, duplication of the solid operations	2
Proj4	Basic solid modeling - Advanced operations on 2D sketches - function relationships of parameters, solid modeling with rotation, solid editing - shell models	2
Proj5	Basic solid modeling - solid modeling with rotation, one and multibody modeling	2
Proj6	Advanced solid operations - sweep, loft, split, scroll	2
Proj7	The project of assembly: the concept, the construction of the parts by using the known solid modeling methods	2
Proj8	The project of assembly: preparing to create an assembly- parts assembling, bonds and relationships in the assembly	2
Proj9	The project of assembly: parts assembling, parts editing in an assembly, a library of standard parts	2
Proj10	The project of assembly: parts modeling in the assembly environment, the adaptability of the parts	2
Proj11	The project of assembly: analysis of the functional correctness of the assembly (parameters analysis, kinematic analysis, analysis of collision) rectify design faults, loads analysis	2
Proj12	The project of assembly: loads analysis, reactions and forces at the nodes, the presentation of the model	2

Proj13	The project of assembly: 2D technical drawings of parts - manufacturing parts drawings	2
Proj14	The project of assembly: 2D technical drawings of assembly - assembly drawings	2
Proj15	Completion of the course: work during classes	2
		Total hours: 30

TEACHING TOOLS USED
N1. project presentation N2. problem discussion N3. self study - preparation for project class N4. independent work on the computer under the tutor supervision

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03 PEU_K01	test, participate in problem discussions
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE Autodesk Inventor Professional 2021 PL / 2021+ / Fusion 360 Metodyka projektowania Andrzej Jaskulski SECONDARY LITERATURE Zbiór ćwiczeń Autodesk Inventor 2020 Kurs podstawowy Fabian Stasiak

SUBJECT SUPERVISOR
dr inż. Tadeusz Lewandowski tel.: 71 320-24-65 email: tadeusz.lewandowski@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Mechanika płynów**
Name of subject in English: **Fluid Mechanics**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0075**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	60	30			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	2	1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a structured knowledge of mathematics, including algebra and mathematical analysis
2. Structured knowledge of physics and mechanics.
3. Structured knowledge of the basics of machine design.

SUBJECT OBJECTIVES

C1. Learning the basic laws of mechanics in relation to the flow of liquids and gases.
C2. Ability to use the basic laws of fluid mechanics in the construction and design of machines.
C3. Ability to use the basic laws of fluid mechanics in the operation of machines.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - PEU_W01 - Be able to define the basic laws in fluid mechanics
PEU_W02 - PEU_W02 - Explain the principles of operation of machines and phenomena occurring in their construction and operation.
PEU_W03 - PEU_W03 - Indicate the connections between the basic laws of fluid mechanics and the principles of operation
machine accessories.

II. Relating to skills:
PEU_U01 - PEU_U01 - Analyze the course of phenomena related to flows in the operation of machines.
PEU_U02 - PEU_U02 - Structured knowledge in the theory of machine construction.
PEU_U03 - PEU_U03 - Can combine the laws of fluid mechanics with the issues of design and operation of machines.

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, properties of liquids and gases, forces and stresses in fluids, Fluids Newtonian and non-Newtonian.	2
Lec2	Methods of fluid motion analysis, streamlines, potential and vortex flows. Flow visualization methods. Fluid kinematics	2
Lec3	Basic equations of fluid mechanics, continuity equation, equation conservation of momentum for ideal and real fluids (Euler equation and Navier-Stokes)	2
Lec4	Hydrostatic equations, connected vessels, pressure of liquid on walls, buoyancy and stability of floating bodies. Fluid balance.	3
Lec5	Inviscid fluid dynamics, Bernoulli equation, examples of applications: measurements speed, flow of liquid through holes, suction action of the jet.	2
Lec6	The principle of angular momentum and angular momentum, hydrodynamic reaction, basic theory flow machines.	2
Lec7	Dynamics of viscous fluids. Flow classification, laminar flow. basics of the boundary layer theory. Navier-Stockes equation	2
Lec8	Examples of solutions to N-S equations, flows in axisymmetric ducts.	2
Lec9	The transition from laminar to turbulent flow. Reynolds experiment. Elements of the theory of turbulent flows. Methods of calculating turbulent flows. Detachment of the boundary layer.	4
Lec10	Hydrodynamic theory of lubrication in bearings, flows through gaps.	1

Lec11	Flow around bodies, flow resistance, hydrodynamic buoyancy, airfoil, characteristics hydrodynamic profiles.	2
Lec12	Fluid flow in pressurized lines. Flow in a closed conduit with a circular cross-section. Hydraulic losses due to friction. Hydraulic losses caused by local resistances.	2
Lec13	Steady flow of fluids in hydraulic systems. Unsteady flow of fluids in lines.	2
Lec14	Numerical methods in fluid mechanics.	2
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Introduction to fluid mechanics exercises. Solving tasks in the field of basic properties of fluids.	1
Cl2	Tasks illustrating the application of Euler's equation and Pascal's law. Calculation hydrostatic forces. Connected dishes. Manometric measurements.	2
Cl3	Fluid statics. Pressure force on straight and curved surfaces.	2
Cl4	Fluid statics. Buoyancy issues. Fluid in equilibrium.	2
Cl5	Application of the Bernoulli equation and the continuity equation for liquid flow calculation and measurement flow rate. Local velocity measurement.	3
Cl6	Calculation of pressure losses in closed pipes. Designation pipeline characteristics.	2
Cl7	Calculation of flows through fractures.	2
Cl8	Final test.	1
		Total hours: 15

TEACHING TOOLS USED
N1. problem lecture N2. traditional lecture with the use of transparencies and slides N3. calculation exercises

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01 - PEU_W03	test
P = 0.5*F1+0.5*FC		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03	test
P = F1=FC		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE B. R. MUNSON, D. F. YOUNG, T. H. OKIISHI: Fundamentals of Fluid Mechanics, SECONDARY LITERATURE B. R. MUNSON, D. F. YOUNG, T. H. OKIISHI: Fundamentals of Fluid Mechanics,

SUBJECT SUPERVISOR
dr inż. Krzysztof Patralski tel.: 2667 email: krzysztof.patralski@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Materiałoznawstwo**
Name of subject in English: **Materials science**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0076**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	90		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	3		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.8		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The basic knowledge of physics and chemistry.
2. The passed lecture of Fundamentals of materials science (the requirement does not have formal character - it is related with knowledge and abilities given in course card - Fundamentals of materials science).
3. Basic knowledge in the fields of classical mechanics and thermodynamics.

SUBJECT OBJECTIVES

C1. Acquiring knowledge about technically important groups of metal alloys, their designation systems and their application criteria in specific service conditions.
C2. Gaining ability to understand the balance between strength and plasticity of metallic materials, as well as possibility to control these properties by chemical composition and microstructure formed in manufacturing process of finished products.
C3. Acquisition of knowledge about the basics of heat, termo-chemical and plastic teratment of iron alloys.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Elementary knowledge of basic construction materials, their properties and possible applications in the construction of machines, devices and vehicles
PEU_W02 - Understanding of phase transitions occurring in metal alloys and knowledge about their effect on selection of thermal and thermochemical treatment parameters.
PEU_W03 - Understanding of information given in material standards concerning delivery conditions, recommended heat treatment and achievable properties.

II. Relating to skills:
PEU_U01 - Ability to select kind and parameters of heat treatment for specific alloys in order to obtain preset properties.
PEU_U02 - Ability to interpret microstructures of products after various manufacturing processes and to relate them to properties.

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Phase transformations in iron-carbon alloys during heating and cooling.	2
Lec2	Basic kinds of annealing iron-carbon alloys. Quench hardening and tempering.	2
Lec3	CTP diagrams and their interpretation.	2
Lec4	Surface treatment: surface hardening, carburizing, nitriding.	2
Lec5	Plastic deformation and recrystallizations annealing of metals.	2
Lec6	Influence of alloying elements for phase transitions in iron-carbon alloys.	2
Lec7	Constructional alloyed steels.	2
Lec8	Steels with special properties, corrosion-resisting steel.	2
Lec9	Steels with special properties, creep-resisting and heat-resisting.	2
Lec10	Cold forming steels. New generation multiphase steels.	2
Lec11	Alloyed tool stels.	2
Lec12	Casting iron alloys.	2
Lec13	Aluminum alloys – classification, designation, structures and properties, heat treatment, selection criteria.	2
Lec14	Heavy and light metal alloys (zinc, lead, nickel, cobalt, magnesium, titanium, beryllium) – classification, designation, structures and properties, heat treatment, selection criteria.	2
Lec15	Copper alloys - classification, structures and properties, application.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Plastic deformation and recrystallizations annealing of steels.	2
Lab2	Influence of thermal treatment on microstructure and properties of steels.	2
Lab3	Microstructure of surface-hardened steel products.	2
Lab4	Microstructure and properties of tool alloyed steels	2
Lab5	Microstructure and properties of corrosion-resisting steel.	2
Lab6	Microstructure and properties of aluminium alloys.	2
Lab7	Microstructure and properties of copper alloys.	2
Lab8	Summary and passing of laboratory classes.	1
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - self studies and preparation for examination N3. self study - preparation for laboratory class N4. laboratory experiment N5. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	Exam
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02	Quiz
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE 1] Haimann.R; Metaloznawstwo; Wyd.PWr; 2000 [2] Dobrzański.L.A, Materiały inżynierskie i projektowanie materiałowe. Podstawy nauki o materiałach i metaloznawstwo, WNT, 2006 [3] Blicharski M., Wstęp do inżynierii materiałowej, WNT, 2012 [4] Dudziński W., Widanka K., Ćwiczenia laboratoryjne z materiałoznawstwa, Oficyna Wydawnicza PWr, 2012 SECONDARY LITERATURE [1] Dudziński W., Materiały konstrukcyjne w budowie maszyn, Wyd.PWr; 1994 [2] Ashby M. F., Jones D.R.H., Materiały inżynierskie, t. 1 i 2, WNT; 1996

SUBJECT SUPERVISOR
dr hab. inż. Dominika Grygier tel.: 320-38-45 email: dominika.grygier@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Równania różniczkowe zwyczajne**
Name of subject in English: **Ordinary differential equations**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0077**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	15			
Number of hours of total student workload (CNPS)	30	30			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	1	1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student knows the differential and integral calculus of function of one variable and other branches of mathematics used in this calculus, particularly linear algebra.
2. Student is able to calculate derivatives of functions of one variable, indefinite and definite integrals using methods by parts and by substitution.
3. Student is able to calculate determinants, eigenvalues and eigenvectors of matrix.

SUBJECT OBJECTIVES

C1. Gain basic knowledge about first-order and second-order ordinary differential equations, and systems of differential equations.
C2. Learn how to choose the appropriate method of solving ordinary differential equations and systems of differential equations.
C3. Develop and consolidate the ability to access information and its analysis.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Student has theoretical knowledge of differential equations and knows methods of their solving.
PEU_W02 - Student has knowledge of methods of solving of systems of differential equations.
PEU_W03 - Student has knowledge about applying differential equations as the mathematical model for a physical phenomenon.

II. Relating to skills:
PEU_U01 - Student is able to solve the first-order differential equations.
PEU_U02 - Student is able to solve the second-order differential equations.
PEU_U03 - Student is able to solve systems of differential equations.

III. Relating to social competences:
PEU_K01 - Student understands the necessity of systematical work on all tasks and can estimate time needed for solving the exercise.
PEU_K02 - Student knows the scope of his/her knowledge and abilities, is able to identify lack of knowledge and complete it using the literature.
PEU_K03 - Student acts ethically and understands the importance of intellectual honesty.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	First-order differential equations: the basic definitions. First-order differential equations: the equations with separated variables.	1
Lec2	First-order homogeneous equations. First-order linear inhomogeneous differential equations. Method of variation of constant.	2
Lec3	Orthogonal trajectories. Geometric vmethod of finding integral curves with isoclines.	2
Lec4	Reducible second-order equations. Second-order linear homogeneous differential equations with constant coefficients.	2
Lec5	Second-order linear homogeneous differential equations. Wronskian.	2
Lec6	Second-order linear Inhomogeneous differential equations with constant coefficients. Method of undetermined coefficients. Method of variation of constants.	2
Lec7	Systems of differential equations. Method of elimination.	2
Lec8	Test	2
		Total hours: 15

Form of classes – Classes		Number of hours
Cl1	Solving first-order differential equations with separated variables	1
Cl2	Solving homogeneous equations. Solving first-order linear inhomogeneous differential equations - the variation of constant method.	2

Cl3	Finding orthogonal trajectories. Solving reducible second-order differential equations.	2
Cl4	Solving second-order linear homogeneous and inhomogeneous differential equations with constant coefficients. The undeterminated coefficients method,	2
Cl5	Solving second-order linear inhomogeneous differential equations with constant coefficients with the variation of constants method.	2
Cl6	Solving second-order linear homogeneous differential equations with usage of Liouville'a formula.	2
Cl7	Solving systems of equations with elimination method.	2
Cl8	Test	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. calculation exercises N3. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01 + PEU_W02 + PEU_W03	Test
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01 +PEU_U02 + PEU_U03, PEU_K01	Test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. M. D. Greenberg, Ordinary differential equations, John Wiley & Sons, 2012.
2. R. Carlson, Linear ordinary differential equations, Society for Industrial and Applied Mathematics, Philadelphia, 1997.
3. R. E. O'Malley, Thinking about ordinary differential equations, Cambridge University Press, 1997.
4. A. Jeffrey, Linear algebra and ordinary differential equations, CRC Press, 1993.
5. G. Birkhoff, G. C. Rota, Ordinary differential equations, John Wiley & Sons, 1989.
6. R. M. M. Mattheij, J. Molenaar, Ordinary differential equations in theory and practice, John Wiley and Sons, 1996.
7. R. K. Miller, A. N. Michel, Ordinary differential equations, Academic Press, 1982.

SECONDARY LITERATURE

J. H. Hubbard, B. H. West, Differential equations: a dynamical systems approach, Cambridge University Press, Cambridge 2003.

2. N. Finizio, G. Ladas, Ordinary differential equations with modern applications, Wadsworth Publ. Co., 1989.

SUBJECT SUPERVISOR

dr inż. Dorota Aniszewska tel.: 320-27-90 email: dorota.aniszewska@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Tworzywa sztuczne**
Name of subject in English: **Polymers**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0078**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has got a basic knowledge in the field of materials science and chemistry.

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge on the structure, preparation, modification and properties of polymeric materials.
C2. Acquisition of basic knowledge of technologies used in the processing of polymeric materials.
C3. Gaining the ability to select polymer materials in basicapplications.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - The student knows the basic groups of polymers, their structure, properties.
PEU_W02 - The student knows the technology used for the processing of polymeric materials.
PEU_W03 - The student knows the basic applications of polymeric materials.

II. Relating to skills:
PEU_U01 - Student is able to identify polymeric materials.
PEU_U02 - Student can indicate the processing technology for the production of a selected plastic product.
PEU_U03 - Student can select polymeric materials for specific applications.

III. Relating to social competences:
PEU_K01 - Student is able to identify polymeric materials.
PEU_K02 - Student can indicate the processing technology for the production of a selected plastic product.
PEU_K03 - Student can select polymeric materials for specific applications.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic knowledge, history of polymeric materials, nomenclature, advantages and disadvantages of polymeric materials.	2
Lec2	Comparison of selected properties of polymeric materials with metals.	2
Lec3	Classification and division of polymeric materials. Processes of polymerization and production of plastics.	2
Lec4	Mechanical models of polymer behavior. Behavior of plastics during processing. Polymer rheology.	2
Lec5	Modification of polymers, mixing with additives. Preparation of plastics for processing.	2
Lec6	Technologies and techniques of joining products made of polymeric materials	2
Lec7	Injection technology and its variants	2
Lec8	Practical aspects of injection molding technology	2
Lec9	Extrusion technology and its varieties	2
Lec10	Thermoforming technology	2
Lec11	Tools used in plastics processing technologies	2
Lec12	Resin processing and composites production, niche technologies	2
Lec13	Plastics application	2
Lec14	Biodegradation of polymers	2
Lec15	Final test	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Introduction, discussion of the rules of passing the laboratory	1
Lab2	Polymer materials - properties, applications and methods of identification	2
Lab3	Technologies of plastics joining	2
Lab4	Mechanical properties of polymers	2
Lab5	Friction and wear of polymeric materials	2
Lab6	Primary processing technology - extrusion	2
Lab7	Primary processing technology - injection molding	2
Lab8	Secondary processing technologies - Vacuum thermoforming	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - preparation for laboratory class N3. laboratory experiment N4. report preparation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	final test
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01	quiz
F2	PEU_U02	test, oral answer
F3	PEU_U03	quiz, oral answer

F4	PEU_K01, PEU_K02, PEU_K03	oral answer, report
P = (F1+F2+F3+F4)/4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Materiały polimerowe; Koszkul, Józef; Wydawnictwo Politechniki Częstochowskiej; Częstochowa; 1999,
2. Kucharczyk, Wojciech Żurowski, Przetwórstwo tworzyw sztucznych dla mechaników, Politechnika Radomska; Radom; 2005;
3. Izabella Hyla, Tworzywa sztuczne : własności, przetwórstwo, zastosowanie, Wydawnictwo Politechniki Śląskiej; Gliwice; 2000.

SECONDARY LITERATURE

1.Piotr Jasiulek, Łączenie tworzyw sztucznych metodami spawania zgrzewania, klejenia i laminowania, Krosno, Wydaw. i Handel Książkami "KaBe", 2004;
2. Physical properties of polymers; Mark James; Cambridge University Press; 2004;
3. Processing of polymers; Defonseka Chris.; Boston : De Gruyter; 2020;

SUBJECT SUPERVISOR

dr inż. Roman Wróblewski tel.: 320-21-70 email: r.m.wroblewski@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Informatyka podstawy programowania (MATLAB)**
Name of subject in English: **Basic programming (MATLAB)**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0079**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				60	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has knowledge in the field of mathematics, including the basic issues of algebra and analysis.
2. Student is able to use basic IT tools.
3. Student has basic knowledge of computer programming.

SUBJECT OBJECTIVES

C1. Learning the principles of programming in the Matlab system, designed to perform engineering and scientific calculations.
C2. Learning the principles of integration of calculations and visualization (2D and 3D graphics).
C3. Learning the principles of modeling technical systems using the Simulink module.
C4. Gaining skills in using the functionality of spreadsheets and computing environments.
C5. Acquiring the ability to think and act in a creative and logical way.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:

PEU_U01 - The student is able to formulate an algorithm for mathematical calculations in the area of algebra and analysis, including: matrix, integral and differential calculus as well as issues related to solving systems of algebraic equations.

PEU_U02 - The student is able to use the two-dimensional and three-dimensional graphics to visualize data and calculation results.

PEU_U03 - The student is able to build a simple object model and run a simulation in the Matlab/Simulink system.

III. Relating to social competences:

PEU_K01 - The student is able to think and act in a creative way using modern IT tools.

PEU_K02 - The student is able to search for and use the literature recommended for the course and to independently acquire knowledge.

PEU_K03 - The student understands the need for systematic and independent work on mastering the course material.

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction to programming in the Matlab.	2
Proj2	Introduction to algebraic and logical calculations.	2
Proj3	Vector and matrix calculus.	2
Proj4	Data visualization using 2D and 3D graphics.	2
Proj5	M-scripts.	2
Proj6	Function application.	2
Proj7	Mathematical instructions.	2
Proj8	Introduction to the Simulink environment.	2
Proj9	Application of Simulink in the field of automation.	2
Proj10	Simulation and visualization of physical phenomena in the Simulink environment.	2
Proj11	Differential calculus using spreadsheets.	2
Proj12	Numerical integration using spreadsheets.	2
Proj13	Matrix operations.	2
Proj14	Solving mathematical problems using functionality spreadsheets.	2
Proj15	Evaluation of acquired skills.	2
		Total hours: 30

TEACHING TOOLS USED
N1. calculation exercises N2. self study - preparation for project class N3. multimedia presentation N4. tutorials N5. report preparation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02, PEU_K03	Evaluation of preparation for the implementation of subsequent project topics. Checking the acquired knowledge on the basis of tasks, exercises and reports.
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE MATLAB : dla naukowców i inżynierów. Pratap, Rudra (1964-) Autor | Sikorski, Witold (1950-) Tłumacz | Wydawnictwo Naukowe PWN Wydawca | Witkom. 2015 MATLAB: an introduction with applications, Amos Gilat 2017 SECONDARY LITERATURE https://www.mathworks.com

SUBJECT SUPERVISOR
dr inż. Emilia Mazgajczyk tel.: 71 320 41 83 email: emilia.mazgajczyk@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Techniki wytwarzania - odlewnictwo**
Name of subject in English: **Chipless processes - Casting**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0080**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge about the metallurgical process of metal ores and receiving ferrous alloys and nonferrous metals. Has a basic knowledge about the types of engineering materials - their properties, applications and principles of their selection. Has a basic knowledge about the structure of metals and alloys as well as the principles of their classification and labeling.
2. Can determine the characteristics of the materials microstructure, identify occurring in material phases. Also is able to differentiate: the microstructure of ferrous alloys (in terms of carbon content), non-ferrous alloys and the effect of the heat treatment.
3. Can read and interpret the figures and diagrams used in the technical documentation.

SUBJECT OBJECTIVES

C1. The acquisition of general knowledge about the basic techniques of foundry manufacturing methods.
C2. Acquiring the selection skills and a critical analysis of chosen casting technology and basic parameters of that process.
C3. Acquisition and consolidation of social skills like the ability of working in a group to solve the problems effectively. The acquisition of sense of responsibility and respect for traditions existing in academia and society.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Has a basic knowledge of the manual and machine manufacturing technologies of foundry moulds and cores.
PEU_W02 - Has a knowledge of the basic methods of melting and treatment of metallurgical alloys.
PEU_W03 - Has a basic knowledge about designing the casting products and the processes for their production with principles of technology of their selection dependent on the type of casting and the type of alloy.

II. Relating to skills:
PEU_U01 - Can analyze and design the process of production casting equipment to a simple product.
PEU_U02 - Can choose the right technology for casting and define the basic parameters of that process.
PEU_U03 - Can choose the right method of treatment of the casting alloy and define its basic parameters.

III. Relating to social competences:
PEU_K01 - Can search for information and critically analyze them, rationally explain them and justify the own point of view using the knowledge of foundry branch.
PEU_K02 - Recognizes the importance of team cooperation on ways to choose a strategy to optimally solve problems assigned to a student's group.
PEU_K03 - Understands the need to respect the traditions and rules in academia and society.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational issues. Discussion about the specific shape of the statethe from liquid metal, fundamental concepts and algorithms for casting production.	1
Lec2	Principles for design and construction of casting equipment.	2
Lec3	Materials and equipment used for the preparation of the moulding and core sands and the methods of their manufacturing and testing their properties.	2
Lec4	Methods for manual and automatic manufacturing of foundry moulds and cores.	2
Lec5	Production of moulds and cores from selfsetting and thermosetting moulding sands.	2
Lec6	Manufacturing the castings using a precise technique of lost models. Manufacturing the castings in metal molds.	2

Lec7	Melting the casting alloys. Metallurgical treatment of casting alloys and heat treatment of castings.	2
Lec8	Discussion of the basic causes of casting defects. Course summary. Test of knowledge.	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Organizational issues. Introduction to the foundry. Health and safety at foundry laboratory work. The specificity of shaping products from the liquid metal state. Basic concepts and algorithms of casting production.	1
Lab2	Research the materials and molding sands.	2
Lab3	Construction of casting models and core boxes. Full mould technology.	2
Lab4	Manual production of foundry moulds and cores.	2
Lab5	Machine production of foundry moulds and cores.	2
Lab6	Production of moulds and cores from self- and thermosetting moulding sands.	2
Lab7	Manufacturing the castings in metal molds.	2
Lab8	Testing the properties of casting alloys.	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - preparation for laboratory class N3. self study - self studies and preparation for examination N4. report preparation N5. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03,	colloquium
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02, PEU_K03,	quiz, report
P = average F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Granat K. Laboratorium z odlewnictwa, skrypt PWr, Wrocław 2007;
[2] Perzyk M. i inni; Odlewnictwo WNT Warszawa 2000;
[3] Murza-Mucha P., Techniki wytwarzania – Odlewnictwo. PWN, Warszawa 1978;
[4] Tabor A. Odlewnictwo wyd. „Akapit” Kraków 1996;

SECONDARY LITERATURE

[1] Lewandowski J. L.; Tworzywa na formy odlewnicze, wyd.: „Akapit” Kraków 1997;
[2] Błaszkowski K. Technologia formy i rdzenia, Warszawa 1990;
[3] Poradnik inżyniera – Odlewnictwo WNT Warszawa 1986;
[4] Perzyk M. i inni: Materiały do projektowania procesów odlewniczych, skr. P. Warsz. Warszawa 1981;
[5] Jaworski R. Ćwiczenia laboratoryjne z Budowy Maszyn, cz. I Odlewnictwo, skrypt PWr, Wrocław 1981;

SUBJECT SUPERVISOR
dr inż. Mateusz Stachowicz tel.: 713204235 email: mateusz.stachowicz@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Podstawy wytrzymałości materiałów**
Name of subject in English: **Fundamentals of materials strength**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0081**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	60	30			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	2	1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of higher mathematics - in particular, vector algebra, integral and differential equations calculation
2. Knowledge of the fundamentals of materials science
3. Knowledge of rigid body mechanics in particular in the principles of statics of bar systems, beams and mass geometry.

SUBJECT OBJECTIVES

C1. Understanding of the basics and applications of deformable body mechanics in homogeneous and heterogeneous systems
C2. Student knows how to characterize the basic cases of bars loading and determine the cross-sectional forces in hyperstatic systems
C3. Student is able to acquire skills in strength calculations in mechanical systems and use them for determining allowable stresses and deflections of structures under specific load cases

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Knows the generalized Hook's law and can use it to calculate stresses and strains in structural elements subjected to a complex stress state
PEU_W02 - Student is able to formulate strength conditions for a variety of bar and beam structures and has the knowledge necessary to design cross-sections of structural elements
PEU_W03 - Students know the most useful failure criteria and their application and possess the knowledge necessary to solve the classic tasks of mechanics

II. Relating to skills:
PEU_U01 - Know how to apply Hooke's law to stress and strain calculations
PEU_U02 - Ability to perform strength analysis of bar and beam structures
PEU_U03 - Student can design a rod under compression that is resistant to loss of stability

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Basic assumptions and concepts. Experimental determination of strength properties. Allowable stresses and safety factor.	2
Lec2	Tension and compression. Static and hyperstatic cases. Thermally stressed rods systems. Stress concentration	2
Lec3	Stress theory. Mohr's circle for a state of plane stress. Physical relationships in spatial stress	2
Lec4	Theory of strain. Engineering measurements of strains	2
Lec5	Torsion of circular shafts	2
Lec6	Torsion of shafts with arbitrary selected cross-section. Torsion of thin-walled members	2
Lec7	Pure shear state. Technical shearing. Calculation of detachable and nondetachable joints - examples	2
Lec8	General case of beam bending. Symmetrical bending. Beams with uniform bending strength	2
Lec9	Unsymmetrical bending. Bending with shear force. Shear centre	2
Lec10	Beam displacements. The differential equation for the elastic curve of a beam	2
Lec11	Buckling of rods under compression	2
Lec12	Combined loading: bending and tension or compression. Cross-section core	2
Lec13	Elastic strain energy of volumetric and non-dilatational strain. Distortion energy theory. Relations between distortion energy, stress and deformation	2
Lec14	Material strength hypotheses in a complex stress state. Equivalent stress.	2
Lec15	Written test	2

		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Structures of statically determinable and indeterminate bar systems in tension and compression	2
Cl2	Transformation of plane state of stress and strain state. Generalized Hooke's law.	3
Cl3	Torsion of circular shafts. Torsion of thin-walled members	2
Cl4	Determination of stresses in a bended beam	2
Cl5	Determination of the beam deflection line	2
Cl6	Buckling of bars - calculations	2
Cl7	colloquium	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. calculation exercises

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	colloquium
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03	colloquium
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE Zielnica J., Wytrzymałość Materiałów, WPP, wyd. III, Poznań 2000, str. 554. Niezgodziński M. E., Niezgodziński T.: Wytrzymałość materiałów. PWN, Warszawa 1998. Niezgodziński M. E., Niezgodziński T.: Wzory, wykresy i tablice wytrzymałościowe. WNT, Warszawa 1996. Niezgodziński M. E., Niezgodziński T.: Zadania z wytrzymałości materiałów. WNT, Warszawa 1997. M. Ostwald: Podstawy wytrzymałości materiałów. Wydawnictwo Politechniki Poznańskiej, Poznań 1997 Jakubowicz A., Orłoś Z., Wytrzymałość materiałów, WNT, Warszawa, 1984 Magnucki K., Szyc W., Wytrzymałość materiałów w zadaniach: pręty, płyty i powłoki obrotowe, Wydawnictwo Naukowe PWN, 2000. SECONDARY LITERATURE Broek D.: Elementary engineering - fracture mechanics. Noordhoff Int. Publishing, Leyden, 1974. Ashby M. F.: Jones D. R.: Materiały inżynierskie. Własności i zastosowania. WNT, Warszawa 1995. R. C. Hibbeler - Mechanics of Materials, Pearson Prentice Hall S. Timoshenko, Strength of Materials Part 1, Elementary Theory and Problems, D. Van Nostrand Company, Inc Willems N., Easley T. J., Rolfe S. T., Strength of Materials, Mc GrawHill Book Company, 1981. Gere M., Timoshenko S., Mechanics of Materials, PWS-Kent Publishing Company, Boston, 1984.

SUBJECT SUPERVISOR
dr hab. inż. Grzegorz Lesiuk tel.: 713204216 email: grzegorz.lesiuk@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Statystyka inżynierska**
Name of subject in English: **Statistics for Engineers**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0082**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic knowledge of mathematics confirmed positive marks on the upper secondary school leaving certificate

SUBJECT OBJECTIVES

C1. To introduce students to statistical models and their possible applications
C2. To introduce students to statistical methods and their possible applications
C3. To introduce students to probability distributions and their possible applications

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - knows basic concepts and facts about mathematical statistics
PEU_W02 - knows the basic probability distributions, their parameters and methods for estimating them

II. Relating to skills:
PEU_U01 - able to apply statistical analysis to the data obtained and draw conclusions from the analysis carried out
PEU_U02 - able to use basic tools to determine the type of probability distribution and to estimate its parameters

III. Relating to social competences:
PEU_K01 - acquisition and consolidation of competence to understand the need for self-study, including the ability to improve attention and focus on what's important and to develop the ability to independently apply their knowledge and skills and to find the information and its critical analysis

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Statistical methods of data analysis - the essence of statistical modeling. Descriptive analysis of data: forms of representation of statistical data, measures of association, variability, asymmetry and concentration.	2
Lec2	Preparation and presentation of statistical material. The grouping of data - ranks easy and distribution. Histogram and empirical cumulative distribution.	2
Lec3	Random variables and their distributions. Numerical characteristics of the distribution. Selected discrete and continuous distributions.	2
Lec4	Interval estimation. Confidence intervals for mean, variance, coefficient of structure.	2
Lec5	Parametric statistical hypothesis. Testing hypotheses about the mean value, of the equality of two average values. Testing hypotheses about the rate structure and the equality of two indicators structure. Testing hypotheses about the variance and the equality of two variances.	2
Lec6	Nonparametric hypothesis testing. Chi-squared test, Kolmogorov-Smirnov. Test of independence Pearson chi-square. Depending measures based on chi-square.	2
Lec7	Correlation and regression analysis. Method of least squares. Linear regression function. Estimation of regression function parameters. Confidence intervals of linear regression parameters.	2
Lec8	Colloquium	1
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Organisational matters. Introduction to using a spreadsheet. Excel's mathematical and statistical functions. Descriptive statistics - calculating measures of location, variability, asymmetry and concentration.	2

Proj2	Construction of distribution series. Determination of parameters of a distribution series (mean, standard deviation, etc.). Graphical presentation of a data set - histogram and empirical distribution and box plot.	2
Proj3	Basic distributions found in mathematical statistics: normal distribution, exponential distribution, Weibull distribution, etc. Determination of distribution parameters. Determining the type of distribution from the histogram and the distribution.	2
Proj4	Calculations in point and interval estimation of expected value, structure index (fraction), variance and standard deviation.	2
Proj5	Statistical hypothesis verification calculations. Parametric significance tests for the expected value and for the variance of the general population. Test for two variances, for two means and two structure indices.	2
Proj6	Calculations for non-parametric significance tests - Pearson's chi-square2 consistency test, Kolmogorov's lambda consistency test.	2
Proj7	Calculations in correlation and regression analysis. Method of least squares. Linear regression function. Estimation of regression function parameters. Confidence intervals of linear regression parameters.	2
Proj8	Colloquium	1
		Total hours: 15

TEACHING TOOLS USED
N1. calculation exercises N2. traditional lecture with the use of transparencies and slides N3. problem discussion

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02	Colloquium
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement

F1	PEU_U01, PEU_U02, PEU_K01	Colloquium
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Bobrowski D: Probabilistyka w zastosowaniach technicznych. Warszawa 1986, WNT[2] Nowak R.: Statystyka dla fizyków. Warszawa 2002, Wydawnictwo Naukowe PWN[3] Ostasiewicz W. (red.): Statystyczne metody analizy danych. Wrocław 1999, Wydawnictwo AE we Wrocławiu[4] Zeliaś A., Pawełek B., Wanat S.: Metody statystyczne. Zadania i sprawdziany. Warszawa 2002, PWE

SECONDARY LITERATURE

[1] Bąk I., Markowicz I., Mojsiewicz M., Wawrzyniak K.: Statystyka w zadaniach. Część I i II. Warszawa 2001. Wydawnictwo Naukowo-Techniczne[2] Cieciura M., Zacharski J.: Metody probabilistyczne w ujęciu praktycznym. Warszawa 2007, VIZJA PRESS&IT Sp. z o. o.[3] Dobosz M.: Wspomagana komputerowo statystyczna analiza wyników badań. Warszawa 2001, Akademicka Oficyna Wydawnicza EXIT.[4] Frątczak E., Gach-Ciepiela U., Babiker H.: Analiza historii zdarzeń. Elementy teorii, wybrane przykłady zastosowań. Warszawa 2005, Szkoła Główna Handlowa w Warszawie.[5] Kukiełka L: Podstawy badań inżynierskich. Warszawa 2002, Wydawnictwo Naukowe PWN. [6] Maliński M.: Statystyka matematyczna wspomagana komputerowo. Gliwice 2000, Wydawnictwo Politechniki Śląskiej [7] Paleczek W.: Metody analizy danych na przykładach. Częstochowa 2004, Politechnika Częstochowska[8] Turzeniecka D.: Ocena niepewności wyniku pomiarów. Poznań 1997, Wydawnictwo Politechniki Poznańskiej

SUBJECT SUPERVISOR

dr hab. inż. Artur Kierzkowski tel.: 71 320-20-04 email: artur.kierzkowski@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Mechanika II**
Name of subject in English: **Mechanics II**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0083**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	30			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	2	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematical analysis (differentiation, integration), linear algebra, trigonometry
2. Differential equations (ordinary, linear) in the variables separation methods and the characteristic equation areas
3. Mechanics in range of statics and kinematics

SUBJECT OBJECTIVES

C1. Solving technical problems of mechanisms in the field of kinematics - acceleration and velocity.
C2. Knowledge of analytical methods for the application of the principles of classical dynamics for typical mechanical systems (discrete systems: mass particle, system of masses particles with holonomic constrains, rigid body).
C3. Resolving some technical problems of structure and mechanical systems under dynamic loads.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Is able to define key concepts in the dynamics of mechanical systems (momentum, angular momentum, force of inertia, work, kinetic and potential energy)
PEU_W02 - Knows the basic concepts in the field of free and forced vibration of mechanical system with one degree of freedom (natural frequency, frequency characteristics, resonance)
PEU_W03 - Knows the basic principles of dynamic (move of the center of mass, momentum, angular momentum, d'Alembert’s principle). He is familiar with the term of conservative system and with energy conservation law. He knows the dynamics equations of rotational motion and plane motion of a rigid body. Dynamics of the rigid body rotation about a fixed point

II. Relating to skills:
PEU_U01 - Can calculate the velocity and acceleration in plane motion of a rigid body and in the relative motion and in the rotation about a fixed point. He can derive the equations of motion of a free and constrained material point for time-varying dynamic loads using the Newton's second principle.
PEU_U02 - Can calculate the frequency of free vibration for systems with one degree of freedom of the linear viscous damping and without damping. He can derive the equations of motion and calculate its parameters (angular velocity and acceleration) for rigid body loaded by torque and moves rotation.
PEU_U03 - Can determine the reaction force constraints under dynamic loads. It can calculate the kinetic and potential energy for complex mechanical systems. He is able to apply the energy conservation law to determine the differential equations of conservative system.

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Program, requirements, literature. Reminder of the basics of kinematics. Velocity in planar motion.	2
Lec2	Acceleration in a planar motion of rigid body.	2
Lec3	Relative motion. Kinematics in a general motion of rigid body. The Coriolis' acceleration.	2
Lec4	The basic principles of classical mechanics. Kinematics and dynamics. Models of discrete and continuous dynamical systems in mechanics.	2
Lec5	The Newton's second law (applicable in the dynamics of the free and constrained point). The concept of inertia force and d'Alembert's principle. The principle of kinetostatics.	2
Lec6	The vibrations of the one-mass single degree of freedom system with the linear viscous damping and without damping. Complex notation. Free vibrations.	2
Lec7	Harmonically forced vibration, frequency characteristics, resonance. Dynamic and kinematic excitations.	2
Lec8	Momentum, and momentum principle. Angular momentum and angular momentum principle.	2

Lec9	The definition of work. Elementary work. The kinetic and potential energy. The principle of work and kinetic energy equivalence.	2
Lec10	Multi-mass systems. Constraints, degrees of freedom. The use of second Newton's laws in multi-mass constrained material systems.	2
Lec11	The principle of the center of mass motion and the principle of momentum in multi-mass systems.	2
Lec12	Total angular momentum and angular momentum principle in the multi-mass systems. Introduction to the dynamics of a rigid body. The equation of the dynamics of a rigid body rotation.	2
Lec13	Using the principle of angular momentum and the equation of rotational dynamics in determining the frequency of free vibration of complex systems. Equivalent mass and stiffness.	2
Lec14	Determination of the dynamic response in a rotating motion. The method of reduction of inertial forces.	2
Lec15	Angular momentum in the plane motion of a rigid body and dynamics of plane motion. The kinetic energy of rigid body in a general motion. The König's theorem.	2
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Kinematics of particle in orthogonal coordinates. Kinematics of rigid body. Plane motion and rotation over permanent axis. Velocity in a plane motion.	2
Cl2	Solving tasks - accelerations in plane motion for mechanisms. The method of superposition and the method of the instantaneous center of accelerations.	2
Cl3	Solving tasks - the kinematics of complex motion. relative motion. Coriolis acceleration.	2
Cl4	Solving examples of tasks with dynamic free mass particle using The Newton's second law (rectilinear and curvilinear motion).	2
Cl5	Solving point dynamics problems using d'Alembert's principle and kinetostatics method.	2
Cl6	The Newton's second law (applicable in the dynamics of the constrained mass particle).	2
Cl7	Solving tasks - dynamics of relative motion of a material point.	2
Cl8	Solving tasks - free vibrations of simple mechanical systems with one degree of freedom (determination of free vibration frequencies and the motion equations) with and without damping.	2
Cl9	Solving tasks - forced vibration of simple mechanical systems with one degree of freedom. Resonance frequency.	2
Cl10	Examples of the tasks of the dynamics of particle (momentum principle, the principle of conservation of energy).	2
Cl11	Examples of the tasks of the dynamics and rotational motion of the rigid body using momentum principle, angular momentum principle and mass center movement rule.	2
Cl12	Solving tasks - dynamic force responses in the supports of rotated body.	2

Cl13	Solving tasks - equations of motion for rigid body in plane movement.	2
Cl14	Test 1	2
Cl15	Test 2	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. calculation exercises N3. tutorials N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01,PEU_U02,PEU_U03	
P = F1		

PRIMARY AND SECONDARY LITERATURE
<u>PRIMARY LITERATURE</u> 1. B. Gabryszewska, A. Pszonka: „Mechanics”, cz. II „Kinematics and Dynamics”, PWr, 1998 2. J. Zawadzki, W. Siuta: „General Mechanics”, PWN, Warszawa 19713. 3. J. Misiak : „General Mechanics. Dynamics”. Tom II, WNT, Warszawa 1993 4. J. Leyko :"General Mechanics", Part 1 Statics and Kinematics, PWN 2022 5. J. Leyko :"General Mechanics", Part 2 Dynamics, PWN 2022 6. J. Nizioł: " Methodology of solving problems in mechanics", PWN 2023 7. I. W. Mieszczerski, "Sets of problems to solving - Mechanics", PWN 1971 <u>SECONDARY LITERATURE</u> 1. J. Giergiel : „General Mechanics”, WNT, Warszawa 1980 2. B. Skalmierski: „Mechanics” PWN, Warszawa 19773. 3. M. Klasztorny: „Mechanics” Dolnośląskie Wyd. Edukacyjne, Wrocław 2000 4. W. Krysicki, L. Włodarski, "Mathematical analysis in problems - Part 2", PWN 2000

SUBJECT SUPERVISOR
dr hab. inż. Daniel Lewandowski tel.: 320-28-99 email: daniel.lewandowski@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Metrologia przemysłowa**
Name of subject in English: **Industrial Metrology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0084**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			15		
Number of hours of total student workload (CNPS)			30		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)			0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of mathematics and physics at secondary school level
2. Student has the ability to read drawings and diagrams contained in the technical documentation.
3. Student has basic knowledge in the design of machine elements. It has a basic knowledge of manufacturing techniques of machine parts.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge on the implementation of measurement and test processes in industrial conditions
C2. Acquisition of knowledge about the types and properties of equipment for measuring geometrical quantities used in industrial manufacturing processes
C3. Searching for relevant information and its critical analysis.
C4. Gaining knowledge and skills in the selection of test equipment, analyze test results, evaluation of measurement errors and the expression of measurement uncertainty.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:

PEU_U01 - Understands the dimensional requirements imposed to products included in the technical documentation. Can use standards for tolerances and fits linear and geometric tolerances. It can calculate the value of measurement errors, estimated measurement uncertainty for the different measurements.
PEU_U02 - He can make the selection of appropriate test equipment and set it up depending on the task measuring. Can use measuring equipment used in engineering to measure the geometrical quantities.
PEU_U03 - Able to solve the basic problems of the practical use of the tools and of measuring. Able to recognize sources of error, their values, and estimate the uncertainty of measurement.

III. Relating to social competences:

PEU_K01 - Search for information and its critical analysis
PEU_K02 - Objective evaluation of arguments, the rational explanation of his own point of view using the knowledge of metrology.

PROGRAM CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Organizational matters.	1
Lab2	Study of the influence of the metrological characteristics of measurement systems on their measurement properties	2
Lab3	Design and verification of the correctness of the dimensional control gauge	2
Lab4	Wzorcowanie wybranych przyrządów pomiarowych	2
Lab5	Determination of measurement uncertainty. Building an uncertainty budget.	2
Lab6	2D coordinate measurements on a measuring microscope using QM Data 200	2
Lab7	2D coordinate measurements on a measuring microscope of rotating elements in a polar coordinate system	2
Lab8	3D coordinate measurements on a coordinate measuring machine	2
		Total hours: 15

TEACHING TOOLS USED

N1. laboratory experiment
N2. self study - preparation for laboratory class
N3. report preparation
N4. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01; PEU_U02; PEU_U03; PEU_K01; PEU_K02;	lab report, oral answer, quiz
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SECONDARY LITERATURE

SUBJECT SUPERVISOR
dr inż. Marek Kuran tel.: 27-28 email: marek.kuran@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Podstawy konstrukcji maszyn I**
Name of subject in English: **Fundamentals of Machine Design I**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0085**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15	30	
Number of hours of total student workload (CNPS)	90		60	60	
Form of crediting	Examination		Crediting with grade	Crediting with grade	
Group of courses					
Number of ECTS points	3		2	2	
including number of ECTS points for practical (P) classes			2	2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.8		14.0	1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge: 1 It has a basic understanding of the types of engineering materials, their structure, properties and properties, processing, applications and selection rules. 2 It has a basic knowledge of mechanics, strength of materials and manufacturing techniques. 3 He has knowledge of the methods of mapping geometric formations on the plane and the principles of saving design of machine elements and the performance of their schemes.
2. Skills: 1 Able to read and interpret drawings and diagrams used in the technical ability to perform the technical documentation. 2 It has self-learning ability, and is able to retrieve information from various sources, to make their interpretation, and to draw conclusions and formulate and justify opinions. 3 It can be used in the process of constructing knowledge gained on subjects: Metallurgy, Mechanics, Strength of materials, Engineering Graphics.
3. Competencies: 1 He can think and act in an entrepreneurial manner. 2. Is aware of the seriousness and impact of activities in mechanical engineering, and understands the need for professional activities (both individually and collectively).

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge about the process of design and engineering.
C2. Gaining knowledge of the construction, operation and use of the major machine components (connections) and the rules for their selection and construction.
C3. Gain practical skills to make a simple construction task through a typical solution to the problem, the content of which is to construct a simple device with screw drive (for example, a screw press, bearing puller, scissor lift, car jack, etc.) while using the knowledge of the connections, used in mechanical engineering (screw, bolt, dowel, keyways, spline, serrated, snap-fitting, welded and spring).

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - He has knowledge in the design, principles of design, design features, and knows the algorithm design and construction.
PEU_W02 - It has a basic knowledge of connections in the construction of machines, their design and strength calculations and applications.
PEU_W03 - He has knowledge of the factors affecting the fatigue strength of machine elements and how they are taken into account in the design calculations.

II. Relating to skills:
PEU_U01 - Able to independently formulate and solve simple technical tasks.
PEU_U02 - He can choose and calculate the basic connection used in mechanical engineering.
PEU_U03 - He can choose the optimal (in light of the criteria used) machine parts and know their limitations.

III. Relating to social competences:
PEU_K01 - Can search information and carry out their critical analysis.
PEU_K02 - Able to work independently and in a team.
PEU_K03 - Objectively evaluate the task, conceptual design, and they can justify the chosen solution and the method of its implementation.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Syllabus and requirements. Defined notions of technical product and design. Design features, principles of design. Rationale for the existence of a product.	2
Lec2	Design and construction - differences. Description of the process of design - examples.	2
Lec3	Algorithmical and heuristic methods of generating of conceptions (method of elementary questions, morphology boards and boxes, biological analogy, brainstorming, 635 method, Delphic method).	2
Lec4	Criteria of conception rating. Methods of selection of the best conception: method of balancing positive and negative features, weighting of criteria method, etc.. Examples.	2

Lec5	Stress, fatigue, fatigue strength and method of its determination. Smith's and Haighe's graphes.	2
Lec6	Stress raisers and possible impacts on strength calculations. Processes resulting in the increased fatigue life of machine elements. β - fatigue stress concentration factor.	2
Lec7	Methods for increasing the fatigue strength. Allowable stress k - means for their appointment. Factor of safety and actual safety factor.	2
Lec8	The actual safety factor in the case of complex stress state. Stages of strength calculations for machine elements loaded forces variables. Calculation example (the roller gear).	2
Lec9	Joints in mechanical engineering, classification and characteristics. Bolted connections, thread specifications. Determination of the forces and moments on the thread.	2
Lec10	Efficiency and self-locking of a power screw. The minimum height of the nut in the screw.	2
Lec11	The notion of preload. Method for the calculation of bolted connections with preload. Calculations of thread forms.	2
Lec12	Shaft-hub connections: keys, splines, serrated joints. Dowel connections. Main features and calculation rules.	2
Lec13	Welded and pin connections. Specifications, principles of design and calculations.	2
Lec14	Pressed connections. Analytical bases of geometry selection, elements fit.	2
Lec15	Steel elastic connectors. Fundamentals of strength calculations of selected types of springs. Forming of cylindrical coil springs.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Introduction. Health and Safety Training. Recognizing of standard machine elements.	1
Lab2	Determination of static stiffness, energy dissipated and acquired in elastic-damping elements.	2
Lab3	Determination of the frictional characteristics of the cross slide bearing.	2
Lab4	Determining of resistance to motion of angular bearing.	2
Lab5	Theoretical and practical identification of phenomenon of the resonance in shaft with one non-balanced mass.	2
Lab6	Research of the pressed connections.	2
Lab7	Investigation of belt transmission with V-belt – elastic slip and efficiency.	2
Lab8	Estimation of efficiency of power screw.	2
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Preparation of design specifications for the designed device.	3

Proj2	Possible solutions of the problem, a draft drawing (without details) of one selected solution (acceptance criteria included).	5
Proj3	Calculations and analysis of designed elements (power screw, bearings, bolts, etc..).	12
Proj4	Performance of assembly drawing designed device and working drawings of elements selected by lecturer.	10
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. calculation exercises N3. tutorials N4. laboratory experiment N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01 - PEU_W03	exam, quiz
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01 - PEU_U03, PEU_K01 - PEU_K03	quizzes, oral answers, report on laboratory exercises
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01 - PEU_U03, PEU_K01 - PEU_K03	defense of project, quizzes, evaluation of computational design review, review of project preparation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. A. Dziama; Metodyka konstruowania maszyn, PWN, Warszawa, 1985.
2. Podstawy konstrukcji maszyn. Praca zbiorowa pod red. Z. Osińskiego. Warszawa, PWN 1999.
3. Dietrych J. i inni; Podstawy konstrukcji maszyn. Tom I i II. Warszawa, WNT.
4. Beitz G.; Nauka konstruowania . Warszawa, WNT 1984.
5. Ćwiczenia z podstaw konstrukcji maszyn. Poradnik. Praca zbiorowa pod red. Z. Lawrowskiego, skrypt PWr., Wrocław , 1982.
6. Roloff / Matek, Maschinenelemente - Normung, Berechnung, Gestaltung, Wiesbaden, Vieweg 1994.

SECONDARY LITERATURE

1. Dietrych M. i inni; Podstawy konstrukcji maszyn. Tom I i II. Warszawa, WNT.1966.
2. Skarbiński M., Skarbiński J.; Technologiczność konstrukcji maszyn. Warszawa, WNT 1982.
3. Niemann G., Winter H.; Maschinenelemente. Band II. Berlin, Springer-Verlag 1985.
4. Niezgodzinski M., Niezgodziński T.; Wzory, wykresy i tablice wytrzymałościowe, Warszawa, PWN 2000.
5. Robert Mott, Edward Vavrek, Jyhwen Wang, Machine elements in mechanical design, Pearson, 2017
6. Norton, Robert L., Machine Design: An Integrated Approach, Pearson, 2019

SUBJECT SUPERVISOR

dr inż. Tadeusz Leśniewski tel.: 71 320-40-31 email: Tadeusz.Lesniewski@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Teoria mechanizmów i manipulatorów**
Name of subject in English: **Theory of Machines and Manipulators**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0086**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			30	
Number of hours of total student workload (CNPS)	60			90	
Form of crediting	Examination			Crediting with grade	
Group of courses					
Number of ECTS points	2			3	
including number of ECTS points for practical (P) classes				3	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2			2.1	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of mathematical analysis, matrix algebra
2. Knowledge of fundamental laws in statics, kinematics and dynamics
3. Skill in fuction analysis, derivatives, basic matrix and vector operations

SUBJECT OBJECTIVES

C1. Acquire knowledge in topology, kinematics and dynamics of mechanisms and manipulators
C2. Acquire and understanding of basic mechanisms and manipulators
C3. Getting skills in determining kinematic and dynamic parameters

SUBJECT LEARNING OUTCOMES
I. Relating to knowledge: PEU_W01 - Understands theoretical fundamentals of mechanism and robot topology PEU_W02 - Has the knowledge of kinematic and dynamic analysis methods PEU_W03 - Is able to commentate results of analysis, evaluate their correctness **II. Relating to skills:** PEU_U01 - Is able to evaluate topological carrectness of kinematic systems PEU_U02 - Is able to determine kinematic and dynamic properties PEU_U03 - Is able to create models of simple planar mechanisms and manipulators **III. Relating to social competences:** PEU_K01 - Has a conviction of responsibility for the work done

PROGRAM CONTENT		
Form of classes – Lecture		Number of hours
Lec1	Topology of mechanisms, movable properties, redundant constraints	3
Lec2	Kinematics of mechanisms - graphic-analytical methods	3
Lec3	Analytical methods in kinematics (vectors, projections, time derivatives)	2
Lec4	Planetary gear trains	2
Lec5	Manipulators' properties. Planar serial and parallel systems	2
Lec6	Kinematics of planar manipulators, jacobian	2
Lec7	Matrix description of spatial systems	2
Lec8	Denavit-Hartenberg notation	2
Lec9	Introduction to mechanisms' dynamics	2
Lec10	Kinetostatic analysis	3
Lec11	Friction in joints, efficiency	3
Lec12	Dynamic motion analysis	2
Lec13	Fluctuation o machine motion, flyweels	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Introduction to modelling mechanisms in SAM (Simulation and Analysis of Mechanisms) – presentation of examplesi	2
Proj2	Mechanisms' topology: rules of drawing digrams, topology analysis - joint classification, mobility (test, project)	2
Proj3	Rules of creating models in SAM system, creating simple models, model motion simulation, presentation of analysis results	2

Proj4	Dimensional modelling of mechanisms, drivers' definition, massis, external loads	2
Proj5	Kinematic analysis - position analysis (project)	2
Proj6	Kinematic analysis - velocity and acceleration determination - vector methods (test, project)	2
Proj7	Kinematic analysis - velocity and acceleration determination using SAM (project)	2
Proj8	Kinematic analysis using analytical methods: loop equation, vectors, projections, time	2
Proj9	Planar manipulators - kinematic analysis using matrix notation	2
Proj10	Modelling manipulators in SAM: forward and inverse tasks (project)	2
Proj11	Anaysis of planetary transmissions, angular velocity ratio determination (test, project)	2
Proj12	Modelling of planetary transmissions and gear linkage mechanisms using SAM (project)	2
Proj13	Joint force and external equilibrium determination (test, project)	2
Proj14	Determination of joint forces including friction (test, project)	2
Proj15	Dynamic force analysis using SAM	2
		Total hours: 30

TEACHING TOOLS USED
N1. problem lecture N2. traditional lecture with the use of transparencies and slides N3. self study - preparation for project class N4. tutorials N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	written examination
P = Ocena z egzaminu		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03	project defence, short test
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE 1. Gronowicz A.: Fundamentals of kinematic systems analysis (in Polish). Oficyna Wydawnicza PWr., Wrocław 2003; 2. Morecki A., Knapczyk J., Kędzior K.: Theory of mechanisms and manipulators (in Polish). WNT 2002; 3. Miller S.: Theory of machines and mechanisms. Analysis of mechanical systems (in Polish). Oficyna Wydawnicza PWr. Wrocław 1996; 4. Gronowicz A. i inni: Theory of machines and mechanisms. Set of analysis and synthesis problems (in Polish). Oficyna Wydawnicza PWr. Wrocław 2002 SECONDARY LITERATURE 1. Olędzki A.: Fundamentals of machines and mechanisms theory (in Polish). WNT 1987; 2. Morecki A., Oderfeld J.: Theory of machines and mechanisms (in Polish). PWN 1987; 3. Waldron K., Kinzel G.: Kinematics, Dynamics and Design of Machinery. John Wiley &Sons, Inc. 1999

SUBJECT SUPERVISOR
dr inż. Sławomir Wudarczyk tel.: 71 320-27-10 email: Slawomir.Wudarczyk@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Techniki wytwarzania - spawalnictwo**
Name of subject in English: **Chipless Processes -Welding Metallurgy**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0087**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge of the basic mechanical properties of engineering materials; has ordered knowledge of the types of metallic engineering materials - their structure, properties, applications and selection rules. Has sufficient knowledge in the field of steel and cast iron structures, the principles of their classification and marking; has basic knowledge of heat treatment and thermo-chemical treatment, has knowledge of alloy steels and non-ferrous metals and alloys.

SUBJECT OBJECTIVES

C1. Familiarizing students with welding processes and techniques used in mechanical engineering.
C2. Acquisition of knowledge in the field of welding techniques and the ability to select parameters for these processes.
C3. Acquiring and consolidating social competences including the ability to cooperate in a student group aimed at effective solving of engineering problems.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Knows the basic methods of welding and process parameters, and has knowledge of the applications of welding processes, resistance welding and soldering in the manufacture of products.

II. Relating to skills:
PEU_U01 - Is able to choose the appropriate method of joining the elements of the product and to determine the basic parameters of the process.

III. Relating to social competences:
PEU_K01 - Is aware of the responsibility for own work and readiness to comply with the rules of teamwork and take responsibility for jointly implemented tasks, correctly assesses the priorities of own and group tasks.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to welding. Health and safety of welding works.	2
Lec2	Arc welding with coated electrode. Submerged arc welding.	2
Lec3	Arc welding in protective gases (MAG, MIG, TIG).	2
Lec4	Laser welding.	2
Lec5	Resistance welding. Friction welding.	2
Lec6	Soldering and brazing.	2
Lec7	Adhesive bonding.	2
Lec8	Final test.	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Welding - introduction and occupational health and safety.	1
Lab2	Manual welding with coated electrodes.	2
Lab3	Gas-shielded welding TIG, MIG, MAG.	2
Lab4	Welding stresses and strains. Submerged arc welding.	2
Lab5	Electric resistance welding. Friction welding.	2
Lab6	Soldering and brazing.	2
Lab7	Gas welding of steel. Thermal cutting - oxygen and plasma.	2
Lab8	Robotic welding.	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. multimedia presentation N3. self study - preparation for laboratory class N4. laboratory experiment

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01	Final test
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_K01	short test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Ambroziak A. (red.): Techniki Wytwarzania. Spawalnictwo. Laboratorium PWr, skrypt, 2010
[2] Pilarczyk J. (red.): Poradnik inżyniera. Spawalnictwo. tom 1 i 2. PWN, 2003

SECONDARY LITERATURE

[1] Klimpel A.: Spawanie, Zgrzewanie i Cięcie Metali., WNT, 1999
[2] Ferenc J., Ferenc K.: Konstrukcje spawane: połączenia, PWN, 2018

SUBJECT SUPERVISOR
dr inż. Tomasz Piwowarczyk tel.: 4255 email: tomasz.piwowarczyk@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Techniki wytwarzania - przeróbka plastyczna**
Name of subject in English: **Chipless processes - Plastic Forming**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0088**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge of basic mechanical properties of engineering materials.
2. Have a basic knowledge of physics and mathematics.
3. Have skills in measurement methods, techniques for measuring and evaluating the results of the measurement.

SUBJECT OBJECTIVES

C1. Understanding the different manufacturing technologies by processing plastic products. Method used to investigate the effect of shaping the properties of the manufactured products.
C2. Understanding the phenomena limiting plastic forming processes.
C3. Knowledge of modern technologies for shaping plastic.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Knows the basic technologies and material plastic forming process parameters.
PEU_W02 - Able to properly define the problem in the field of plastic forming and properly be characterized.
PEU_W03 - Can choose the right technology plastic forming and defining the basic parameters of the process.

II. Relating to skills:
PEU_U01 - Can search for information on plastic forming and execute their critical analysis.
PEU_U02 - Can use the theoretical knowledge gained in forming the lecture and apply it in practice.
PEU_U03 - Able to perform selected laboratory tests and correct to assess their performance.

III. Relating to social competences:
PEU_K01 - Can think and act in a creative way.
PEU_K02 - Acquires the ability to work as a team.
PEU_K03 - Understands the impact of engineering.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, History of plastic processing.	2
Lec2	Effect of strain on the structure and properties of the material.	2
Lec3	Processes of forming lumps. Analysis of the process of rolling plates and profiles.	2
Lec4	The conduct and analysis of the extrusion process.	2
Lec5	The course and forging process analysis.	2
Lec6	Manufacture of metal in the drawing process.	2
Lec7	Sheet metal forming processes. Analysis of cutting and bending processes.	2
Lec8	Final test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Cold deformation and annealing of metals. Health and safety	2
Lab2	Rolled metal sheets and profiles.	2
Lab3	Metallurgical extrusion and machine parts.	2
Lab4	Manufacture of metal in the process of drawing.	2
Lab5	Stamping - cutting, bending and embossing.	2
Lab6	Free forging and matrix.	3
Lab7	Cupping test sheets.	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - preparation for laboratory class N3. report preparation N4. laboratory experiment

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01÷ PEU_W03	Colloquium
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01÷PEU_U03 PEU_K01÷PEU_K03	quizzes, laboratory report, participate in discussions problem
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

The Gronostajski J., Plastic processing of metals, Wroclaw 1974Morawiecki M., Sadok L., Wosiek the E., Theoretical bases of technological processes of plastic alteration, Wyd. Silesia, Katowice 1981
http://www.metalplast.pwr.wroc.pl/instrukcje.html

SECONDARY LITERATURE

The Romanowski P., Guide of plastic processing on hold, the Publishing house Scientifically - Technical, Warsaw 1976. the Erbel the S., Kuczyński the K., Marciniak the Z., plastic Processing of, PWN, Warsaw 1981.

SUBJECT SUPERVISOR
dr inż. Marcin Kaszuba tel.: 713202175 email: marcin.kaszuba@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Wytrzymałość materiałów**
Name of subject in English: **Strength of Materials**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0089**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	2	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the fundamentals of solid mechanics: tensor analysis, static laws.
2. Knowledge of the fundamentals of materials strength
3. Knowledge of higher mathematics in integral and differential calculation - solving differential equations

SUBJECT OBJECTIVES

C1. To solve technical problems based on the principles of the mechanics.
C2. To perform strength analysis of machine components
C3. To obtain knowledge of energy methods in the mechanics of deformable bodies

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Students know how to determine stresses and displacements in rotating discs and in pipes and thick-walled cylindrical vessels, know the theory of thin-walled axisymmetric shells loaded with pressure
PEU_W02 - Knowledge of the theoretical basis and methods of determining stresses in a complex state of stress in any structural component
PEU_W03 - Student is able to define the elastic energy of a system and can formulate the Castigliano and Menabrea-Castigliano theorems

II. Relating to skills:
PEU_U01 - Student knows how to check the strength conditions and evaluate the state of the stress in rotating discs and pipes &
thick-walled vessels, knows the theory of thin-walled axisymmetric shells loaded with pressure
PEU_U02 - Student knows how to apply Castigliano's theorem to determine displacements of the structure as well as the Menabrea-Castigliano method to calculate hyperstatic systems
PEU_U03 - The student is able to design mechanical systems and perform their strength analysis

III. Relating to social competences:
PEU_K01 - Understanding of the social impact of engineering activities and related responsibility for decisions made
PEU_K02 - Students is ready to take responsibility for the tasks carried out; can work individually and in teams.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Multiaxial stress condition; analysis of selected engineering load cases and evaluation of stress condition based on selected stress hypotheses	2
Lec2	Energy methods for determining displacements in the bar systems. Statically indeterminate systems	2
Lec3	Determination of displacements by the Maxwell-Mohr method. Force method.	2
Lec4	Bending of strongly curved beams	2
Lec5	Eccentric compression of straight bars	2
Lec6	Thick-walled single and multi-layer cylinders	2
Lec7	Shields and rotating discs.	2
Lec8	Symmetrically loaded circular plates. Rectangular plates.	2
Lec9	Axially symmetric shells.	2
Lec10	Time and temperature dependent loads – creep, relaxation.	2
Lec11	Material fatigue - basics of calculations	2
Lec12	Basics of fracture mechanics. Determination of crack propagation rate.	2
Lec13	Impact loads of rod elements	2
Lec14	Contact stress. Stresses under compression of balls and rollers.	2
Lec15	Internal stresses - causes, prevention, tests	2

		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Calculation of structural elements under complex stress state.	3
Cl2	Calculation of displacements of structures in statically determinate systems using energy methods	2
Cl3	Statically indeterminate systems - solving tasks using the Menabrea-Castigliano theorem	2
Cl4	Thick-walled single and multilayer cylinders - calculations	2
Cl5	Shields and rotating discs - calculations	2
Cl6	Powłoki osiowo-symetryczne - obliczenia	2
Cl7	Colloquium	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. calculation exercises

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	exam
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02	colloquium
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] M. E. Niezgodziński, T. Niezgodziński: Wytrzymałość materiałów, PWN, 1998.
[2] Z. Dyląg, A. Jakubowicz, Z. Orłoś: Wytrzymałość materiałów. Tom I. WNT, 1999.
[3] M. Zakrzewski, J. Zawadzki: Wytrzymałość materiałów, PWN, 1983.
[4] Z. Brzoska: Wytrzymałość materiałów. PWN, 1979.
[5] R. Żuchowski: Wytrzymałość materiałów, Oficyna Wydawnicza PWr., 1996.
[6] M.E. Nizgodziński, T. Niezgodziński: Obliczenia zmęczeniowe elementów maszyn, PWN, Warszawa 1973
[7] Jakowluk A.: Procesy pełzania i zmęczenia w materiałach, WN-T, 1998,
[8] German J. Podstawy mechaniki pękania, Wyd. Politechniki Krakowska, 2011

SECONDARY LITERATURE

[1] S. Katarzyński, S. Kocańda, M. Zakrzewski: Badania własności mechanicznych metali. WNT, 1967.
[2] J. Walczak: Wytrzymałość materiałów oraz podstawy teorii sprężystości i plastyczności, PWN, 1973.
[3] S. Kocańda: Zmęczeniowe niszczenie metali, WN-T, Warszawa 1978,
[4] S. Kocańda, J. Szala., Podstawy obliczeń zmęczeniowych, PWN, Warszawa 1985,
[5] Brózda J.: Wprowadzenie do mechaniki pękania, Politechnika Śląska, Instytut Spawalnictwa, Gliwice 2008

SUBJECT SUPERVISOR

dr hab. inż. Grzegorz Lesiuk tel.: 713204216 email: grzegorz.lesiuk@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Układy napędowe pojazdów**
Name of subject in English: **Vehicles Drive Systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0090**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. positive marks of mechanics, mathematical analysis and construction of foundations
2. basic knowledge of working various systems or machines devices
3. Basic ability to work in groups

SUBJECT OBJECTIVES

C1. The aim of the course is to broaden the knowledge of the construction vehicle drive systems and their components. The student gets acquainted with the methods of developing and preparing the characteristics of individual components of drive systems, traction characteristics and primary energy sources.
C2. The aim of the course is to acquire practical knowledge of the methods of calculation and selection of individual drive components and determine how to prevent undesirable phenomena such as the cruise power, etc. He knows the need for further professional development
C3. The aim of the course is the acquisition of practical skills experiment planning, conducting it and interpreting the results. The student is aware of the impact of selected environmental solutions and is able to use the correct terminology. Student is responsible for own work and group work

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - primary energy sources can be selected and the characteristics are known; Student can describe the power flow through the various elements of the powertrain, hydrostatic, hydrodynamic and mechanical, powertrain components are selected on the basis of calculations and characteristics.
PEU_W02 - can point out already used drive systems and improve them to suit the needs based on the development of technology
PEU_W03 - is able to describe and explain the principles of operation of the various components of driving systems, indicate the potential for adverse effects and identify methods for their elimination.

II. Relating to skills:
PEU_U01 - can also use foreign literature to interpret the results obtained in the laboratory experiments and can use of catalogs;
PEU_U02 - is able to analyze and develop the results in order to obtain the characteristics or parameters measured in the driving system of vehicles and machinery at different settings of the control system
PEU_U03 - is able to offer own ideas and design own driving control systems performing similar functions.

III. Relating to social competences:
PEU_K01 - is capable and understands the need for continuous updating of skills and acquire new kwowledge;
PEU_K02 - is responsible for the decisions both in terms of environmental and mechanical engineering activities;
PEU_K03 - is able to work in a team and solve the tasks assigned to the various positions and is responsible for the group to achieve its intended purpose.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Conventional and non-conventional energy sources. Storage methods for mechanical, electrical and hydraulic energy. Characteristics of energy sources - control principles. Non-conventional energy sources (e.g. fuel cells and others) - examples of applications and development trends.	2

Lec2	Systematics of drive systems (single-source, multi-source, series, parallel, hybrid systems) - application examples. Basic functions performed by drive systems. Construction and principle of operation of the various components downstream of the energy source to the ground (gears, various types of wheel speed differential mechanisms, decelerators, tire wheel theory).	2
Lec3	Drive systems with "rigid" and "flexible" kinematic coupling. The issue of kinematic incompatibility and circulating power in drive systems - physical basis, technical effects, ways to eliminate - examples. The efficiency of mechanical transmissions.	2
Lec4	Fundamentals of drivetrain structure selection and primary energy source selection issues: a) typical mechanical drivetrain b) typical hydrokinetic drivetrain. Resistance to the motion of vehicles and energy requirements of machinery and vehicles. Tire wheel theory, rolling resistance, coefficient of adhesion. Traction characteristics of on-road and off-road vehicles.	2
Lec5	Electric vehicles and their classification. Parameters determine the electric motor's suitability for use in electric and hybrid vehicle drive systems. Design, speed, and torque control methods strategies, efficiency maps. Calculation of reduced drive torque and moment of inertia to the motor shaft. Selection of moto-reducers and determination of transmission system dynamics.	2
Lec6	Hybrid series and parallel drive systems. Methods of calculating power requirements during movement and selection of both energy sources, secondary energy source capacities, urban, non-urban cyclograms.	2
Lec7	Basics of vehicle recuperative braking. Energy recovery, braking system control strategies. 45 minuts exam.	3
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Experimental testing of a hydrostatic vehicle driving system	2
Lab2	Experimental study of the hydrostatic boom lift drive system of a vehicle	2
Lab3	Determination of the external characteristics of a self-ignition combustion engine	2
Lab4	Experimental determination of the characteristics of a selected energy consumer and determination of transmission efficiency.	2
Lab5	Study of the influence of the stiffness of the elastic bond in the drive train on its dynamic loads	2
Lab6	Experimental testing of elastomeric tracks hybrid drive	2
Lab7	Comparison of the start-up process of a drive system with an asynchronous motor	2
Lab8	Preparatory activities. Presentation of the rules of the course, plan, health, and safety. General information about the implemented course.	1
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. laboratory experiment N3. multimedia presentation N4. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01 PEU_W02 PEU_W03	written exam
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03 PEU_K01-PEU_K03	mid-term test, exercise report, oral answer
P = pozytywne oceny z wszystkich ćwiczeń laboratoryjnych		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SECONDARY LITERATURE

SUBJECT SUPERVISOR
dr inż. Aleksander Skurjat tel.: 71 320-23-46 email: Aleksander.Skurjat@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Metrologia wielkości geometrycznych**
Name of subject in English: **Geometric metrology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0091**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of mathematics and physics at secondary school level
2. Student has the ability to read drawings and diagrams contained in the technical documentation.
3. Student has basic knowledge in the design of machine elements. It has a basic knowledge of manufacturing techniques of machine parts.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge about quantities and units of measurement associated with the geometry of the product description.
C2. Acquisition of knowledge about the types and characteristics of equipment for the measurement of geometrical quantities.
C3. Learning how to use the equipment for measurement of geometrical quantities.
C4. Gaining knowledge and skills in the selection of test equipment, analyze test results, evaluation of measurement errors and the expression of measurement uncertainty.
C5. Searching for relevant information and its critical analysis.
C6. The acquisition and consolidation of social skills including emotional intelligence, involving the cooperation among students with a view to effective problem solving. Responsibility, honesty and fairness in the academic society life.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - It can identify the quantity associated with of the geometrical description of the product, can name units of measure used to describe them, know diferences between universal and dedicated equipment for the measurement of geometrical quantities, know how to describe its metrological characteristics. He knows and is able to explain the terms used in metrology of geometrical quantities.
PEU_W02 - Able to define the elements of the measurement process and their impact on the result of the measurement.

II. Relating to skills:
PEU_U01 - Understands the dimensional requirements imposed to products included in the technical documentation. Can use standards for tolerances and fits linear and geometric tolerances. It can calculate the value of measurement errors, estimated measurement uncertainty for the different measurements.
PEU_U02 - He can make the selection of appropriate test equipment and set it up depending on the task measuring. Can use measuring equipment used in engineering to measure the geometrical quantities.

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Basic concepts of metrology. Quantities and units of measurement. Systems of SI units of measurement, standards of measurement units, measurement traceability.	2
Lec2	Classification of measuring equipment for measuring the geometry of products and its metrological characteristics.	3
Lec3	Measurement uncertainty, its sources in measurements of geometrical quantities. The role of uncertainty in adjudicating on the product's compliance or non-compliance with the specification.	2

Lec4	Types of product dimensional characteristics. Ways of their specification and tolerance in accordance with the provisions of the ISO GPS standards	2
Lec5	Types of geometric characteristics of the product. Ways of their specification and tolerance in accordance with the provisions of the ISO GPS standards	2
Lec6	Types of characteristics of the geometric structure of the surface of the product. Ways of their specification and tolerance in accordance with the provisions of the ISO GPS standards	2
Lec7	Basics of coordinate measuring technology of product geometry.	2
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Organizational matters. General principles of using measuring equipment	1
Lab2	Linear sizes measurements	2
Lab3	Measurements of angular sizes and cones	2
Lab4	Measurements of geometric deviations	2
Lab5	Measurements of the surface texture	2
Lab6	Identification and measurement of external threads	2
Lab7	Identification and measurements of spur gears	2
Lab8	Basics of coordinate measurements	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. laboratory experiment N3. report preparation N4. self study - preparation for laboratory class N5. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01; PEU_W02;	test
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01; PEU_U02;	lab report, test, oral answers
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SECONDARY LITERATURE

SUBJECT SUPERVISOR
dr inż. Marek Kuran tel.: 27-28 email: marek.kuran@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Hydrostatyczne układy napędowe**
Name of subject in English: **Hydrostatic drive systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0092**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student posses basic knowledge of fluid mechanics.
2. Student can solve diferential equations of mathematical models of hydraulis components and systems.
3. Student possess basic knowledge of classic mechanics.

SUBJECT OBJECTIVES

C1. Students acquaintance withbasic lows of hydrostatic drive systems.
C2. Students acquaintance with hydraulic components and their working principle.
C3. Students acquaintance with configuration of simple hydrostatic drive systems.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - - In the result of lesson student should be able to define requirements for hydraulic fluids of hydrostatic drive systems.
PEU_W02 - In the result of lesson student should be able to describe working pinciple of basic components of hydrostatic system.
PEU_W03 - - In the result of lesson student should be able to characterize of working of basic hydrostatic drive systems.

II. Relating to skills:
PEU_U01 - In the result of lesson student should be able to analyse operation of hydrostatic components and systems.
PEU_U02 - In the result of lesson student should be able to calculate basics parameters of hydrostatic drive system.
PEU_U03 - In the result of lesson student should be able to interpret basic characteristic of hydrostatic components and systems.

III. Relating to social competences:
PEU_K01 - In the result of lesson student should possess ability of information analysis with diferent complex level.
PEU_K02 - In the result of lesson student should possess ability of objective argument evaluate, efficient explanation and justification own opinion with help of knowledge of hydrostatic drive systems.
PEU_K03 - In the result of lesson student should possess ability of follow the rules valid in academic environment.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, lecture range presentation, check form, requirements.	1
Lec2	Basic symbols of hydraulic components.	1
Lec3	Contaminations - sources, reasons and results - filtration.	1
Lec4	Hydraulic fluids - their properties.	2
Lec5	Hydraulic and volumetrics losses in displacement machines and in the system.	2
Lec6	Positive displacement pumps - systematics, characteristics, efficiencies.	2
Lec7	Valves - systematics, types, functions.	2
Lec8	Positive displacement hydraulic motors - systematics, characteristics, efficiencies.	2
Lec9	Credit of lecture.	2
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introduction, laboratory range presentation, check form, requirements. BHP training.	1
Lab2	Experimental determination properties of working fluid - bulk modulus.	2

Lab3	Experimental determination resistance character in hydraulic pipes - linear resistance.	2
Lab4	Local resistences in hydraulic systems. Orifice as a local resistance - cavitation effect.	2
Lab5	Experimental determination pump characteristic.	2
Lab6	Static characteritics of conventional directional control valve.	2
Lab7	Description of transient states in hydraulic systems - experimental determination of basic dynamic factors.	2
Lab8	Check.	2
		Total hours: 15

TEACHING TOOLS USED
N1. multimedia presentation N2. laboratory experiment N3. self study - preparation for laboratory class

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01-PEU_W03, PEU_K01-PEU_K03	Colloquium, oral answer
P = p		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01- PEU_U03, PEU_K01-PEU_K03	reports, mid-term test, oral answer
P = F, p		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SECONDARY LITERATURE

SUBJECT SUPERVISOR
dr hab. inż. Michał Stosiak tel.: 71 320-45-99 email: Michal.Stosiak@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Metoda elementów skończonych**
Name of subject in English: **Finite Element Method**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0093**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			30	
Number of hours of total student workload (CNPS)	30			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of strength materials. Analysis of beam, plate and shell structures. Fundamentals of engineering materials.
2. Matrix algebra.
3. Skills in basic CAD tolls. Skills for solving basic engineering elements with use of classical elastic theory.

SUBJECT OBJECTIVES

C1. Learn the basics of the finite element method theory.
C2. Learn how to prepare proper model for FEM calculations.
C3. Ability to carry out computer simulations in the FEM program.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Have knowledge in the fundamentals of finite element method
PEU_W02 - Have the knowledge to prepare proper geometrical and discrete model to solve FEM task.
PEU_W03 - Has a basic knowledge of the possibilities of applying the finite element method in engineering calculations

II. Relating to skills:
PEU_U01 - Has the ability to use computer systems to carry out numerical calculations with the use of FEM.
PEU_U02 - Have the knowledge to prepare proper geometrical and discrete model to solve the task in the range of elastic deformation.
PEU_U03 - He can perform FEM calculations in the field of statics, free vibrations and elastic stability.

III. Relating to social competences:
PEU_K01 - Acquires the ability to bear responsibility for the work done.
PEU_K02 - Think and act creatively.
PEU_K03 - Acquires teamwork skills.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Development of the numerical methods	1
Lec2	The place of the finite element method in the process of modeling real systems	1
Lec3	The essence of FEM, interpolation functions, convergence conditions of the method	2
Lec4	Classification of finite elements	2
Lec5	Principles of finite element stiffness matrix construction.	4
Lec6	Modeling boundary conditions in numerical models.	2
Lec7	Examples of practical application of modern computational methods in CAD design (FEM)	2
Lec8	Test	1
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Introduction. Presentation of the software	1
Proj2	Principles of building a physical model, idealization of the system, simplifications used in physical models.	2
Proj3	Discretization of solid models, analysis of factors (type of element finite element, density of discretization) affecting the accuracy of the calculations	6

Proj4	Plane state of stress on the example of a rectangular plate with a hole. Accuracy analysis using different types of finite elements and the influence of partition density in comparison with the theoretical solution of the Kirsch problem.	4
Proj5	Bending analysis of a plate using different types and densities of shell and solid elements division. Influence of the number of layers in a solid model on the accuracy of calculations of displacements and stresses in comparison with the theoretical solution. The use of symmetry.	4
Proj6	Analysis of the state of stresses and forces in the elements of a truss, using both a bar model and a beam model. Analysis of the elastic stability of the truss elements calculated with the use of the beam model.	6
Proj7	The problem of elastic stability of axially compressed cylindrical shell. Analysis of the impact of shell geometry on the value of the critical load. Local and global stability.	2
Proj8	The axial-symmetric problem on the example of a thick-walled pipe subjected to internal pressure. The contact problem on the example of two composite pipes with a clamp. Analysis of the distribution of radial displacements, radial and circumferential stresses.	2
Proj9	Performing a project - computer simulation of the stress state of the selected load-bearing structure.	3
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. problem exercises N3. self study - preparation for project class N4. project presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	Colloquium final
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03 PEU_K01, PEU_K02, PEU_K03	The rating for the execution of project
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Rusiński E., Czmochowski J., Smolnicki T. Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000

Rakowski G., Kacprzyk Z.: Metoda elementów skończonych w mechanice konstrukcji, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2016

Zienkiewicz O.C.: Metoda elementów skończonych, Arkady 1972

SECONDARY LITERATURE

Szmelter J., Dacko M., Dobrociński S., Wieczorek M.: Metoda elementów skończonych w statyce konstrukcji, Arkady 1979

Gawroński W., Kruszewski J., Ostachowicz W., Tarnowski K., Wittbrodt E.: Metoda elementów skończonych w dynamice konstrukcji, Arkady, Warszawa 1984

Waszczyszyn Z., Cichoń Cz., Radwańska M.: Metoda elementów skończonych w stateczności konstrukcji, Arkady, Warszawa 1990

Kleiber M.: Wprowadzenie do metody elementów skończonych, PWN, Warszawa-Poznań 1989

Cichoń Cz., Cecot W., Krok J., Pluciński P.: Metody Komputerowe w liniowej mechanice konstrukcji, Wydawnictwo Politechniki Krakowskiej, Kraków, 2010

Olszowski B. Wybrane metody numeryczne, Wydawnictwo Politechniki Krakowskiej, Kraków, 2007

SUBJECT SUPERVISOR
dr inż. Artur Górski tel.: 71 320-28-47 email: artur.gorski@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Podstawy konstrukcji maszyn II**
Name of subject in English: **Fundamentals of Machine Design II**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0094**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			30	
Number of hours of total student workload (CNPS)	60			90	
Form of crediting	Examination			Crediting with grade	
Group of courses					
Number of ECTS points	2			3	
including number of ECTS points for practical (P) classes				3	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2			2.1	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge: 1 It has a basic knowledge of metallurgy, construction materials, mechanics, strength of materials and manufacturing techniques, engineering graphics. 2 It has a basic knowledge of Fundamentals od Machine Design I (process design and engineering, connections used in mechanical engineering) and perform the technical documentation using AutoCAD.
2. Skills: 1 It has self-learning ability, and is able to retrieve information from various sources, to make their interpretation, and to draw conclusions and formulate and justify opinions. 2 It can be used in the process of constructing knowledge gained on subjects: metallurgy, mechanics, strength of materials, Engineering Graphics, Fundamentals of Machine Design I.
3. Competencies: 1 He can think and act in an entrepreneurial manner. 2 Is aware of the seriousness and impact of activities in mechanical engineering, and understands the need for professional activities (both individually and collectively).

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge about the design of machine shafts (structural calculations, the selection of geometric features, resonance, mounting elements on the shaft) and the holder shafts - bearings (bearings characteristics, selection criteria, rules for bearing and fit).
C2. Gaining knowledge of the construction, operation, selection, design calculations and operation of the couplings and conveyor units and changing the rotation (mechanical transmission belts, chains and gears).
C3. Gain practical skills to make a simple construction task through a typical solution to the problem, the content of which is the optimal design of the drive unit driven machine (eg conveyor, ball mill, crusher, rotary kiln, etc.) The process of constructing a computer-aided both in the selection of design features (using the computer programs for the calculation of constructed elements) as well as at the stage of their graphical application (AutoCAD).

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - He knows the algorithm design calculations machine shafts and shafts supporting elements.
PEU_W02 - It has an extended knowledge in the construction of clutches, their applications and the selection and calculation.
PEU_W03 - It has a basic knowledge of construction, operation, principles of selection and design calculations of the conveyor units and changing the rotation (mechanical gears: belt, chain and gear).

II. Relating to skills:
PEU_U01 - Able to independently formulate and solve simple technical tasks.
PEU_U02 - He can choose and calculate the shafts, bearings, couplings, mechanical.
PEU_U03 - It can construct an optimal (in light of the criteria used) drive any machine work.

III. Relating to social competences:
PEU_K01 - Can search information and carry out their critical analysis.
PEU_K02 - Able to work independently and in a team.
PEU_K03 - Objectively evaluate the task, conceptual design, and they can justify the chosen solution and the method of its implementation.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Syllabus and requirements. Shafts and axes – characteristics. Theoretical bases selection of constructional features of shafts. Fundamentals of shafts and axes forming. Methods for the axial location of machine elements on a shaft.	2
Lec2	Design calculations of the shafts (preliminary, checkout). The phenomenon of resonance. Calculations of shafting for resonance in bending mode.	2
Lec3	Main features of rolling and sliding friction. Classification of bearings, main features of rolling contact and sliding bearings. Procedure and criteria for the selection of roller contact bearings.	2
Lec4	Bearing arrangement. Fits, lubrication and sealing in application for roller bearings.	2

Lec5	Classification of coupling and clutches. Main features of couplings. Selection and calculation rules.	2
Lec6	Main features of clutches. Engagement process, Work and friction losses, heat balance, service life. Equivalent friction radius.	2
Lec7	Belt transmissions, classification, general characteristic and selection criteria. Friction coupling of the belt with the wheel. Elastic slip, actual transmission ratio, load transfer coefficient.	2
Lec8	Force distribution, tensioning devices in belt. Required tension force and ways of regulation.	2
Lec9	Efficiency of belt transmission and belt durability. Characteristics material for belts. The design of pulleys (material, main dimensions). Design calculations of V-belt transmissions.	2
Lec10	Chain transmissions – characteristic and calculation.	2
Lec11	Gear transmissions. Classification and main features. Fundamental rule of engagement. Cycloid and involute profiles.	2
Lec12	Basic rack tooth profile. Standardization of involute wheels. Basic notions. Geometry of spur gears. Generation methods.	2
Lec13	Boundary tooth number, mesh correction, addendum modification.	2
Lec14	Tooth loading model for bending and contact pressure. Service factor. Distribution of forces in spur and helical gearing.	2
Lec15	ISO recommended methods for the calculation of gear transmission, a summary.	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Preparation of design specifications for the designed drive system (operation principles, location data, quantitative data, operation conditions).	2
Proj2	Possible solutions of the problem, a draft drawing (without details) of one selected solution (acceptance criteria included).	4
Proj3	Assumption of acceptance criteria for each of the sub-assemblies of the unit. Selection of the best solution using a dedicated software.	12
Proj4	Implementation stage of the design process: assembly and selected working drawings. Drafting technique - CAD.	12
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. calculation exercises N3. tutorials N4. self study - preparation for project class N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01 - PEU_W03	exam, quiz
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01 - PEU_U03, PEU_K01 - PEU_K03	defense of project, quizzes, evaluation of computational design review, review of project preparation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1.Podstawy konstrukcji maszyn. Praca zbiorowa pod red. Z. Osińskiego. Warszawa, PWN 1999.
2.Dietrych J. i inni; Podstawy konstrukcji maszyn. Tom II i III, Warszawa, WNT.
3. Dziama A. i inni; Przekładnie zębate. Warszawa, PWN 1995.
4. Dietrych M. i inni; Podstawy konstrukcji maszyn. Tom III i IV. W-a, WNT 1996.
5. Ćwiczenia z podstaw konstrukcji maszyn. Poradnik. Praca zbiorowa pod red. Z. Lawrowskiego, skrypt PWr., Wrocław , 1982.
6.Krawiec S.; Obliczenia konstrukcyjne przekładni pasowych i zębatych wspomagane mikrokomputerem, skrypt PWr., Wrocław, 1992.
7. Capanidis D, Krawiec S. Wieleba W.; Materiały pomocnicze do ćwiczeń projektowych z PKM wspomaganych komputerowo, IKEM PWr., 1993.
8. Roloff/Matek; Maschinenelemente - Normung, Berechnung, Gestaltung, Wiesbaden, Vieweg 1994.

SECONDARY LITERATURE
1.Jaśkiewicz Z., Wąsiewski A.; Przekładnie walcowe. Warszawa, WKŁ 1992.
2. Niemann G., Winter H.; Maschinenelemente. Band II. Berlin, Springer- Verlag 1985.
3. Niemann G., Winter H.; Maschinenelemente. Band III. Berlin, Springer- Verlag 1983.
4. Skarbiński M., Skarbiński J.; Technologiczność konstrukcji maszyn. Warszawa, WNT 1982.
5. Robert Mott, Edward Vavrek, Jyhwen Wang, Machine elements in mechanical design, Pearson, 2017
6. Norton, Robert L., Machine Design: An Integrated Approach, Pearson, 2019

SUBJECT SUPERVISOR

dr inż. Tadeusz Leśniewski tel.: 71 320-40-31 email: Tadeusz.Lesniewski@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Podstawy automatyki**
Name of subject in English: **Fundamentals of Automatic Control**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0095**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of mathematics, including: complex functions, differential equations, systems of equations, matrix algebra.
2. Has knowledge of the basic laws and principles of physics.
3. Can describe and analyze the operation of basic mechanical and physical systems.

SUBJECT OBJECTIVES

C1. Familiarizing students with methods of describing the static and dynamic properties of linear automation components in the construction of machines and devices.
C2. Familiarizing students with the basic control systems and methods of testing their stability.
C3. Familiarization students with the procedure for dealing with control systems in mechanics and machine construction.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Has knowledge of the basic methods of describing automation systems.
PEU_W02 - Has knowledge of the basic methods of automation systems analysis.
PEU_W03 - Has knowledge of the basic methods of automation systems synthesis.

II. Relating to skills:
PEU_U01 - Can define the mathematical description of the automation system.
PEU_U02 - Can analyze the function of the automation system.
PEU_U03 - Can design an automation system.

III. Relating to social competences:
PEU_K01 - Can expand knowledge using additional aids.
PEU_K02 - Can think and act in a creative way.
PEU_K03 - Understands the need to respect the customs and rules of the academic environment and society.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, basic concepts, structure of automation systems and their classification.	2
Lec2	Basic automation signals. Description of linear automation systems: mathematical models, operator transfer function, time characteristics.	2
Lec3	Dynamic non-linear systems. Methods of description and analysis. Operating point of a dynamic system, linearization. Static characteristics.	2
Lec4	Basic dynamic terms and their mathematical models. Examples of physical systems.	2
Lec5	Description of linear automation systems: spectral transmittance, frequency characteristics.	2
Lec6	Systems with a complex structure. Block diagrams of automation systems and methods of their transformations.	2
Lec7	Regulators used in automation, classification. Two-position and three-position regulation.	2
Lec8	Control: P, PI, PD, PID. Methods of P, I, D setting selection.	2
Lec9	Stability of control systems. Stability theorem, properties of stable and unstable systems. The stability criteria.	2
Lec10	Elements of logic. Boolean Algebra. Analysis and synthesis of logic circuits. Logic gates.	2
Lec11	Relay - contactor control systems. Designing of schematic diagrams.	2
Lec12	Application of PLC controllers in industrial automation. Designing and writing control algorithms.	2
Lec13	Combination logic circuits in control systems.	2

Lec14	Sequential logic circuits in industrial automation.	2
Lec15	Summary. Test of knowledge in the form of a colloquium.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Organizational activities. Health and safety regulations in the automation laboratory. Introduction, basic concepts. Classification of control systems.	2
Lab2	Static characteristics of automation elements.	2
Lab3	Dynamic time characteristics of automation elements.	2
Lab4	Frequency characteristics of automation elements.	2
Lab5	Simulation tests of automation elements in the Matlab-Simulink environment.	2
Lab6	Two-position regulation method.	2
Lab7	Three-position regulation method.	2
Lab8	Studying the properties of control systems with P, PI, PID controllers in the Matlab-Simulink environment.	2
Lab9	Application of the PID control method in industrial automation.	2
Lab10	Control in industrial pneumatic systems.	2
Lab11	Relay - contactor control elements and systems.	2
Lab12	Synthesis of combinational control systems.	2
Lab13	Synthesis of sequential control systems.	2
Lab14	Modeling and programming of sequential processes.	2
Lab15	Modeling and programming of concurrent and complex processes.	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - preparation for laboratory class N3. report preparation N4. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement

F1	PEU_W01-PEU_W03, PEU_K03	Exam
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01,PEU_K02, PEU_K03	report, quiz
P = average F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE [1] Greblicki W., Podstawy automatyki. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2006. [2] Awrejcewicz J., Wodzicki W. Podstawy automatyki, Teoria i przykłady, Łódź 2001 [3] Laboratorium podstaw automatyki i automatyzacji, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2005 SECONDARY LITERATURE [1] Wawrzycki J. Podstawy automatyki. Wykład dla kierunku transport, Wydawnictwo AHE, Łódź 2012

SUBJECT SUPERVISOR
dr inż. Mateusz Stachowicz tel.: 713204235 email: mateusz.stachowicz@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Techniki wytwarzania - obróbka ubytkowa**
Name of subject in English: **Production Technics - Machining**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0096**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	45		30		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student should have knowledge of technical drawing, designation of dimensions and tolerances, deviations in shape and location, surface roughness.
2. The student should have basic knowledge in mathematics, physics, materials science.
3. The student should have the ability to generally plan the experiment and solve simple technical problems.

SUBJECT OBJECTIVES

C1. Providing information on the basics, methods and possibilities of shaping objects by means of machining, such as machining, abrasive and erosive.
C2. Presentation of tools, tool materials, machining parameters in particular types of machining along with the method of their selection.
C3. Presentation of technological possibilities of machining and familiarizing students with the methodology of solving technological problems in the field of machining and the economics of machining.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - The student should know the physicochemical basis of machining. Should define and describe the most important tool materials used and tool protective coatings.
PEU_W02 - The student should know and define the most important machining. Should describe the machining applications. He should explain kinematics, describe and define tools and machine tools for machining, as well as know the achievable technological effects as a result of the use of machining.
PEU_W03 - The student should know and define the most important abrasive and erosive treatments. Should describe the applications of abrasive and erosive treatments. He should explain kinematics, describe and define tools and machine tools for abrasive and erosive machining, as well as know the achievable technological effects as a result of using abrasive and erosive machining.

II. Relating to skills:
PEU_U01 - The student should be able to plan a laboratory experiment in the field of machining, as well as carry out measurements (e.g. forces, surface roughness, wear) and analyze the results obtained.
PEU_U02 - Students should choose tools, machine tools, parameters and processing conditions, both in machining as well as abrasive and erosive machining, due to the expected technological effects.
PEU_U03 - The student should interpret the tasks assigned to him in the field of machining, as well as solve technological problems.

III. Relating to social competences:
PEU_K01 - The student should be aware of professional behavior on the test stand and know the main principles of safe work with machine tools.
PEU_K02 - The student should be aware of the responsibility for their own work and that of the whole team.
PEU_K03 - The student should understand the need for continuous training and deepening their own knowledge and skills along with changing technical and social conditions.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basics of the machining process, physical phenomena accompanying cutting.	3
Lec2	Materials and coatings used for cutting tools.	3
Lec3	Mechanics of chip formation. The surface layer of the workpiece. Physical and geometric features of the surface layer.	3
Lec4	Construction of cutting tools. Cutting edge geometry	3
Lec5	Wear of cutting edges. Tool life. Geometrical, technological, physical and economic criteria for blade dulling.	3
Lec6	Construction and scope of machine tools applications	3
Lec7	Cutting fluids in the machining process. Types of coolants, ways of their application. Economic and ecological aspects of the use of cutting fluids in machining.	3
Lec8	Characteristics of turning, slotting, boring, - phenomena, parameters, technological effects, tools and machine tools.	3

Lec9	Drilling characteristics - phenomena, parameters, technological effects, tools and machine tools. Methods of increasing the quality of the holes produced.	3
Lec10	Characteristics of milling and broaching - phenomena, parameters, technological effects, tools and machine tools.	3
Lec11	Machining of threads. Modern methods of manufacturing gears.	3
Lec12	Abrasive machining - basics, physical and chemical phenomena, abrasive materials, construction of abrasive tools. Grinding of rotating and flat surfaces.	3
Lec13	Possibilities of effectively increasing the quality of the elements with abrasive methods - lapping, superfinishing, honing.	3
Lec14	Possibilities of effectively increasing the quality of the elements with abrasive methods - polishing, rotary and vibratory smoothing	3
Lec15	Abrasive blastings and erosive machining - phenomena, parameters, technological effects, machine tools.	3
		Total hours: 45
Form of classes – Laboratory		Number of hours
Lab1	Possibilities of shaping the surface by turning.	2
Lab2	Possibilities of shaping the surface on drilling machines.	2
Lab3	Possibilities of surface machining by milling.	2
Lab4	Possibilities of surface machining by grinding with a grinding wheel.	2
Lab5	Selected methods of abrasive machining.	2
Lab6	Threading and machining of gear wheels.	2
Lab7	Measurement of cutting forces and moments.	2
Lab8	Shaping machine elements by wire electrical discharge machining.	2
Lab9	Possibilities of surface shaping by means of superfinishing and burnishing	2
Lab10	Abrasive cutting of materials with diamond tools.	2
Lab11	Mechanics of material decohesion.	2
Lab12	Influence of OUPN system stiffness and non-uniformity of allowance distribution on turning errors.	2
Lab13	Construction and use of modern folding and modular tools.	2
Lab14	CNC Programming Manual.	2
Lab15	Passing of the course.	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. multimedia presentation N3. laboratory experiment N4. report preparation N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01; PEU_W02; PEU_W03	Exam
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01; PEU_U02; PEU_U03	quiz, oral answer, laboratory exercises report
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE 1. Żebrowski Henryk: Techniki wytwarzania - Obróbka wiórowa, ścierna, erozyjna. Wydawnictwo: Oficyna Wyd. PWr, rok: 2004. 2. Cichosz Piotr i inni: Techniki wytwarzania - Obróbka Ubytkowa - Laboratorium. Wydawnictwo: Oficyna Wyd. PWr, rok: 2002. 3. Cichosz Piotr i inni: Techniki wytwarzania - Obróbka Ubytkowa - Laboratorium cz. II. Wydawnictwo: Oficyna Wyd. PWr, rok: 2008 SECONDARY LITERATURE 1. JEMIELNIAK K.: Obróbka skrawaniem – podstawy, dynamika, diagnostyka, Ofic. Wyd. PW, Warszawa 2018 2. OLSZAK W.: Obróbka skrawaniem, PWN, Warszawa 2021.

SUBJECT SUPERVISOR
dr inż. Marek Kołodziej tel.: 41-81 email: marek.kolodziej@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Bezpieczeństwo maszyn i procesów technologicznych**
Name of subject in English: **Safety of Machines and Technological Processes**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0097**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				15
Number of hours of total student workload (CNPS)	60				30
Form of crediting	Examination				Crediting with grade
Group of courses					
Number of ECTS points	2				1
including number of ECTS points for practical (P) classes					1
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2				0.7

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. A student has knowledge on the foundations of machines designing, manufacturing and operation.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge on methods for evaluating and shaping the machines safety during various phases of operation of a technical object.
C2. Acquisition of knowledge on legal regulations in the area of responsibility for desined, manufactured and used machines.
C3. Familiarizing the student with the methods of identifying threats using individual and team analysis of cases.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Student knows the methods for safety and risk evaluation and shaping during various phases of the technical object lifetime.

II. Relating to skills:
PEU_U01 - Student can apply methods for the safety evaluation of machines and processes as well as can identify preventive and mitigation measures for the recognized hazards.

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Discussion on the lecture content and exam requirements. Basic concepts and definitions. Models of an incident and protection.	1
Lec2	Formulation of safety requirements for a technical object. HAZOP as the method for the identification of process hazards.	2
Lec3	FMEA / FMECA – the methods supporting the designing and evaluation of technical object and process safety.	2
Lec4	FTA, ETA methods.	2
Lec5	The reliability structure of an unrecoverable system. Basic and mixed structures. The methods for the reliability increase of a system.	2
Lec6	Legal regulations on machines and processes safety.	2
Lec7	Case studies of safety hazards of machines and technological processes. Assessment of the possibility of earlier threats identification.	4
		Total hours: 15

Form of classes – Seminar		Number of hours
Sem1	Introduction. Discussion on the seminar content and exam requirements.	1
Sem2	Formulation of the safety requirements and identification of the causes of incidents - a case study.	2
Sem3	Application of HAZOP method for the identification of hazard in a technological process.	4
Sem4	Failure Modes and Effects Analysis (FMEA).	4
Sem5	Fault Tree Analysis and Event Tree Analysis for a chosen machine / machine’s subsystem. Identification of protection and mitigation means.	4
		Total hours: 15

TEACHING TOOLS USED
N1. multimedia presentation N2. problem discussion N3. case study N4. informative lecture

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01	written exam
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Seminar)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01	participation in problem discussions
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Ważyńska_Fiok K., Jaźwiński J.: Niezawodność systemów technicznych. PWN, Warszawa 1990.
[2] Podstawy racjonalnej eksploatacji maszyn. Red. M. Woropay. Biblioteka Problemów Eksploatacji. ITE, Radom 1996.
[3] Dwiliński L., Wstęp do teorii eksploatacji obiektu technicznego, Wyd. Politechniki Warszawskiej, Warszawa 1991.
[4] Poradnik niezawodności, tom I. Red. J. Migdalski. WEMA, Warszawa 1982.
[5] Poradnik Niezawodności, tom II. Red. J. Migdalski. WEMA, Warszawa 1992.
[6] Lorenc A.K., Szkoda M., Rezerwowanie jako metoda zwiększenia gotowości i niezawodności floty pojazdów. Instytut Logistyki i Magazynowania 2014.
[7] Kozłowski M. (red.), Budowa i eksploatacja pojazdów. Cz. 2, Obsługa, diagnostyka i naprawa zespołów i podzespołów, Wrocław: Vogel Business Media 2005.
[8] Kozłowski M. (red.), Budowa i eksploatacja pojazdów. Cz. 1, Działanie zespołów i podzespołów, Wrocław: Vogel Business Media 2005.

SECONDARY LITERATURE
[1] Szopa T., Niezawodność i bezpieczeństwo, Wyd. Politechniki Warszawskiej, Warszawa 2009.
[2] Młynarski S., Problemy prognozowania niezawodności pojazdów eksploatowanych w transporcie drogowym. Monografie Politechniki Krakowskiej. Seria Mechanika. Kraków: Wydawnictwo PK 2018.
[3] OprzędkiewiczJ., Technologia budowy samochodów: skrypt dla studentów wyższych szkół technicznych do przedmiotów: technologia pojazdów samochodowych i technologia silników spalinowych. Cz. 11, Podstawy niezawodności maszyn i urządzeń. Kraków: Wydawnictwa Politechniki Krakowskiej 1982.

SUBJECT SUPERVISOR

dr inż. Tomasz Siwulski tel.: 71 320-28-92 email: tomasz.siwulski@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Maszyny technologiczne CNC i roboty**
Name of subject in English: **Technological CNC machines and robots**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0098**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15	15	
Number of hours of total student workload (CNPS)	30		30	30	
Form of crediting	Crediting with grade		Crediting with grade	Crediting with grade	
Group of courses					
Number of ECTS points	1		1	1	
including number of ECTS points for practical (P) classes			1	1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6		0.7	0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge of the design and construction process, the construction and operation of machine components and assemblies, and the principles of their selection and construction.
2. Has a well-established knowledge of basic manufacturing techniques and the role of process machinery.
3. Able to design a technological process in the field of non-cut and cavity machining.

SUBJECT OBJECTIVES

C1. To familiarize with the construction of basic CNC technological machines and robots, in particular their systems: control, drive and measurement.
C2. To learn the principles of programming CNC machines and the principles of construction and implementation of control programs, and to learn methods to support the programmer's work.
C3. To learn the principles and possibilities of using automated single- and multi-machine systems to perform specific machining tasks.

SUBJECT LEARNING OUTCOMES
I. Relating to knowledge: PEU_W01 - As a result of the course, the student should be able to explain the construction and principles of operation of modern CNC technological machines, especially the principles of control of their work. PEU_W02 - As a result of the course, the student should be able to describe the principles of selection of CNC technological machines for specific machining tasks. PEU_W03 - As a result of the course, the student should be able to describe the basics of CNC machine programming. **II. Relating to skills:** PEU_U01 - As a result of the class, the student should be able to evaluate CNC technological machines for their suitability to perform specific machining tasks. PEU_U02 - As a result of the course, the student should be able to develop a program structure for basic CNC machines, and be able to use subroutines and standard cycles. PEU_U03 - As a result of the activities, the student should be able to analyse how a process machine functions. **III. Relating to social competences:** PEU_K01 - Able to search and use the literature recommended for the course and acquire independently knowledge. PEU_K02 - Able to use modern IT tools. PEU_K03 - Understands the need to work systematically and independently to master the course material.

PROGRAM CONTENT		
Form of classes – Lecture		Number of hours
Lec1	General characteristics of technological machines and their classification. Geometric, kinematic and power structures of machines. Technical and operational parameters. Basic requirements.	1
Lec2	Parts, mechanisms and components of CNC process machines: bodies, spindle and slide assemblies, tool and object systems.	2
Lec3	Main and feed drive systems in modern technological machines. Measuring, diagnostic and supervisory systems.	2
Lec4	Fundamentals of automatic control of technological machines. Classification of control systems (NC, CNC, DNC, AC and PLC systems).	1
Lec5	Introduction to programming of numerically controlled machine tools - geometric basics of CNC control, coordinate systems, structure of the control program, interpolation. Ways to support programming - machining simulators.	2
Lec6	Review of groups of CNC machines: lathes, milling machines, grinding machines (technical & usable features and purpose of the machines).	2
Lec7	CNC machines for erosion and laser machining (technical and usage features and purpose of machines).	2
Lec8	Industrial robots and manipulators (construction, classification and areas of application).	1

Lec9	Machines and equipment for manufacturing products by Additive Manufacturing and implementation of Reverse Engineering techniques - examples of applications.	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction, familiarization with technological machines	1
Lab2	Computer tomography application in geometry measurements and defectoscopy	2
Lab3	Rapid Prototyping technology based on Additive manufacturing - metal	2
Lab4	Rapid Prototyping technology based on Additive manufacturing - plastics	2
Lab5	The structure, operation and programming of the industrial robot	2
Lab6	Using CNC machines in machining processes	2
Lab7	Using a manipulator in processes of cold gas spraying	2
Lab8	The use of robots in sheet and spot welding processes	2
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Choice of machine tool, preparation of process card, definition of preparation, selection of tools and tooling, determination of machining parameters.	1
Proj2	Preparing the machine tool and programming environment, configuring the simulator. Determining the positioning of the workpiece in the workspace of the machine tool. Creating the control program.	2
Proj3	Programming of basic technological procedures using rectilinear movements.	2
Proj4	Programming arc and circle movements. Coordinate system transformations.	2
Proj5	Programming motion along a contour using tool path correction. Combining motion segments by rounding and chamfering.	2
Proj6	Subroutine technique, incremental programming, use of loop functions in program flow.	2
Proj7	Use of machining cycles in programming.	2
Proj8	Advanced programming techniques.	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - preparation for laboratory class N3. self study - preparation for project class N4. self study - self studies and preparation for examination coloqium N5. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	Written exam
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U03, PEU_U03,	Short test / lab report
P = średnia z F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U03, PEU_U03,	Short test
F2	PEU_U01, PEU_U03, PEU_U03,	Evaluation of the prepared project
P = 0.4*F1 + 0.6*F2		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE
SECONDARY LITERATURE

SUBJECT SUPERVISOR
dr inż. Marcin Madeja tel.: 3204185 email: marcin.madeja@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Praktyka**
Name of subject in English: **Practice**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0099**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					
Number of hours of total student workload (CNPS)				90	
Form of crediting					
Group of courses					
Number of ECTS points				3	
including number of ECTS points for practical (P) classes				3	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				3.0	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The practice should be carried out after the 6th semester of studies has been completed, after which the student already has theoretical knowledge in all basic areas of the mechanical engineer's activity

SUBJECT OBJECTIVES

C1. Practical use in industrial and economic practice of the student's theoretical knowledge acquired during studies at a technical university
C2. Acquisition of practical skills deepening and supplementing the student's theoretical knowledge obtained during classes at the university
C3. Acquisition of practical skills of cooperation of an engineer in an industrial and economic environment in relation to employers and co-workers

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:
PEU_U01 - The student should learn the organizational structures of economic units in the practical aspect and the nature of the work and tasks of an engineer in the basic departments of the enterprise
PEU_U02 - The student should verify and deepen his skills in solving real problems and engineering tasks
PEU_U03 - The student should learn the principles of work organization in an economic unit, know the technological processes, organization of production, control of processes from the practical side

III. Relating to social competences:
PEU_K01 - The student should verify and deepen his teamwork skills in the economic reality
PEU_K02 - The student should verify the knowledge of the legal conditions in force in the business unit (applicable legal regulations in the field of the Labor Code, trade secrets, internal regulations, etc.)
PEU_K03 - The student should shape his personality in terms of creative and innovative action, responsibility and reliability in professional activities, identification with the employer and colleagues

PROGRAM CONTENT

TEACHING TOOLS USED

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

SUBJECT SUPERVISOR

dr inż. Tadeusz Lewandowski tel.: 71 320-24-65 email: tadeusz.lewandowski@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Podstawy organizacji produkcji**
Name of subject in English: **Production System Organisation**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0100**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows and understands the nature of the management process and the basic functions of management.
2. Understands the basic concepts and basic economic rights and economic phenomena and their effects.
3. Posesses a basic knowledge of manufacturing processes.

SUBJECT OBJECTIVES

C1. Knowing the specifics of management of the production and manufacturing processes
C2. Getting familiar with types of production organisation, as well as methods and techniques for managing different types of manufacturing processes
C3. The acquisition of skills in planning, organizing and controlling of production processes

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Distinguishes and characterizes by different types of production systems.
PEU_W02 - Can define the concepts of production and technological processes.
PEU_W03 - Has knowledge on production organisation, as well on the methods and techniques of production systems management.

II. Relating to skills:

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Characteristics of manufacturing organizations	2
Lec2	Characteristics of production systems	2
Lec3	Manufacturing system, its organization and components	2
Lec4	Classifications of production processes	2
Lec5	Methods of production control - pull systems. Just In Time concept. Lean manufacturing concept.	4
Lec6	Methods of production control - push systems. MRP, MRP II, ERP concepts.	4
Lec7	Methods of production control - squeeze systems. OPT concept.	2
Lec8	Methods of organization of production systems	2
Lec9	Production inventory management methods	2
Lec10	Principles of planning and scheduling of production processes	4
Lec11	Methods of production data acquisition/registration. Traceability systems.	4
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01-PEU_W03	Written test
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SECONDARY LITERATURE

SUBJECT SUPERVISOR
dr inż. Jarosław Chrobot tel.: 20-66 email: jaroslaw.chrobot@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Podstawy eksploatacji remontów maszyn**
Name of subject in English: **Fundamentals of exploitation of machinery repairs**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0101**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of chemistry, physics, engineering graphics, materials science, construction of machine elements. He knows the basic elements of machines, he can select them from the catalogue, he knows what is the need to use lubricants and preventive principles in the operation of machines. He knows the basic technological processes of typical machine parts. He is able to protect the natural environment, rationally use its resources and reduce the generation of waste. He is aware of the consequences of polluting the environment with post-production waste.
2. He can recognize the risks associated with the industrial operation of machinery, knows international conventions and Polish legal acts in the field of environmental protection. He knows the ecological principles of construction, use and modernization of machines. Is aware of the importance and understanding of non-technical aspects and effects of the engineer's and production manager's activities, including its impact on the environment, and the related responsibility for decisions made.

SUBJECT OBJECTIVES

C1. The student is to acquire basic knowledge about machine operation processes; to understand the systemic approach to operation and to the description and assessment of the operation process; to learn to describe the technical condition and reliability of an object.
C2. The student is to learrn models of the reliability of simple repairable und unrepairable and complex objects.
C3. The student is to acquire skills of planning stocks of spare parts and consumable materials; to learn the principles of implementing repair management, the methods of regenerating worn out machine parts, modernizing machines, waste acquisition and recycling; to learn the principles of preventing and diagnosing in the operation of machines and the environmental principles of their operation.
C4. The student is to learn how to process rating indices and operational test simulation results; to acquire basic knowledge relating to diagnosing and assessing the condition of machines through the measurement and analysis of such machine operating parameters as energy consumption, machine component heating, vibration and noise levels and machine unit positioning accuracy; to learn to determine the technical condition of a machine, the degree of its wear and the range of repairs.
C5. The student is to acquire the skill of selecting a machine repair system and organizing repairs.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - The student understands the systemic approach to the operation process, knows how to describe this process and the technical condition of an object and knows the principles of assessing its reliability.
PEU_W02 - The student has knowledge relating to the assessment of the technical condition of an object, the cost-effectiveness of a machine repair, the way of preparing and carrying out the repair; understands the impact of the machine and the processes being conducted on the human being and the environment; knows the principles of eco-friendly machine operation.
PEU_W03 - The student knows the methods of assessing machine condition;can assess the need for, viability and range of a machine repair.

II. Relating to skills:
PEU_U01 - The student can assess the condition of simple and complex technical objects and their reliability
PEU_U02 - The student can assess the need for repair and its essential extent, select a method of regenerating oarts, manage the stock of consumable materials and spare parts
PEU_U03 - The student can minimize the adverse effects of a machine and the process being run on the oersonnel and the environment

III. Relating to social competences:
PEU_K01 - The student knows how to search for information on machine repairs and to critically evaluate this information.
PEU_K02 - The student can objectively evaluate diagnostic parameters and collaborate in a team to select the optimum method of bringing a machine back to its original operating condition.
PEU_K03 - The student can objectively evaluate arguments, substantiate her/his ideas, using machine operation knowledge.

PROGRAM CONTENT

Form of classes – Lecture	Number of hours

Lec1	Basic machine operation terms.	1
Lec2	The praxeological and systemic approach to operation.	2
Lec3	The description and assessment of the operation process.	2
Lec4	The description of the technical condition of an object.	2
Lec5	The notion of reliability.	2
Lec6	The reliability of simple reapairable and unrepairable objects.	2
Lec7	The reliability of complex objects.	2
Lec8	The planning of spare parts and consumable materials inventories.	2
Lec9	The technically justified methods of regenerating machine parts.	2
Lec10	Repair management, repair systems, machine modernization.	3
Lec11	Prevention and diagnostics in machine use.	3
Lec12	Waste acqisition, recycling and neutralization.	1
Lec13	Environmental aspects of constructing, operating and repairing machines.	2
Lec14	The rational lubrication of machines, lubrication tecgniques, minimal lubrication.	2
Lec15	The treatment and neutralization of lubricants, cooling agents and techological fluids.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	The basic operational states of a technical object, operating process rating indices.	1
Lab2	The analisysis of the condition of a technical object (a car, an engineering machine) on the basis of its fuel and energy consumption.	2
Lab3	The analysis of the undamageability of a selected technical object. Basic reliability indices.	2
Lab4	The analysis of the repairability of a selected technical object. The determination of repair time and weak links.	2
Lab5	The power losses and efficiency of complex drive system, the assessment of the condition of a drive.	2
Lab6	The assessment of the enery consumption and condition of bearings.	2
Lab7	The acoustic diagnosis of the technical condition of machine assembiles, the testing ofthe dynamic properties of machines.	2
Lab8	The operating properties of and the determination of the charakteristic of a drive system with a ball screw.	2
		Total hours: 15

TEACHING TOOLS USED
N1. laboratory experiment N2. self study - preparation for laboratory class N3. report preparation N4. traditional lecture with the use of transparencies and slides N5. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01 ÷ PEU_W03	written exam
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01 ÷ PEU_U03, PEU_K01 ÷ PEU_K03	short test
F2	PEU_U01 ÷ PEU_U03, PEU_K01 ÷ PEU_K03	ocena ze sprawozdania
P = F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Konspekty przekazane przez prowadzącego,
2. Ziemba S: Problemy rozwoju nauki o eksploatacji maszyn i urządzeń technicznych, PWN W-wa 1983,
3. Olearczyk E: Zarys teorii użytkowania urządzeń technicznych, WNT W-wa,
4. Gołąbek A: Elementy teorii eksploatacji - skrypt PWr,
5. Podniało A: Paliwa, oleje i smary w ekologicznej eksploatacji, WNT W-wa 2002

SECONDARY LITERATURE
Miesięcznik: Inżynieria i Utrzymanie Ruchu Zakładów Przemysłowych

SUBJECT SUPERVISOR

dr inż. Paweł Turek email: pawel.turek@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Zarządzanie w produkcji**
Name of subject in English: **Management in production**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0102**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows and understands the nature of the management process and the basic functions of management.
2. Understands the basic concepts and basic economic rights and economic phenomena and their effects.
3. Posesses a basic knowledge of manufacturing processes.

SUBJECT OBJECTIVES

C1. Knowing the specifics of management of the production and manufacturing processes.
C2. Knowledge of methods and techniques for managing different types of manufacturing processes.
C3. The acquisition of skills in planning, organising and controlling of production processes.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Distinguishes and characterises by different types of production systems.
PEU_W02 - Can define the concepts of production and technological processes.
PEU_W03 - Has knowledge of the methods and techniques of production systems management.

II. Relating to skills:

III. Relating to social competences:

PROGRAM CONTENT		
Form of classes – Lecture		Number of hours
Lec1	Characteristics of manufacturing organizations	1
Lec2	Characteristics of production systems	1
Lec3	Manufacturing system, its organization and components	1
Lec4	Classifications of production processes	1
Lec5	Types and forms of production	1
Lec6	Production control methods (pull, push and squeeze systems)	2
Lec7	Methods of organization of production systems	2
Lec8	Characteristics of bottlenecks in manufacturing processes	2
Lec9	Production inventory management methods	2
Lec10	Principles of planning and scheduling of production processes	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement

F1	PEU_W01, PEU_W02, PEU_W03	Colloquium
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SECONDARY LITERATURE

SUBJECT SUPERVISOR
dr inż. Jarosław Chrobot tel.: 20-66 email: jaroslaw.chrobot@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Technika wojskowa w konfliktach zbrojnych**
Name of subject in English: **Military technology in armed conflicts**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W10MBM-SI0103**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. General knowledge in the field of state security.
2. Basic knowledge of military technology.
3. General knowledge of the law of armed conflicts.

SUBJECT OBJECTIVES

C1. Getting to know the basic information about individual categories of individual and collective armament and their combat functions against the historical background to the present day.
C2. Acquisition of elementary knowledge in the field of the law of war, weapons science, the combat capabilities of the discussed weapon systems and the ways of using it against the background of the development of the art of war from the earliest times to the present day.
C3. Ability to interpret basic legal acts, especially the law on weapons and ammunition and the defense capabilities of the state.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - He has knowledge about the defense potential of the state in the structure of internal security and alliance systems.
PEU_W02 - He can explain the specifics of the armament of the Polish army against the background of the armies of other countries in history and the present day.
PEU_W03 - He has knowledge of military terminology in the field of armaments, both modern and historical.

II. Relating to skills:

III. Relating to social competences:
PEU_K01 - He understands the need to shape the awareness of engineering activities in terms of the development of military thought and technology.
PEU_K02 - Skilful selection of tactical and technical capabilities of the armament elements of the world's leading armies.
PEU_K03 - He understands the need to shape knowledge in the field of the main directions of development of military technology on the example of armed conflicts.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic concepts related to armed conflicts and military equipment - definitions of weapons and armaments, the role of weapons in the culture and history of mankind.	2
Lec2	Cutting and stabbing weapons. Old war machines, rolling stock equipment, horse tack and riding equipment.	2
Lec3	Weapon transformations in modern times.	2
Lec4	Small arms development.	2
Lec5	Genesis and development of ammunition for small arms and small hands.	2
Lec6	Protective armament from historical times to the present day.	2
Lec7	Artillery in modern and contemporary times. Its importance on the modern battlefield and in future armed conflicts.	2
Lec8	Combat vehicles and their importance in the perspective of robotization of the future battlefield.	2
Lec9	Heavy combat vehicles - tanks. The genesis and tactics of their use against the background of the past and present century.	2
Lec10	Means of air attack against the historical background to the present day.	2
Lec11	Missile and hypersonic weapons.	2
Lec12	Naval armament in historical and contemporary outline and directions of development.	2
Lec13	Other types of conventional weapons (explosives, mines, etc.).	2

Lec14	Customization of military technology and armament resulting from the defense needs of the changing situation of armed conflicts.	2
Lec15	Knowledge check. Test.	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03.	Test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Encyklopedia wojskowa. Dowódcy i ich armie. Historia wojen i bitew. Technika wojskowa. T. 1 (A-M), Wyd. PWN, Bellona, Warszawa 2007.
2. Gwóźdź Z., Zarzycki P., Polskie konstrukcje broni strzeleckiej. SIGMA-NOT, Warszawa 1993.
3. Hogg I., Encyklopedia uzbrojenia. Rozwój uzbrojenia od prehistorii do XXI wieku. Warszawa 2009.
4. Kochański S., Małokalibrowa broń samoczynna. Wydawnictwo Politechniki Warszawskiej, Warszawa 1989.
5. Kwaśniewicz W., Encyklopedia dawnej broni i uzbrojenia ochronnego. Bellona, Warszawa 2022.
6. Weir W., 50 broni, które zmieniły sposób prowadzenia wojen. Warszawa 2005.
7. Wiśniewski A., Pancerze, budowa, projektowanie i badania. WNT, Warszawa 2001.
8. Włodarczyk E., Podstawy fizyki wybuchu. WNT, Warszawa 2012.
9. Zasieczny A., Broń Wojska Polskiego 1939-1945. Warszawa 2010.
10. Żygulski Z., Gradowski M., Słownik uzbrojenia historycznego. Warszawa 1998.

SECONDARY LITERATURE

1. Ciepliński A., Woźniak R., Ilustrowana encyklopedia współczesnej broni palnej. Wydawnictwo Lampart, Warszawa 1997.
2. Hart R., Współczesne czołgi i pojazdy opancerzone od 1991 do dzisiaj. Wyd. 2, Alma-Press, Warszawa 2023.
3. Hazell P.J., Armour: Materials, Theory, and Design. CRC Press, Taylor & Francis Group, New York 2016.
4. Ius ad bellum versus ius in bello (Międzynarodowe Prawo Humanitarne. Tom IX). Praca zbiorowa, Wydawnictwo Marynarki Wojennej, Gdynia 2018.
5. Jamroziak K., Kędzia K., Śliwa Z., Standaryzacja amunicji strzeleckiej: budowa, znakowanie i przechowywanie. Skrypt. Wydawnictwo Wyższej Szkoły Oficerskiej Wojsk Lądowych. Wrocław 2003.
6. Puchała F., Budowa potencjału bojowego Wojska Polskiego 1945-1990. Bellona, Warszawa 2013.
7. Ustawa z dnia 21 maja 1999 r. o broni i amunicji (Dz.U. z 2022 r. poz. 2516).

SUBJECT SUPERVISOR
dr hab. inż. Krzysztof Jamroziak tel.: 320 27 60 email: krzysztof.jamroziak@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Ochrona własności intelektualnej**
Name of subject in English: **Intellectual Property Law**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W10MBM-SI0104**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. General knowledge in the area of innovation.
2. Basic knowledge of accounting and finance.
3. General knowledge of commercial law and marketing.

SUBJECT OBJECTIVES

C1. Getting to know the basic information about the functioning legal protection system intellectual property and various forms of goods: copyright, industrial property law, patents, utility designs and industrial, etc.
C2. Acquiring elementary skills to prepare application descriptions for inventions, utility and industrial designs, etc.
C3. Skills to use patent information.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - He has knowledge of patent information.
PEU_W02 - Can explain patentability.
PEU_W03 - He has knowledge of plagiarism.

II. Relating to skills:

III. Relating to social competences:
PEU_K01 - Understands the need to shape awareness of engineering activities in terms of intellectual property protection.
PEU_K02 - Skillful verification of legal aspects in the field of copyright and related rights as well as industrial property law.
PEU_K03 - Ability to work in a group.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic concepts of intellectual property protection. Research, science, knowledge, discovery, invention and innovation, patent claim, utility designs, industrial designs, integrated circuit topography.	2
Lec2	Examination procedure for patent applications and utility designs.	2
Lec3	Patentability assessment. Application description of the invention.	2
Lec4	Patent information: sources and collections of patent documentation and literature, access to information and databases of the Patent Office of the Republic of Poland.	2
Lec5	Trademarks and their legal protection. Copyright and related rights of literary and artistic works.	2
Lec6	Protection of intellectual property of software. Organizations dealing with collective management of copyrights.	2
Lec7	Protection of intellectual property of databases and domains.	2
Lec8	Plagiarism and engineering work.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03.	Test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Michniewicz G. Protection of intellectual property. Academic textbooks,. 5th Edition.C.H.Beck. Warsaw 2022.
2. Czub K. Intellectual property law. Wolters Kluwer. Warsaw 2021.
3. Kostański P. Żelechowski Ł., Industrial property Law. Academic Handbook. Warsaw 2014.
4. Barta J., Markiewicz R. Copyright and related rights. 5th edition. Warsaw 2011.
5. Adamczak A., Gedłek M. Trademarks in the activities of small and medium enterprises. National Chamber of Commerce. Warsaw 2009.
6. Adamczak A., Dobosz E., Gedłek M. Industrial designs in the activities of small and medium enterprises. National Chamber of Commerce. Warsaw 2009.
7. Kondrat M., Dreszer-Lichańska H. Industrial property in the UE. Gdansk 2007.

SECONDARY LITERATURE

1. Pawlik K., Zenderowski R. Internet Diploma. How to use the Internet when writing diploma theses?CeDeWu. Warsaw 2013.
2. Jeziorow J. Wroclaw code of good practice in the use of the results of intellectual work. Marshal's Office of the Lower Silesian Voivodeship. Wroclaw 2010.
3. Act of June 30, 2000. Industrial property law (tj. Dz.U. 2003 nr 119, poz. 1117 z późn. zm.).
4. Act of February 4, 1994 on copyright and related rights (tj. Dz.U. 2006 nr 90, poz. 631 z późn. zm.).
5. Convention on the Grant of European Patents (European Patent Convention), done at Munich on 5 October 1973. (Dz. U. z 2004 r. Nr 79, poz. 737), Act of 29 November 2000 revising the Convention on the Grant of European Patents, done at Munich on 5 October 1973. (Dz. U. z 2007 r. Nr 236, poz. 1736).
6. Paris Convention for the Protection of Industrial Property of March 20, 1883, as amended by Brussels on December 14, 1900, Washington on June 2, 1911, The Hague on November 6, 1925, London on June 2, 1934, in Lisbon on 31 October 1958 and in Stockholm on 14 July 1967 - Stockholm Act of 14 July 1967 (Dz. U. z 1975 r. Nr 9, poz. 51).
7. Basic - applicable legal acts in the field of industrial property protection on the website of the Patent Office of the Republic of Poland: https://uprp.gov.pl/pl.

SUBJECT SUPERVISOR
dr hab. inż. Krzysztof Jamroziak tel.: 320 27 60 email: krzysztof.jamroziak@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Podstawy wytrzymałości materiałów**
Name of subject in English: **Fundamentals of materials strength**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0105**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			15		
Number of hours of total student workload (CNPS)			30		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)			0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of higher mathematics - in particular, vector algebra, integral and differential equations calculation.
2. Knowledge of the fundamentals of materials science engineering
3. Knowledge of rigid body mechanics in particular in the principles of statics of bar systems, beams and mass geometry.

SUBJECT OBJECTIVES

C1. Understanding of the basics and applications of deformable body mechanics in homogeneous and heterogeneous bodies
C2. Performing strength analysis of machine components and calculating stresses and strains
C3. Students are able to experimentally determine the mechanical properties of materials and calculate permissible stresses

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:
PEU_U01 - Know how to apply Hooke's law to stress and strain calculations
PEU_U02 - Ability to perform strength analysis of bar and beam structures
PEU_U03 - Student can design a rod under compression that is resistant to loss of stability

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Introduction; health and safety rules and organization of measurement methods in the laboratory	1
Lab2	Investigation of mechanical properties of metals. Tensile test	2
Lab3	Strain gauge analysis	2
Lab4	Fatigue testing of metals	2
Lab5	Combined loading - torsion + bending. Strength hypotheses testing - torsion and bending. Determination of Kirchohoff modulus - pure torsion test	2
Lab6	Loss of rod stability - buckling. Compression test	2
Lab7	Symmetrical and unsymmetrical bending - model tests	2
Lab8	Summary of laboratories and examination	2
		Total hours: 15

TEACHING TOOLS USED

N1. laboratory experiment
N2. self study - preparation for laboratory class

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03	reports on laboratory experiments, oral answers

P = F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Zielnica J., Wytrzymałość Materiałów, WPP, wyd. III, Poznań 2000, str. 554.
Niezgodziński M. E., Niezgodziński T.: Wytrzymałość materiałów. PWN, Warszawa 1998.
Niezgodziński M. E., Niezgodziński T.: Wzory, wykresy i tablice wytrzymałościowe. WNT, Warszawa 1996.
Niezgodziński M. E., Niezgodziński T.: Zadania z wytrzymałości materiałów. WNT, Warszawa 1997.
M. Ostwald: Podstawy wytrzymałości materiałów. Wydawnictwo Politechniki Poznańskiej, Poznań 1997
Jakubowicz A., Orłoś Z., Wytrzymałość materiałów, WNT, Warszawa, 1984
Magnucki K., Szyc W., Wytrzymałość materiałów w zadaniach: pręty, płyty i powłoki obrotowe, Wydawnictwo Naukowe PWN, 2000.

SECONDARY LITERATURE
Broek D.: Elementary engineering - fracture mechanics. Noordhoff Int. Publishing, Leyden, 1974.
Ashby M. F.: Jones D. R.: Materiały inżynierskie. Własności i zastosowania. WNT, Warszawa 1995.
R. C. Hibbeler - Mechanics of Materials, Pearson Prentice Hall
S. Timoshenko, Strength of Materials Part 1, Elementary Theory and Problems, D. Van Nostrand Company, Inc
Willems N., Easley T. J., Rolfe S. T., Strength of Materials, Mc GrawHill Book Company, 1981.
Gere M., Timoshenko S., Mechanics of Materials, PWS-Kent Publishing Company, Boston, 1984.

SUBJECT SUPERVISOR

dr hab. inż. Grzegorz Lesiuk tel.: 713204216 email: grzegorz.lesiuk@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Analiza MES w zastosowaniach silnie nieliniowych w pakiecie MSC .MARC**
Name of subject in English: **FEM analysis of strongly nonlinear applications in the MSC.MARC**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W10MBM-SI0106**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	
Number of hours of total student workload (CNPS)				30	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic understanding of the pechnological processes
2. It has a basic understanding of the foundations of the theory of finite element methods.
3. It has a basic understanding of the strength of materials and mechanics.

SUBJECT OBJECTIVES

C1. Gain the knowledge in the field of mathematical modeling tools for the analysis and optimization of strongly nonlinear engineering problems.
C2. To gain the basic knowledge and skills to construct mathematical models of the technological processes.
C3. To understand the influence of the process modeling on strongly nonlinear problems.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:

PEU_U01 - It gains the skills necessary to build mathematical models of the technological processes.
PEU_U02 - Is able to perform the calculation and initial optimization of the plastic forming process.
PEU_U03 - Is able to determine the critical parameters of modeling in strongly nonlinear problems.

III. Relating to social competences:

PEU_K01 - It acquires conviction about the responsibility for the work.

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction to computer simulation of the technological processes in the computing environment.	1
Proj2	Modelling of selected examples of thermo mechanical forming processes.	2
Proj3	Performing the analysis and determination of the mathematical model for selected material model an boundary of contact.	2
Proj4	Performing the analysis and determination of the mathematical model for selected convergence calculation and method of remesching of elements during solving.	2
Proj5	Development of design assumptions, model construction for selected nonlinear problems.	2
Proj6	Making calculations and development of the results for the various process parameters of modeling.	4
Proj7	Presentation of results, report execution.	2
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. problem exercises
N3. self study - preparation for project class
N4. project presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01	project rating
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE Gronostajski Z.: Badania stosowane w zaawansowanych procesach kształtowania plastycznego. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2003 Gabryszewski Z., Gronostajski J.: Mechanika procesów obróbki plastycznej, PWN, Warszawa 1991. Milenin A.: Podstawy MES. Zagadnienia termomechaniczne. AGH. 2010. SECONDARY LITERATURE Marc and Mentat documentation Ambroziak A., Kłosowski P.: Podstawy obliczeń układów powierzchniowych w sytemie MSC.Marc/Mentat. Wydawnictwo Politechniki Gdańskiej. 2015. Zienkiewicz O.: Metoda elementów skończonych Warszawa Arkady 1972. Wiśniewski S., Wisniewski T.: Wymiana ciepła WNT. Warszawa 1997.

SUBJECT SUPERVISOR
dr inż. Sławomir Polak tel.: 21-72 email: slawomir.polak@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Grafika inżynierska 3D-SolidWorks**
Name of subject in English: **3D Engineering Graphics - Solid Works**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W10MBM-SI0107**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	
Number of hours of total student workload (CNPS)				30	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the course „Chipless processes – Casting” is required.
2. Knowledge of the " Engineering Graphics – Descriptive geometry” course is required.
3. Knowledge of the " Engineering Graphics - Engineering Drawing " course is required.

SUBJECT OBJECTIVES

C1. Achievement knowledge and skills in the field of spatial modeling of foundry equipment.
C2. Achievement knowledge and skills in the field of research and analysis of casting models and molds on virtual models.
C3. Achievement knowledge and skills in the scope of the possibility of using computer systems supporting engineering works for creative and innovative design.
C4. Achievement knowledge and skills in designing castings and foundry models. The ability to choose of allowances, radii and casting inclinations as well as the plane of the mold division depending on the size and degree the complexity and material of the casting.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:
PEU_U01 - The student should be able to build spatial models of foundry equipment.
PEU_U02 - The student should be able to build spatial models of casting models and molds and to analyze the correctness of models and their parameters.
PEU_U03 - The student should be able to make 2D drawing documentation based on the spatial model.

III. Relating to social competences:
PEU_K01 - The student wins the skills to be responsible for the work done.

PROGRAM CONTENT		
Form of classes – Project		Number of hours
Proj1	General principles of designing foundry tooling.	2
Proj2	Design guidelines for selected casting models. Introduction of allowances for shrinkage, radii and casting inclinations.	2
Proj3	Designation of structural elements of castings on the executive drawings.	2
Proj4	Principles of designing core boxes and foundry cores on the basis of selected elements of machines.	2
Proj5	Designing machining allowances on the basis of selected elements of machines. Cast machining bases.	2
Proj6	Construction of foundry molds. Rules for creating an assembly drawing of forms.	2
Proj7	Creating flat assembly documentation - assembly drawings of casting molds.	2
Proj8	Evaluation of students' works.	1
		Total hours: 15

TEACHING TOOLS USED
N1. self study - preparation for project class N2. problem discussion N3. Independent work at the computer under the supervision of the teacher N4. European standards

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SolidWorks (Basics); DPS publisher. SECONDARY LITERATURE Beginner’s Guide to SOLIDWORKS 2018: Level 1

SUBJECT SUPERVISOR
dr inż. Patrycja Paduchowicz email: patrycja.paduchowicz@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Inspekcja wymiarowo-kształtowa 3D z wykorzystaniem programów GOM Inspect i SolidWorks**

Name of subject in English: **Three-dimensional shapes inspection using GOM Inspect and Solidworks**

Main field of study (if applicable): **Mechanical Engineering and Machine Building**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **W10MBM-SI0108**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	
Number of hours of total student workload (CNPS)				30	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of machine design and manufacturing technologies.
2. Student has a knowledge of geometrical metrology.
3. Student has a knowledge of Computer Aided Design (CAD).

SUBJECT OBJECTIVES

C1. Providing students with knowledge of application of reverse engineering in quality control.
C2. Producing in students the ability of applying data from 3D scanning in the evaluation of the geometrical accuracy of products and in designing new products.
C3. Providing students with knowledge of methods of 3D scanning and reconstructions of 3D CAD models of physical objects.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:
PEU_U01 - Students can evaluate the data from 3D scanning and perform basic editing operations.
PEU_U02 - Student can perform the process of comparison a model from 3D scanning with CAD data.
PEU_U03 - Student is able to use data from a 3D scanner to design a new product.

III. Relating to social competences:
PEU_K01 - Students should be conscious of their responsibility for the results of their own and other team members' work.

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction. Presentation of 3D scanners. 3D scanning of a selected object.	3
Proj2	Learning the program interface. Import and basic editing operations on3D scanning data.	2
Proj3	Orientation of models in space, best-fit function. Comparison of two models, and generating deviation maps.	2
Proj4	Advanced inspection functions.	2
Proj5	Reconstruction of CAD model using data from scanning process (data preparation, CAD modelling).	4
Proj6	Reconstruction of CAD model using data from scanning process (result assessment). Assessment.	2
		Total hours: 15

TEACHING TOOLS USED

N1. case study
N2. self study - preparation for project class
N3. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement

F1	PEU_U01, PEU_U02, PEU_U03	project evaluation
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE [1] GOM Inspect Manual - Basic [2] GOM Inspect Manual - Advanced SECONDARY LITERATURE [1] Savio E., De Chiffre L., Schmitt R. “Metrology of freeform shaped parts”. CIRP Annals – Manufacturing Technology. 56, 2 (2007): s. 810–835. [2] Wang J., Gu D., Yu Z., Tan Ch., Zhou L. “A framework for 3D model reconstruction in reverse engineering”. Computers & Industrial Engineering. 63 (2012): s. 1189–1200 [3] Ameen W., Al-Ahmari A.M., Mian S.H. “Evaluation of handheld scanners for automotive applications”. Applied Sciences. 8 (2018), 217 [4] Gapinski B., Wieczorowski M., Marciniak-Podsadna L., Dybala B., Ziolkowski G. “Comparison of different methods of measurement geometry using CMM, optical scanner and computed tomography 3D”. Procedia Engineering. 69 (2014): s. 255–262

SUBJECT SUPERVISOR
dr inż. Tomasz Będza tel.: 71 320 42 08 email: tomasz.bedza@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Komputerowo wspomagane wytwarzanie w systemie CAD-CAM-CATIA V5**
Name of subject in English: **Computer-aided manufacturing in the CAD-CAM-CATIA V5 system**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W10MBM-SI0109**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	
Number of hours of total student workload (CNPS)				30	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Have a basic knowledge of the technological processes.
2. Have a basic knowledge of design in 3D.
3. Have a basic understanding of the strength of materials, mechanics and the theory of machines and mechanisms.

SUBJECT OBJECTIVES

C1. To gain the knowledge in the field of modern engineering tools for analysis and optimization of technological processes in CATIA system
C2. To gain the basic knowledge and skills to construct mathematical models of the technological processes.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:
PEU_U01 - It gains the skills necessary to build mathematical models of the technological processes.
PEU_U02 - Is able to perform the calculation and initial optimization of the plastic forming process.

III. Relating to social competences:
PEU_K01 - It acquires conviction about the responsibility for the work.

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction to computer simulation of the technological processes in the computing environment.	2
Proj2	Modelling of selected examples of plastic forming processes.	3
Proj3	Preparation of design assumptions for the selected item shaped by forming processes.	3
Proj4	Description of the process geometry.	2
Proj5	Making calculations for the various process parameters and/or the geometry of the process.	5
		Total hours: 15

TEACHING TOOLS USED

N1. problem exercises
N2. self study - preparation for project class
N3. project presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_K01	project rating
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Rusiński E., Czmochowski J., Smolnicki T.: Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000.
Lisowski E., Automatyzacja i integracja zadan projektowania, Wydaw. PK, rok: 2007
Nelson D. H., Applied manufacturing process planning : with emphasis on
metal forming and machining, Prentice Hall, 2001
Szabo B., Introduction to finite element analysis : formulation, verification and validation. Chichester, John Wiley and Sons, 2011.
Zimmerman W. J., Multiphysics modelling with finite element methods. Singapore [etc.], World Scientific, 2008. World Scientific,

SECONDARY LITERATURE
Gronostajski Z.: Badania stosowane w zaawansowanych procesach kształtowania plastycznego. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2003
Morawiecki M., Sadok L., Wosiek E.: Przeróbka plastyczna- podstawy teoretyczne. Wydawnictwo Śląsk 1986
Gabryszewski Z., Gronostajski J.: Mechanika procesów obróbki plastycznej, PWN, Warszawa 1991

SUBJECT SUPERVISOR

dr inż. Artur Górski tel.: 71 320-28-47 email: artur.gorski@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Modelowanie bryłowe i powierzchniowe w systemie CATIA**
Name of subject in English: **Solid and surface modeling in CATIA**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W10MBM-SI0110**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	
Number of hours of total student workload (CNPS)				30	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge in terms of descriptive geometry.
2. Fundamentals of machines design
3. Ability to use CAD / CAE programs

SUBJECT OBJECTIVES

C1. Getting acquainted with the methods of creating surface and solid models
C2. Mastering methods for creating assemblies and defining mechanism animations
C3. Acquaintance with methods of shaping the strength of thin-walled and solid structures.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:
PEU_U01 - Can develop solid or surface model in CATIA
PEU_U02 - He can execute the assembly model and perform a motion animation in CATIA
PEU_U03 - Can perform strength analysis of solid or thin-walled structure in CATIA

III. Relating to social competences:
PEU_K01 - Acquires the ability to take responsibility for the work done
PEU_K02 - Think and act in a creative way
PEU_K03 - Acquires the skill of teamwork

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction, getting to know the CATIA environment, working with a sketchbook	2
Proj2	Fundamentals of solid modeling in CATIA	2
Proj3	Fundamentals of surface modeling in CATIA	2
Proj4	Creating assemblies and motion animation	2
Proj5	Performing stress analysis for solid structures	2
Proj6	Performing stress analysis for thin-walled structures	2
Proj7	Preparation of design documentation	2
Proj8	Development of the project report	1
		Total hours: 15

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. multimedia presentation
N3. project presentation
N4. report preparation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03, PEU_K01-PEU_K03	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Rusinski E., Czmochowski J., Smolnicki T. The advanced finite element method in the load-bearing construction (in Polish), Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000
Rakowski G., Kacprzak Z.: Finite element method in the mechanics of the structure (in Polish), Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2016
Wyleżoł M. CATIA. Basics of surface and hybrid modeling (in Polish), Helion, Gliwice 2003
Wełyczko A. CATIA V5. The art of surface modeling (in Polish), Helion 2008
Sokół K. CATIA. Use of the finite element method in engineering calculations (in Polish), Helion 2014

SECONDARY LITERATURE

Wyleżoł M. CATIA v5 Modeling and analysis of kinematic systems (in Polish), Helion 2007
Skarka W., Mazurek A. CATIA. Fundamentals of modeling and recording construction (in Polish), Helion 2005
Pieczonka K.: Engineering of work machines. Vol I. The basics of making, driving, lifting and turning (in Polish), Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2007
Dudczak A.: Excavators. Theory and design (in Polish), PWN, Warszawa 2000
Augustyn J., Śledziewski, Technology of steel welded constructions (in Polish), Arkady, Warszawa 1981
Ferenc K., Ferenc J.: Welded constructions. Designing connections. (in Polish) WNT, Warszawa 2000

SUBJECT SUPERVISOR
dr hab. inż. Jerzy Czmochowski tel.: 71 320 42 84 email: jerzy.czmochowski@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Modelowanie numeryczne**
Name of subject in English: **Numerical modelling**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W10MBM-SI0111**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	
Number of hours of total student workload (CNPS)				30	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of any CAD program
2. Basic knowledge of physics, machine design, theory of mechanisms, mechanics of materials, engineering drawing
3. Ability to work within groups and creative thinking

SUBJECT OBJECTIVES

C1. Introduction and fundamentals of new Computer Aided Engineering Software.
C2. Learning rules of modelling and conducting simulation experiments using the new software and its packages.
C3. Learning to use the software to the modeling and analysis of multi-domain low-emission solutions.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Knows the principles of preparing and conducting simulation of the operation of mechatronic systems.
PEU_W02 - Knows the principles of simulational testing and optimization of mechanical components.

II. Relating to skills:
PEU_U01 - Is able to recognize the adequate tools (package) and simulation types allowing solution of various engineering problems.
PEU_U02 - Is capable of preparing simulation models in an ordered way, selecting all the options and parameters consciously.
PEU_U03 - Is capable of preparing high-quality simulation test reports.

III. Relating to social competences:
PEU_K01 - Is capable of modelling in teamwork: knows the rules for ordering and naming new models, which help to onboard new users.

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction and presentation of the subject, first contact with the software.	1
Proj2	Design and simulation studies of a simple mechanical system - learning how to use the program.	3
Proj3	A Project and simulational tests of selected mechatronic system for a ground vehicle.	5
Proj4	Design and simulation tests of a device combining mechanical, pneumatic, hydraulic and signal libraries.	6
		Total hours: 15

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. case study
N3. problem discussion
N4. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_U01, PEU_K01, PEU_U03	project defence, assessment of project preparation
F2	PEU_W02, PEU_U02, PEU_K01, PEU_U03	project defence, assessment of project preparation
F3	PEU_U03, PEU_K01	project defence, assessment of project preparation
P = średnia(F1,F2,F3)		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
https://community.sw.siemens.com/s/

SECONDARY LITERATURE
J. C. Dixon. Suspension geometry and computation. Wiley. New York 2009.
R.N. Jazar. Vehicle Dynamics. Theory and Application. Springer-Verlag New York 2008.
G. Genta, L. Morello (2008). The automotive chassis. Volume 2: System Design. Springer Science & Business Media.

SUBJECT SUPERVISOR

dr inż. Gustaw Sierzputowski email: gustaw.sierzputowski@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Obliczenia inżynierskie z użyciem arkusza kalkulacyjnego**
Name of subject in English: **Engineering calculations with usage of spreadsheet**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W10MBM-SI0112**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	
Number of hours of total student workload (CNPS)				30	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Using a computer as a tool for organization, communication, research, and problem solving.

SUBJECT OBJECTIVES

C1. Presentation of data in graphical form.
C2. Use of iterative methods for solving nonlinear equations and calculating the chosen numerical methods for integration.
C3. Learn about VBA capabilities.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:
PEU_U01 - Can graphically develop data.
PEU_U02 - Can use iterative methods to solve nonlinear equations and to calculate the selected integral with the numerical methods.
PEU_U03 - Can use VBA.

III. Relating to social competences:
PEU_K01 - Can use gathered knowledge for engineering problems solving
PEU_K02 - Can work in a team and fulfil assigned tasks

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Import data to a spreadsheet. Formatting data. Tabels.	2
Proj2	Graphical representation of data.	2
Proj3	Solving equations by graphical method.	2
Proj4	Iterative solving of nonlinear equations.	2
Proj5	Numerical integration.	2
Proj6	Correlation and regression.	2
Proj7	VBA	3
		Total hours: 15

TEACHING TOOLS USED

N1. laboratory experiment
N2. tutorials
N3. self study - preparation for laboratory class
N4. report preparation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement

F1	PEU_U01-PEU_U03	reports evaluation
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE 1. Maciej Gonet "Excel w obliczeniach naukowych i inżynierskich". Helion. 2. Daniel Brzózka "Excel - szybkie przetwarzanie danych. Sztuczki i gotowe rozwiązania". Wydawnictwo: Videopoint. SECONDARY LITERATURE 1. Jarosław Baca "Excel 2016 i programowanie VBA. Kurs video. Poziom drugi. Zaawansowane techniki tworzenia makr". Wydawnictwo: Videopoint.

SUBJECT SUPERVISOR
dr inż. Maciej Panek tel.: 071 320 47 79 email: maciej.panek@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Podstawy modelowania geometrii i generowanie dokumentacji z wykorzystaniem oprogramowania PTC Creo Parametric**

Name of subject in English: **Fundamentals of geometry modelling and documentation generation using PTC Creo Parametric software**

Main field of study (if applicable): **Mechanical Engineering and Machine Building**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **W10MBM-SI0113**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	
Number of hours of total student workload (CNPS)				30	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of modelling the geometry of objects using any CAD program. Recommended knowledge of parametric modelling.
2. Knowledge of engineering drawing. Obligatory condition: completed course "Engineering Graphics" or related.

SUBJECT OBJECTIVES

C1. Become acquainted with the basic features of parametric modelling of solid and assemblies using the CREO Parametric software.
C2. Become acquainted with the rules of creating 2D documentation using previously defined geometric models. Creating documentation of parts and assemblies.
C3. Become acquainted with the bsaasic principles of creating 3D documentation. (if time permits)

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:

PEU_U01 - The student is able to use PTC Creo Parametric software to create solid models, mainly using such features as: extrusion, rotation, hole, phase, radius, duplication.
The student is able to model a simple assembly using a few parts he has created, he can apply constraints to parts of assembly defining permanent and mobile connections (mechanisms).
In solid models, the student is able to correctly define cross-sections, tolerances of dimensions as well as shapes, and surface roughness.
PEU_U02 - Using previously defined geometric models, the student is able to create technical documentation using two ways of defining dimensions and tolerances: defining dimensions in a flat drawing and recalling dimensions from a 3D model.
The student can generate documentation for both individual parts and the assembly.
Student is able to export documentation and models to standard data exchange files: step, pdf (also 3D), dwg, dxf and others.
PEU_U03 - Student is able to modify the geometric model while maintaining a full mapping of changes on the documentation generated by him. The student is able to modify selected features of the solid model using only 2D documentation of that particular solid model.

III. Relating to social competences:

PEU_K01 - Students will learn to cooperate both in the field directly related to the task being performed and in the field of joint learning about the functional features of the software.

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction. Description of program installation and configuration. Division into the groups.	1
Proj2	Approval of projects. Solid modelling - introduction. Program configuration.	2
Proj3	Solid modelling. Parametrization of the structure.	2
Proj4	Assembly modelling.	2
Proj5	Generating 2D documentation. Defining cross sections.	2
Proj6	Dimensioning of 2D documentation.	2
Proj7	Dimensioning, defining shape tolerances. Describing the surface condition.	2
Proj8	Examination.	2
		Total hours: 15

TEACHING TOOLS USED
N1. case study N2. self study - preparation for project class N3. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03,	
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE Help included with PTC Creo. SECONDARY LITERATURE

SUBJECT SUPERVISOR
mgr inż. Rafał Fenc email: rafal.fenc@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Programowanie obróbki szybkościowej w programie Inventor HSM**
Name of subject in English: **Programming high-speed machining in Inventor HSM**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W10MBM-SI0114**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	
Number of hours of total student workload (CNPS)				30	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Well-established knowledge of the design process s from a CAx enviroment.
2. Able to design a technological process in the field of sub- and additive- machinning.
3. Knowledge in the field of construction and operation of numerically controlled machine tools.

SUBJECT OBJECTIVES

C1. Mastering the methods of planning machining operations in terms of technological performance, selection of cutting tools and tooling as well as conducting and supervising the cutting process.
C2. Familiarizing students with advanced programming tools, building control programs based on the ISO standard and the operation of postprocessors.
C3. Presentation of modern IT tools supporting production, discussing the issues of selection, implementation and integration of CAD / CAM systems.
C4. Familiarizing students with the principle of operation, health and safety requirements and the operation of CNC machine tools and the specificity of developing technological processes for machining and implementing them on these machine tools.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:
PEU_U01 - Preparation of both the control program and the machine tool for work and verification of the correctness of the program's operation by understanding the generated control code and the analysis of the generated tool paths and solid simulation.
PEU_U02 - Design of the technological process from documentation analysis, 3D modeling selection of appropriate operations in the CAM system, selection of instrumentation, cutting tools and parameters.
PEU_U03 - Mastering the basic operating range of a selected CNC machine, fix a workpiece and tools, measure their characteristic features.

III. Relating to social competences:
PEU_K01 - Ability to work in a design and technology groups.
PEU_K02 - Ability to critically evaluate the obtained results and their impact on the functioning of the company.
PEU_K03 - Acquires the ability to make decisions and take responsibility for the work done.

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Zajęcia organizacyjne. Wprowadzenie w środowisko oprogramowania wspierającego technologie wytwarzania CAx.	1
Proj2	Configuration of the tool database and methods for entering tools into the database.	2
Proj3	Overview of basic machining operations for 2.5D and 3D.	2
Proj4	Discussion of the technologicity of the selected detail, development of the technology process of the selected detail or design of special equipment.	2
Proj5	Discussing the basic G code commands for the selected machine control, overview of the generated machining program.	2
Proj6	Preparing the machine for work, setting the selected WCS, arming the tool magazine, handling the subject and tool probe.	2

Proj7	Preparation of the workpiece blank, setting of the base point and machining of the part and verification of the generated program.	2
Proj8	Safe NC program startup, part machining and verification of machining parameters, measurements with manual measuring devices.	2
		Total hours: 15

TEACHING TOOLS USED
N1. laboratory experiment N2. problem exercises N3. problem discussion N4. tutorials N5. self study - preparation for project class

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03	short test, project
P = F1		

PRIMARY AND SECONDARY LITERATURE
<u>PRIMARY LITERATURE</u> [1]. Autodek CAM "Fundamentals of CNC Machining A Practical Guide for Beginners" Compliments of Autodesk,Inc [2]. G. Nikiel, „Programowanie obrabiarek CNC na przykładzie układu sterowania Sinumerik 810D/ 840D”, Prace Akademi Techniczno-Humanistycznej w Bielsku-Białej, Bielsko-Biała 2004, opracowanie dostępne w Internecie [3]. J. Szadkowski, R. Stryczek, Grzegorz Nikiel, Projektowanie procesów technologicznych na obrabiarki sterowane numerycznie, skrypt Akademi Techniczno-Humanistycznej w Bielsku-Białej, Bielsko-Biała 1995, opracowanie dostępne w Internecie <u>SECONDARY LITERATURE</u> [1]. B. Pytlak, R. Stryczek "Elastyczne programowanie obrabiarek" Wydawnictwo Naukowe PWN [2]. Augustyn, Krzysztof. NX CAM : programowanie ścieżek dla obrabiarek CNC / Gliwice : Helion, 2010

SUBJECT SUPERVISOR
dr hab. inż. Bogdan Dybała tel.: 40 61 email: bogdan.dybala@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Projektowanie form wtryskowych i odlewniczych w programie Solid Works**
Name of subject in English: **Designing injection and casting molds in Solidworks**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W10MBM-SI0115**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	
Number of hours of total student workload (CNPS)				30	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge and skills from courses of "Engineering graphics 3D", "CAD modeling" or similar.
2. Ability to use CAD / CAE programs.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge and skills to design and model an injection mold in the Solidworks environment.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:
PEU_U01 - The student is able to model a complete injection mold.

III. Relating to social competences:
PEU_K01 - The student acquires the ability to take responsibility for the work done.

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction, overview of the Solidworks software environment.	1
Proj2	Introduction to tooling modeling - differences in approaches between solid and surface modeling.	2
Proj3	Basic aspects in mold modeling: shrinkage, draft angles, neutral lines, neutral surfaces, shut-off surfaces.	2
Proj4	Modeling of side cores and ejectors, considering their roles in the molding process.	2
Proj5	Mold modeling using surface modeling.	2
Proj6	Alternative methods of injection mold modeling.	2
Proj7	Using library operations for designing cooling channels.	2
Proj8	Assessment work - modeling of complete injection mold.	2
		Total hours: 15

TEACHING TOOLS USED

N1. problem discussion
N2. project presentation
N3. self study - preparation for project class

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement

F1	PEU_U01,PEU_K01	evaluation of credit work
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE [1]. Tornincasa S., Technical Drawing for Product Design: Mastering ISO GPS and ASME GD&T, Springer, 2021 [2]. Planchard D., Drawing and Detailing with SOLIDWORKS 2022, SDC Publications [3]. Tran P. The Complete Guide to Mold Making with SOLIDWORKS 2022 SECONDARY LITERATURE

SUBJECT SUPERVISOR
dr hab. inż. Bogdan Dybała tel.: 40 61 email: bogdan.dybala@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Projektowanie zespołów maszyn roboczych w systemach CAD(Inventor, AutoCAD)**
Name of subject in English: **Design of working machines assemblies in CAD systems (Inventor, AutoCAD)**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W10MBM-SI0116**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	
Number of hours of total student workload (CNPS)				30	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. He knows the issues related to the use of tools of CAD in the field of design.
2. Be able to work design and construction of simple assemblies; can be used in the practice known computer programs aided engineering.
3. He can build models, solve the basic issues of static, dynamic in machines and vehicles.

SUBJECT OBJECTIVES

C1. Acquiring the ability to synthesize elements and assemblies in machine systems.
C2. Acquiring the ability to use modern methods and tools for virtual design of industrial vehicles and machines.
C3. Consolidation of ability to work in a group.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:

PEU_U01 - can make collections of conceptual solutions kinematic systems of machines and equipment, to make a selection; is able to use modern strategies and techniques in the design of components and units of machines and vehicles.
PEU_U02 - able to carry out the selection of the material or to develop a conceptual design based on databases and assumptions concerning the operational requirements components or assemblies and equipment
PEU_U03 - is able to acquire and use information from the literature, databases, and other available sources to the activities of engineering in the design, operation of machines

III. Relating to social competences:

PEU_K01 - Acquires care about the aesthetics of the work, including projects and reports.
PEU_K02 - Can properly determine priorities for implementation specified by yourself or other tasks.
PEU_K03 - Able to work in a group, taking on different roles.

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Overview of the conditions for passing the course. Object selection and development of the concept. Defining the proposed facility and determine the system of construction - features, dimensions, load and speed of movement.	2
Proj2	Construction of a geometric model (3D) of the proposed object.	3
Proj3	Modeling mass properties, connections, kinematic and sensitive subject. Modeling of the drive system facility and extortion external.	2
Proj4	Numerical calculations: optimization of dynamic properties of an object, the term burdens for strength calculations.	2
Proj5	Rating geometrical model of the proposed facility. Required modifications and simplified geometric model. Verification of the proposed materials and the selection of the parameters necessary for numerical analysis (FEA).	2
Proj6	Construction of numerical model (FEA) designed components. The choice of method of numerical analysis (FEA) due to a possible geometric nonlinearity and material nonlinearity Identify and analyze the required load combinations. Numerical calculations. Verification and analysis of the results of calculations.	3
Proj7	Presentation and evaluation of the project	1
		Total hours: 15

TEACHING TOOLS USED
N1. self study - preparation for project class N2. project presentation N3. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03, PEU_K01-PEU_K03	completion of the project
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE Dudzinski P., Lenksysteme für Nutzfahrzeuge, Springer, 2004 Ahmed A. Shabana, Dynamic of Multibody Systems, Cambridge University Press, 1998 Rakowski G., Kacprzyk Z., Metoda elementów skonczonych w mechanice konstrukcji, Oficyna Wydawnicza Politechniki Warszawskiej, 2005 Rusiński E., Czmochowski J., Smolnicki T.: Zaawansowana metoda elementów skończonych w konstrukcjach nośnych. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000. SECONDARY LITERATURE Rusiński E.: Zasady projektowania konstrukcji nośnych pojazdów samochodowych. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2002. Pieczonka, K., Inżynieria maszyn roboczych. Część I. Podstawy urabiania, jazdy, podnoszenia i obrotu, Oficyna Wydawnicza Politechniki Wrocławskiej, 2007 Dudczak, A., Koparki: teoria i projektowanie, PWN, 2000 Piatkiewicz, A. , Sobolski R., tytuł: Dzwignice, WNT, 1978

SUBJECT SUPERVISOR
dr inż. Robert Czabanowski tel.: 71 320-28-37 email: robert.czabanowski@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Rozwiązywanie zagadnień mechaniki w systemie ABAQUS**
Name of subject in English: **Solving problems of mechanics in the ABAQUS**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI0117**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	
Number of hours of total student workload (CNPS)				30	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of mechanics, materials science and strength of materials.
2. Skill of using CAD / CAE software.

SUBJECT OBJECTIVES

C1. Getting acquainted with the methods of discrete models analysis considering physical and geometric nonlinearities.
C2. Mastering the methods of performing static and dynamic analyzes using the finite element method.
C3. Acquainting with the methods of modeling the contact phenomena and the definition of interactions between objects in the computational model.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:

PEU_U01 - Student can develop the model and parameters for the states of large deformation, large displacements and elastic-plastic deformations.
PEU_U02 - Student can create a model and define parameters of dynamics analysis of machine structures.
PEU_U03 - Student can develop a model and define parameters for analysis of thermoelastic problems in steady and transient states.

III. Relating to social competences:

PEU_K01 - Acquires the ability to take responsibility for the work done.
PEU_K02 - Acquires the teamwork skills.

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction to design classes.	1
Proj2	Preparation of the model to the analysis of the large displacements and / or large deformations and / or elasto-plastic deformation.	2
Proj3	Perform analysis and development of calculation results for large displacements and / or large deformations and / or elasto-plastic deformation.	2
Proj4	Modeling for dynamic analysis by direct numerical integration of motion equations.	2
Proj5	Performing the analysis and assessment of the results of dynamical analysis by direct numerical integration of the motion equations.	2
Proj6	Preparing the model for thermoelastic analysis in steady and transient state.	2
Proj7	Performing the analysis and processing of the results from the thermoelastic calculations in steady state and transient state.	2
Proj8	Develop a project with advanced MES analysis.	2
		Total hours: 15

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. project presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01 PEU_U02 PEU_U03 PEU_K01 PEU_K02	evaluation of the computational part of the project, oral examination
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Rusiński E., Czmochowski J., Smolnicki T. Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000
Rakowski G., Kacprzak Z.: Metoda elementów skończonych w mechanice konstrukcji, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2016
Zienkiewicz O.C.: Metoda elementów skończonych, Arkady Warszawa 1972

SECONDARY LITERATURE
Skrzypek J.: Plastyczność i pełzanie. Teoria, zastosowania, zadania. PWN, Warszawa 1986
Uhl T.: Komputerowo wspomagana identyfikacja modeli konstrukcji mechanicznych, WNT Warszawa 1997
Gawroński W., Kruszewski J., Ostachowicz W., Tarnowski J., Wittbrodt E. : Metoda elementów skończonych w dynamice konstrukcji. Arkady. Warszawa, 1984
Giergiel J.: Drgania mechaniczne, Uczelniane Wydawnictwa Naukowo-Dydaktyczne, Kraków 2000
Gryboś R.: Drgania maszyn, Wydawnictwo Politechniki Śląskiej, Gliwice 1998
Kostowski E.: Przepływ ciepła, Wydawnictwo Politechniki Śląskiej, Gliwice 2000
Dobrociński S.: Modelowanie zagadnień obliczania naprężeń cieplnych. WNT, Warszawa 2000

SUBJECT SUPERVISOR

dr hab. inż. Jacek Karliński tel.: 71 320-29-46 email: jacek.karlinski@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Techniki projektowania - SolidWorks**
Name of subject in English: **Design techniques - SoldWorks**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W10MBM-SI0118**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	
Number of hours of total student workload (CNPS)				30	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student should know the basic construction elements of machines and their ways of operation.
2. The student should have basic knowledge of technical drawing.

SUBJECT OBJECTIVES

C1. The aim of the course is to present knowledge in the field of design in the SolidWorks environment
C2. Get to know the tools to create sketches, assemblies and documentation.
C3. Learning how to use the ToolBox library.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:
PEU_U01 - As a result of the course, the student should be able to design solids and assemblies, create documentation, constraints, model movement and study displacements.
PEU_U02 - The student knows how to use the uploaded databases and libraries of standardized parts.

III. Relating to social competences:
PEU_K01 - The student is able to solve defined construction problems in a group.

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction, familiarization with the SolidWorks environment	2
Proj2	2D drawing and sketchs	2
Proj3	3D drawing	2
Proj4	Design of a typical machine part	2
Proj5	Design of a typical machine part	2
Proj6	Design of a typical machine part	2
Proj7	Design of a typical machine part	2
Proj8	Project completion	1
		Total hours: 15

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02	Evaluation for the project

P = F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

SUBJECT SUPERVISOR

dr inż. Kamil Waszczuk tel.: (071) 320-27-34 email: Kamil.Waszczuk@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Tworzenie dokumentacji technicznej w programie SolidWorks**
Name of subject in English: **Technical drawing with Solidworks**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W10MBM-SI0119**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	
Number of hours of total student workload (CNPS)				30	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge and skills from courses of "Engineering graphics", "Geometrical drafting", "Construction drafting" or similar
2. Knowledge and skills from courses of "Engineering graphics 3D", "CAD modeling" or similar
3. Ability to use CAD / CAE programs.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge and skills to prepare 2D technical documentation of parts and assemblies based on 3D models

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:
PEU_U01 - The student is able to make a complete technical documentation of the part and assembly based on the 3D model

III. Relating to social competences:
PEU_K01 - The student acquires the ability to take responsibility for the work done

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction, overview of the SOLIDWORKS software environment	1
Proj2	Modeling of parts using the known methods.	2
Proj3	Creating 2D technical drawing of modeled part	2
Proj4	Modeling of assembly using the known methods.	2
Proj5	Creating 2D technical drawing of modeled assembly	2
Proj6	BOM generation - component lists, auto-numbering of parts, discussion of formats	2
Proj7	Creating 2D technical drawing of welded construction	2
Proj8	Assessment work to be done in class.	2
		Total hours: 15

TEACHING TOOLS USED

N1. problem discussion
N2. project presentation
N3. self study - preparation for project class

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01,PEU_K01	Evaluation of credit work

P = F1

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE Tornincasa S., Technical Drawing for Product Design: Mastering ISO GPS and ASME GD&T, Springer, 2021 Planchard D., Drawing and Detailing with SOLIDWORKS 2022, SDC Publications SECONDARY LITERATURE

SUBJECT SUPERVISOR
mgr inż. Michał Karoluk tel.: 20-44 email: michal.karoluk@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Zaawansowane funkcje i programowanie w Microsoft Excel**
Name of subject in English: **Advanced functions and programming in Microsoft Excel**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W10MBM-SI0120**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	
Number of hours of total student workload (CNPS)				30	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has knowledge in the field of mathematics covering the basic issues of algebra and analysis.
2. The student is able to use basic IT tools.
3. The student has basic knowledge of computer programming.

SUBJECT OBJECTIVES

C1. Acquisition by students of the practical use of advanced functions and programming in MS Excel.
C2. Obtaining knowledge in the field of computer science applications and numerical computational techniques in engineering with the use of MS Excel software.
C3. Familiarizing students with basic data analysis using the available tools in MS Excel.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:

PEU_U01 - The student has the knowledge to consciously apply formulas and perform data operations in MS Excel.
PEU_U02 - The student knows how to use and perform operations with the use of Excel pivot tables.
PEU_U03 - The student is able to create simple reports on maps in Excel.

III. Relating to social competences:

PEU_K01 - The student is able to think and act in a creative way using modern IT tools.
PEU_K02 - The student understands the need for systematic and independent work on mastering the course material.

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction to Excel formulas.	2
Proj2	Data operations (sorting and filtering; finding and replacing; conditional formatting).	2
Proj3	Introduction to pivot table: basic calculations, layout, formatting and sorting of a pivot table.	2
Proj4	Grouping and filtering a pivot table.	2
Proj5	Pivot Charts. Calculated field. Designing a dashboard on a pivot table.	2
Proj6	Advanced calculations and pivot charts Power Map 3D.	2
Proj7	Examples of projects with maps in Excel Evaluation of acquired skills.	2
Proj8	Evaluation of acquired skills.	1
		Total hours: 15

TEACHING TOOLS USED

N1. problem exercises
N2. tutorials
N3. self study - preparation for project class
N4. project presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02	Evaluation of preparation for the implementation of subsequent project topics. Checking the acquired knowledge on the basis of tasks and exercises.
P =		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1]. M. Milton, D. Suma (tłum.) Excel, wydawnictwo Helion, 2011
[2]. A. Murray Advanced Excel Formulas: Unleashing Brilliance with Excel Formulas, 2022
[3]. J. Walkenbach Excel 2010PL: programowanie w VBA, wydawnictwo Helion, 2011
[4]. W.L. Winston Microsoft Excel: analiza i modelowanie danych, w-wo Warszawa : APN PROMISE, 2005

SECONDARY LITERATURE

Excel Guide (www.microsoft.com)

SUBJECT SUPERVISOR

dr hab. inż. Bogdan Dybała tel.: 40 61 email: bogdan.dybala@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Zaawansowane metody modelowania i analizy w systemach CAD\FEM**
Name of subject in English: **Advanced modeling and analysis methods in CAD / FEM systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W10MBM-SI0121**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	
Number of hours of total student workload (CNPS)				30	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the theory of elasticity, plasticity, dynamics and thermoelasticity
2. Fundamentals of the finite element method.
3. Skill to use CAD / CAE programs

SUBJECT OBJECTIVES

C1. Getting to know with FEM analysis for large deformations, large displacements and elastic-plastic deformations
C2. Mastering methods of analyzing dynamics of machine construction
C3. Introduction to methods of thermoelasticity analysis in steady state and transient.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:
PEU_U01 - He can develop the model and parameters for the states of large deformation, large displacements and elastic-plastic deformations
PEU_U02 - He can model and define parameters of dynamics analysis of machine constructions
PEU_U03 - Can model and define parameters for analysis of thermoelastic problems in steady and transient states

III. Relating to social competences:
PEU_K01 - Acquires the ability to take responsibility for the work done
PEU_K02 - Think and act in a creative way
PEU_K03 - Acquires the skill of teamwork

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction to design classes	1
Proj2	Preparation of the model to the analysis of the large displacements and / or large deformations and / or elasto-plastic deformation	2
Proj3	Perform analysis and development of calculation results for large displacements and / or large deformations and / or elasto-plastic deformation	2
Proj4	Modeling for dynamic analysis by modal superposition and / or direct numerical integration of motion equations	2
Proj5	Performing the analysis and development of dynamical analysis results by means of the modal superposition and / or by direct numerical integration of the motion equations	2
Proj6	Preparing the model for thermoelastic analysis in steady state and transient	2
Proj7	Performing the analysis and development of the results from the thermoelastic calculations in steady state and transient state	2
Proj8	Develop a project with advanced MES analysis	2
		Total hours: 15

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. project presentation
N3. report preparation
N4. multimedia presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03 PEU_K01, PEU_K02, PEU_K03	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Rusiński E., Czmochowski J., Smolnicki T. The advanced finite element method in the construction of load-bearing (in Polish), Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000

Rakowski G., Kacprzak Z.: Finite element method in structural mechanics (in Polish), Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2016

Zienkiewicz O.C.: Finite Element Method (in Polish), Arkady Warszawa 1972

SECONDARY LITERATURE

Skrzypek J.: Plasticity and creep. Theory, applications, tasks. (in Polish) PWN, Warszawa 1986

Uhl T.: Computer-aided identification of models of mechanical structures (in Polish), WNT Warszawa 1997

Gawroński W., Kruszewski J., Ostachowicz W., Tarnowski J., Wittbrodt E. : Finite Element Method in the dynamics of the construction (in Polish). Arkady. Warszawa, 1984

Giergiel J.: Mechanical vibrations (in Polish), Uczelniane Wydawnictwa Naukowo-Dydaktyczne, Kraków 2000

Gryboś R.: Machine vibrations (in Polish), Wydawnictwo Politechniki Śląskiej, Gliwice 1998

Kostowski E.: Heat flow (in Polish), Wydawnictwo Politechniki Śląskiej, Gliwice 2000

Dobrociński S.: Modeling of thermal stress calculation problems (in Polish). WNT, Warszawa 2000

Kalinowski E.: Heat transfer and heat exchangers (in Polish). Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 1995

Wiśniewski S., Wiśniewski T.: Heat transfer (in Polish). WNT, Warszawa 199

SUBJECT SUPERVISOR
dr hab. inż. Jerzy Czmochowski tel.: 71 320 42 84 email: jerzy.czmochowski@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Zarządzanie konfiguracjami i budowanie sparametryzowanych bibliotek danych CAD z wykorzystaniem programów SolidWorks i Microsoft Excel**

Name of subject in English: **Configurations management and building parameterised CAD data libraries using SolidWorks and Microsoft Excel**

Main field of study (if applicable): **Mechanical Engineering and Machine Building**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **W10MBM-SI0122**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	
Number of hours of total student workload (CNPS)				30	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge about the basics of machine design and the principles of technical drawing
2. Knowledge of the course "Engineering graphics 3D"
3. Knowledge of spreadsheet functions and basic 3D modelling functions of the SolidWorks package

SUBJECT OBJECTIVES

C1. To acquire the skills of parametric modelling of machine parts and assemblies and variants of CAD3D models of designed machine parts and assemblies.
C2. Acquired skills in building CAD3D models taking into account mathematical relationships between values of selected dimensions of the geometrical structure of a product and their integration with external data sources in the form of spreadsheets.
C3. Acquired skills in building CAD3D models taking into account mathematical relationships between values of selected dimensions of the geometrical structure of a product and their integration with external data sources in the form of spreadsheets.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:
PEU_U01 - Can use CAD computer tools to build parametric geometric models and create libraries of CAD3D models aggregating various design variants in a single file.
PEU_U02 - Can integrate parametric CAD3D geometric models into a spreadsheet and edit selected features of the geometric structure of the developed structural solutions using the spreadsheet.

III. Relating to social competences:
PEU_K01 - Is aware of responsibility for own work and for tasks carried out jointly.
PEU_K02 - Appropriately assesses the priorities of own and group tasks.

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction to the topic of the project. Discussion of the principles of implementation and credit. Introduction to basic concepts of parametrisation of CAD3D models.	2
Proj2	Development of a parameterised CAD3D model of a selected machine part based on 2D documentation. Effect of local and global variables. Editing of mathematical dimension relationships.	2
Proj3	Development a parameterised assembly model (sub-assembly consisting of several parts) using local and global variables.	4
Proj4	Integration of CAD3D models of machine parts with external data sources in the form of spreadsheets. Editing of selected parameters from the spreadsheet level.	2
Proj5	Creation and sharing of parametric libraries of CAD3D models managed from within spreadsheets. Develop a library of selected components (e.g. fasteners).	2

Proj6	Development of a parametric model of a selected mechanical sub-assembly (e. g. gear, forming tool, etc.), using parts from developed libraries and mathematical relationships between selected dimensions and global variables linked to an external spreadsheet.	2
Proj7	Passing the course.	1
		Total hours: 15

TEACHING TOOLS USED

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02	Assessment of project preparation
F2	PEU_K01, PEU_K02	Activity during classes
P = 0,75 F1 + 0,25 F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Tayseer Almattar Learn SOLIDWORKS - Second Edition. Packt Publishing, 2022
[2] Nathan Brown & Ibrahim Zeid Mastering SolidWorks: The Design Approach, 3rd Edition. Peachpit Press. 2021

SECONDARY LITERATURE
[1] Almattar, T. Learn SOLIDWORKS 2020: A Hands-On Guide to Becoming an Accomplished SOLIDWORKS Associate and Professional. Birmingham: Packt Publishing, Limited. 2019
[2] Lombard, M., Mastering SolidWorks. [Online]. Newark: John Wiley & Sons, Incorporated., 2018
[3] Wang, H. Y. et al., The Parametric Design for Hydraulic Cylinder Based on SolidWorks. Applied Mechanics and Materials. [Online] 380-384132–135, 2018

SUBJECT SUPERVISOR

dr inż. Mariusz Frankiewicz tel.: 713202083 email: mariusz.frankiewicz@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Zaawansowane wspomaganie wytwarzania w systemie CATIA**
Name of subject in English: **Advanced computer-aided design in the CATIA system**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W10MBM-SI0123**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	
Number of hours of total student workload (CNPS)				30	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Skills to use CAD/CAM systems.
2. Knowledge gained during the course of "Engineering Graphics: descriptive geometry".
3. Fundamentals of solid modeling and FEM simulations in CATIA system.

SUBJECT OBJECTIVES

C1. Getting familiar with the use of the constraintless method of building the assembly.
C2. Presentation of modern methods of construction optimization.
C3. Mastering the methods of creating the visualization of machine parts.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:

PEU_U01 - Can use the skeleton method of building the assembly, without using assembly constraints and adaptive relations.
PEU_U02 - Is able to plan a numerical experiment, know how to automate the optimization of the model using FEM.
PEU_U03 - Is able to render and visualize the constructed model.

III. Relating to social competences:

PEU_K01 - Knows how to think and act in a creative way.
PEU_K02 - Recognizes the need to improve professional, personal and social skills.
PEU_K03 - Appreciates the possibility of using computer tools in the automatization of the optimizationion process and creating a visually attractive graphic design of created models.

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	The use of boolean functions in solid modeling.	1
Proj2	Basics of skeleton modeling.	2
Proj3	The use of skeleton modeling to build assemblies of machines.	2
Proj4	Design of numerical experiment (DoE).	2
Proj5	Automatization of structure optimization using FEM.	2
Proj6	Rendering and visualization of CAD models.	2
Proj7	Basics of surface reconstruction, creating a solid model from a point cloud.	2
Proj8	Project presentation and final evaluation.	2
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. project presentation
N3. report preparation
N4. CAD/FEM system: CATIA
N5. self study - preparation for project class

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01; PEU_U02; PEU_U03; PEU_K01; PEU_K02; PEU_K03	report
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE Michaud M.: Catia. Tools and modules. Engineer's manual! Helion publishing house. 2014 Sokół K.: Catia. The use of the finite element method in engineering calculations. Helion publishing house. 2014 SECONDARY LITERATURE Rusiński E.: Principles of supporting structures designing of automotive vehicle. Wroclaw University of Technology publishing house. 2002.

SUBJECT SUPERVISOR
dr inż. Paweł Kaczyński tel.: +48 71 320 3701 email: pawel.kaczynski@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Komputerowa analiza danych pomiarowych**
Name of subject in English: **Computer analysis of measurement data**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W10MBM-SI0124**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	
Number of hours of total student workload (CNPS)				30	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Using a computer as a tool for organization, communication, research, and problem solving.

SUBJECT OBJECTIVES

C1. Presentation of measurement data in graphical form.
C2. Interpolation and aproximation of measurement data.
C3. Fourier transformation and its application to measurement data analysis.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:

PEU_U01 - Student can present data graphically.
PEU_U02 - Student can interpolate and aproximate of measurement data.
PEU_U03 - Student is able to use Fourier transformation to measurement data analysis.

III. Relating to social competences:

PEU_K01 - Student understands the necessity of systematical work on all tasks and can estimate the time needed for solving the exercise.

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction. Generating "synthetic" data with given parameters.	1
Proj2	Visualization of measurement data.	2
Proj3	Polynomial interpolation. Spline interpolation.	2
Proj4	Trigonometric interpolation.	2
Proj5	Fast Fourier Transform (FFT).	2
Proj6	Approximation of measurement data.	2
Proj7	Numeric errors. Accuracy of calculations.	2
Proj8	Artificial intelligence.	2
		Total hours: 15

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. tutorials
N3. report preparation
N4. laboratory experiment

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01+PEU_U02+PEU_U03	reports
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE J. M. i Jankowscy, Przegląd metod i algorytmów numerycznych. Cz. 1, Wydawnictwa naukowo-techniczne, 1988. SECONDARY LITERATURE R. P. Feynman, Feynman lectures on computation, T. Hey and R. W. Allen, Eds., Crc press, 2018.

SUBJECT SUPERVISOR
dr inż. Dorota Aniszewska tel.: 320-27-90 email: dorota.aniszewska@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Modelowanie komputerowe w projektowaniu I**
Name of subject in English: **Computer Aided Machine Design I**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Konstrukcja maszyn, urządzeń i pojazdów**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI1011**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	
Number of hours of total student workload (CNPS)				30	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of strength of materials, Analytical methods in strength calculations. Knowledge of types of engineering materials.
2. Student can implement a construction project using computer methods in the field of design and numerical analyses.
3. Ability to perform strength analysis using numerical methods.

SUBJECT OBJECTIVES

C1. Acquisition of the ability to design the load-bearing structure considering the definied criteria.
C2. Ability to define input data (boundary and initial conditions) necessary for modeling loads acting on the load-bearing structure.
C3. Acquisition the ability to use CAD/CAE systems in designing.
C4. Acquisition and consolidating the ability to work in a group and the ability to search for information.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:
PEU_U01 - Student can design a mechanical assembly including the selected criteria, using the appropriate methods, techniques and tools, along with calculations of their components, using the computer-aided design software.
PEU_U02 - Student can correctly formulate the kinetic and kinematic conditions that a machine or machine assembly is subjected to.
PEU_U03 - Student can prepare the documentation concerning the implemented engineering tasks and prepare a presentation of the results of this task.

III. Relating to social competences:
PEU_K01 - Acquires the ability to take responsibility for the work done.
PEU_K02 - Able to work in a group, taking different roles.
PEU_K03 - Acquires the teamwork skills.

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Overview of the curriculum. Presentation of the goal and scope of the project. The proposals for the subjects of construction works (multi-body systems).	1
Proj2	Selecting the project subject. Overview of sources: parts catalogs, standards. Neutral design data exchange formats used in CAD.	2
Proj3	Analysis of existing design solutions (multimedia presentation).	2
Proj4	Identification of features and structure. Definition of design assumptions. Analysis of fulfillment of functional requirements and parameters.	2
Proj5	Development of the structural form (considering the kinematic chain) - construction and analysis of the model.	2
Proj6	Analysis of the possibility of using unified subassemblies, parts and drives.	2
Proj7	Development of a preliminary design using CAD systems.	4
		Total hours: 15

TEACHING TOOLS USED
N1. self study - preparation for project class N2. multimedia presentation N3. project presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02, PEU_K03	Evaluation of the completed project
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Rusiński E., Czmochowski J., Smolnicki T. Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000
[2] Rakowski G., Kacprzyk Z.: Metoda elementów skończonych w mechanice konstrukcji, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2016
[3] Zienkiewicz O.C.: Metoda elementów skończonych, Arkady 1972

SECONDARY LITERATURE

[1] Szmelter J., Dacko M., Dobrociński S., Wieczorek M.: Metoda elementów skończonych w statyce konstrukcji, Arkady 1979
[2] Gawroński W., Kruszewski J., Ostachowicz W., Tarnowski K., Wittbrodt E.: Metoda elementów skończonych w dynamice konstrukcji, Arkady, Warszawa 1984
[3] Waszczyszyn Z., Cichoń Cz., Radwańska M.: Metoda elementów skończonych w stateczności konstrukcji, Arkady, Warszawa 1990
[4] Kleiber M.: Wprowadzenie do metody elementów skończonych, PWN, Warszawa-Poznań 1989
[5] Cichoń Cz., Cecot W., Krok J., Pluciński P.: Metody Komputerowe w liniowej mechanice konstrukcji, Wydawnictwo Politechniki Krakowskiej, Kraków, 2010
[6] Olszowski B. Wybrane metody numeryczne, Wydawnictwo Politechniki Krakowskiej, Kraków, 2007

SUBJECT SUPERVISOR
dr hab. inż. Jacek Karliński tel.: 71 320-29-46 email: jacek.karlinski@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Budowa pojazdów samochodowych**
Name of subject in English: **Vehicle engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Konstrukcja maszyn, urządzeń i pojazdów**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI1012**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	90				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	3				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.8				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of fundamentals of machine design
2. Ability to associate and use the acquired knowledge

SUBJECT OBJECTIVES

C1. Getting to konow the design and functional structure of motor vehicle systems
C2. Getting to know the basic technical and operational characteristics of a motor vehicle
C3. Understanding the basic principles of selection of systems of motor vehicles

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

PEU_W01 - Is able to distinguish and characterize elements and systems of a motor vehicle
PEU_W02 - Can define and explain the motion of a motor vehicle and select the source of its propulsion
PEU_W03 - Knows the current state and indicates development trends in the design of motor vehicles

II. Relating to skills:

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic information about components of the road transport system	2
Lec2	Motor vehicle classification. homologation. Identification elements	2
Lec3	Fundamentals of vehicle motion mechanics. Movement resistances	2
Lec4	Characteristics of propulsion systems. Vehicle drive selection.	2
Lec5	Design of vehicle chassis. Systems: carrier and suspension	3
Lec6	Road wheels. Tires	2
Lec7	Design of steering system	2
Lec8	Construction of braking system	2
Lec9	Automation of vehicle systems	2
Lec10	Car safety assessment criteria	2
Lec11	Vehicle Compatibility	2
Lec12	Exterior lighting of the vehicle	2
Lec13	CAN/BUS networks	1
Lec14	Features of vehicles with special purpose	2
Lec15	Final test	2
		Total hours: 30

TEACHING TOOLS USED

N1. problem lecture
N2. multimedia presentation
N3. case study
N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	Activity during class
F2	PEU_W01, PEU_W02, PEU_W03	Final test
P = F1*0,2+F2*0,8		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE 1.Reimpell J., Betzler J.: Podwozia samochodów. Podstawy konstrukcji. WKŁ Warszawa 2001. Wrzecioniarz P.A., Ambroszko W., Górniak A.: Energy Efficient design of powetrain and body, PWr, 2011. 2.Merkisz, J., Pielecha I., Układy mechaniczne pojazdów hybrydowych, Polit. Poznańska, 2015. 3.Zieliński A., Konstrukcja nadwozi samochodów osobowych i pochodnych. WKiŁ Warszawa 2018 4.Wicher., J. , Bezpieczeństwo samochodów i ruchu drogowego. Pojazdy samochodowe, WKŁ, 2004. 5.Kwaśniowski S. Systemy transportowe. Skr. MWSLiTr we Wrocławiu. W-w 2012. SECONDARY LITERATURE 1. Leon Prochowski, Mechanika ruchu, Pojazdy samochodowe, WKŁ, 2005. 2. Informatory techniczne „Bosch”. 3. Materiały konferencyjne prowadzącego dotyczące rozwiązań układów i zespołów pojazdów samochodowych. 4. Basiewicz T., Gołaszewski A., Rudziński L., Infrastruktura transportu. Of. Wyd. Pol.War. 1998.

SUBJECT SUPERVISOR
dr hab. inż. Zbigniew Sroka email: zbigniew.sroka@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Podstawy tribologii**
Name of subject in English: **Fundamentals of Tribology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Konstrukcja maszyn, urządzeń i pojazdów**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI1013**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge: 1 He has ordered knowledge about the types of engineering materials - metal, ceramic, polymer and composite materials.2. It has a basic knowledge of the construction, operation and use of the main components and machine assemblies.3. It has a basic knowledge of physics, chemistry, statistics.
2. Skills: 1. It can analyze the macroscopic fractures, microstructure of materials, technological drawbacks of origin, is able to determine the characteristics of the microstructure of metallic materials.2. He can choose the material on a given machine element and can explore its basic properties.
3. Competencies: 1 Is aware of the importance and understanding of non-technical aspects and impacts of mechanical engineer.2. Is aware of the importance of behavior in a professional manner and have a sense of responsibility for their own work.

SUBJECT OBJECTIVES

C1. Familiar with the processes of friction, wear and lubrication of moving nodes and methods for machine control these processes in terms of minimizing their effects (special attention will be paid to the construction and technological methods of increasing the reliability and durability of sliding pairs, as well as the problem of lubrication and lubricant selection as an effective prevention of friction and wear).
C2. Understanding the impact of selected parameters of friction vector, ie, pressure, velocity slip material cooperating associations and grease on the tribological characteristics of sliding pairs. Get to know the influence of the structure of the material to abrasion and impact bushing stiffness for load distribution in the bearing friction.
C3. Show students that they can effectively counteract the negative effects of friction in the moving solid contact with real objects illustrate some of the issues discussed theoretically in the lecture.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Has knowledge of the processes of friction, wear and lubrication of moving nodes machine.
PEU_W02 - Know the basic types of lubricants and their applications.
PEU_W03 - He knows the design and technological methods of increasing the reliability and durability of sliding pairs.

II. Relating to skills:
PEU_U01 - It can choose materials for sliding nodes and understand relationships and dependencies between the material used and its durability.
PEU_U02 - It can perform basic tests of materials used in the nodes of friction, interpret them and implement in the final node machines.
PEU_U03 - He can use the theoretical knowledge acquired friction and lubrication of the lecture and apply it in practice.

III. Relating to social competences:
PEU_K01 - It can search for information and critically analyze them.
PEU_K02 - Properly define and resolve dilemmas, adheres to the principle of professional ethics.
PEU_K03 - Able to work independently and as a team, and properly assess their own tasks and priorities of the group.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Program and requirements. Brief history of tribology.	1
Lec2	Elastic contact of smooth bodies. The real contact of solids. The problem of the surface layer. Friction processes, their distribution and characteristics. Sliding and rolling friction. Theories of friction.	2
Lec3	Wear processes, their distribution and characteristics. Effect of pressure and sliding velocity on the friction and wear.	2
Lec4	Characteristics of materials (metal and others) on the sliding nodes and the rules for their selection. Simple and reversed pair of friction.	2

Lec5	Susceptibility, stiffness and configuration elements as factors that increase the wear resistance.	2
Lec6	Grease as a construction material. Objectives lubrication. The way of obtaining o fluid friction. Distribution of lubricants. Lubricating oils and their properties.	2
Lec7	Greases, their distribution and characteristics.Their characteristics.	2
Lec8	Final test.	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Determining of properties of slide bearing materials.	2
Lab2	Determining of coefficient of static friction.	2
Lab3	Research of lubricity of greases using a four ball tester.	2
Lab4	Determination of the behavior of friction materials for brakes and clutches.	2
Lab5	Analysis of the impact bushing stiffness for load distribution in the sliding bearing.	2
Lab6	Analysis of the impact on the structure of the material on abrasive wear (Tester T-07).	2
Lab7	Determination of tribological characteristics of engine oils.	2
Lab8	Study materials for the seizure.	1
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - preparation for laboratory class N3. laboratory experiment N4. tutorials N5. multimedia presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01 - PEU_W03	test, quiz
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01 - PEU_U03 PEU_K01 - PEU_K03	quiz - entrance ticket, the report of the laboratory exercises, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Lawrowski Z.; Tribologia: Tarcie, zużywanie i smarowanie, Wydawnictwo Politechniki Wrocławskiej, 2008.
[2] Czarny R.; Smary plastyczne. Warszawa, WNT, 2004.
[3] Ćwiczenia laboratoryjne z podstaw konstrukcji maszyn. Praca zbiorowa pod red. F. Szymankiewicza, skrypt PWr., Wrocław , 1990 (detailed exercise instructions available on the website).
[4] Current tribology journals: „Tribologia", „Wear", „Tribology letters".
[5] Bushan B., Modern tribology handbook, 2000, Taylor & Francis Stmnetbase.

SECONDARY LITERATURE

[1] Bartz W.; Schmierfette, Zusammensetzung, Eingeschaften, Prüfung und Anwen-dung. Renningen, Export Verlag 2000
[2] Lawrowski Z.; Technika smarowania. W-a, PWN
[3] Płaza S.; Fizykochemia procesów tribologicznych, Łódź, Wyd. Uniwersytetu Łódzkiego, 1997

SUBJECT SUPERVISOR
dr inż. Tadeusz Leśniewski tel.: 71 320-40-31 email: Tadeusz.Lesniewski@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Modelowanie komputerowe w projektowaniu II**
Name of subject in English: **Computer Aided Machine Design II**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Konstrukcja maszyn, urządzeń i pojazdów**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI1014**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				90	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				3	
including number of ECTS points for practical (P) classes				3	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				2.1	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of strength of materials, Analytical methods in strength calculations. Knowledge of types of engineering materials.
2. Student can implement a construction project using computer methods in the field of design and numerical analyses.
3. Ability to perform strength analysis using numerical methods.

SUBJECT OBJECTIVES

C1. Acquisition of the ability to design the load-bearing structure considering the defined criteria.
C2. Ability to define input data (boundary and initial conditions) necessary for modeling loads acting on the load-bearing structure.
C3. Acquisition of the ability to use CAD/CAE systems in designing.
C4. Acquisition and consolidating the ability to work in a group and the ability to search for information.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:
PEU_U01 - Student can design a mechanical assembly including the defined criteria, using the appropriate methods, techniques and tools, along with calculations of the components, using the computer-aided design software.
PEU_U02 - Student can correctly formulate the kinetic and kinematic conditions to which machine or machine assembly is subjected.
PEU_U03 - Student can prepare the documentation concerning the implemented engineering tasks and prepare a presentation of the results of this task.

III. Relating to social competences:
PEU_K01 - Acquires the ability to take responsibility for the work done.
PEU_K02 - Able to work in a group, taking different roles.
PEU_K03 - Acquires the teamwork skills.

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Overview of the curriculum. Introduction to the environment of adapted tools for computer-aided design.	2
Proj2	Determination of loads acting on the assembly and its individual members in various configurations using CAD.	4
Proj3	Analysis of the selection of materials for individual elements of the designed assembly (devices, machines). Determination of properties and geometric features of members and connecting elements.	2
Proj4	Development of a geometric model for numerical analysis using a computer-aided design (CAD) system.	4
Proj5	Development of a computational model with initial-boundary conditions (numerical model) in CAE systems.	6
Proj6	Numerical studies (depending on the type of project and the type of initial-boundary conditions).	4
Proj7	Development of a project in a computer-aided design (CAD) system.	4

Proj8	Development of technical documentation for the project (assembly drawing and detailed drawings of selected parts).	4
		Total hours: 30

TEACHING TOOLS USED
N1. self study - preparation for project class N2. multimedia presentation N3. project presentation N4. report preparation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02, PEU_K03	Evaluation of the completed project
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Rusiński E., Czmochowski J., Smolnicki T. Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000
[2] Rakowski G., Kacprzyk Z.: Metoda elementów skończonych w mechanice konstrukcji, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2016
[3] Zienkiewicz O.C.: Metoda elementów skończonych, Arkady 1972

SECONDARY LITERATURE

[1] Szmelter J., Dacko M., Dobrociński S., Wieczorek M.: Metoda elementów skończonych w statyce konstrukcji, Arkady 1979
[2] Gawroński W., Kruszewski J., Ostachowicz W., Tarnowski K., Wittbrodt E.: Metoda elementów skończonych w dynamice konstrukcji, Arkady, Warszawa 1984
[3] Waszczyszyn Z., Cichoń Cz., Radwańska M.: Metoda elementów skończonych w stateczności konstrukcji, Arkady, Warszawa 1990
[4] Kleiber M.: Wprowadzenie do metody elementów skończonych, PWN, Warszawa-Poznań 1989
[5] Cichoń Cz., Cecot W., Krok J., Pluciński P.: Metody Komputerowe w liniowej mechanice konstrukcji, Wydawnictwo Politechniki Krakowskiej, Kraków, 2010
[6] Olszowski B. Wybrane metody numeryczne, Wydawnictwo Politechniki Krakowskiej, Kraków, 2007

SUBJECT SUPERVISOR
dr hab. inż. Jacek Karliński tel.: 71 320-29-46 email: jacek.karlinski@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Ustroje nośne**
Name of subject in English: **Carrying Structures**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Konstrukcja maszyn, urządzeń i pojazdów**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI1015**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			30	
Number of hours of total student workload (CNPS)	30			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Strength of materials fundamentals; trusses , beams, plates and shells analysis. Fundamentals of materials science
2. Fundamentals of Finite Element Method
3. Ability to perform numerical strength analysis of basic elements in the elastic range behavior

SUBJECT OBJECTIVES

C1. Recommendations for trusses, thin and thick plates elements design
C2. Presentation of problem related to proper design of connections and structural nodes under static and alternating loads
C3. Ability to design basic load carryings structures with use of the CAD/CAE software

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Knowledge in the field of design of load carrying structure under alternating loads, prone to fatigue (trusses, frames, thin shell, solid elements)
PEU_W02 - Knowledge in the field of designing of structural nodes and connections of load carrying structures
PEU_W03 - - Knowledge in the field of designing on the basis of standards (cranes, steel structures) with respect to the stiffness and durability criterion

II. Relating to skills:
PEU_U01 - Ability to develop numerical model of basic structural elements for strength, buckling and vibrations analysis
PEU_U02 - Ability to define proper kinetic, kinematic boundaries to the structure
PEU_U03 - Ability to proper results intepretation

III. Relating to social competences:
PEU_K01 - Acquire skills in the responsibility of performed tasks
PEU_K02 - Acquire skills of creative engineering
PEU_K03 - Acquire skills of team work

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Survey of the machines load carrying structures	1
Lec2	Failures and disasters analysis of load carrying structures	2
Lec3	Load carrying structures modeling	2
Lec4	Recommendations for connecting structure elements under alternating loads	2
Lec5	Recommendations for design of thin shell elements. Local and global stability approach.	2
Lec6	Recommendations for structural nodes design	2
Lec7	Calculation methods in load carrying structures design – permissible stresses method, limiting stresses method	2
Lec8	Fatigue phenomenon of load carrying structures	2
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Description and scope of the project classes. Introduction to the software.	2
Proj2	Designing, modeling of volume/solid elements structures	2
Proj3	Boundary conditions: support definition; symmetry, kinetic and kinematic load, strength analysis	2
Proj4	Optimization of the solid elements structures (mass minimization)	2
Proj5	Designing and modeling of thin shell elements (I profiles, box profiles)	2

Proj6	Designing and modeling of thin shell elements (mass minimization)	4
Proj7	Designing and modeling of truss elements (3D truss)	2
Proj8	Designing and modeling of structural nodes (rigid, elastic and revolute joints)	4
Proj9	Designing and modeling of 3D beam structures of machines and vehicles	4
Proj10	Design optimization of the 3D beam structure	2
Proj11	Definition and combination of fundamental loads for cranes	2
Proj12	Natural frequencies and linear buckling analysis of load carrying structures	2
		Total hours: 30

TEACHING TOOLS USED
N1. Individual work – project development N2. Design tasks assignments N3. Multimedia presentation N4. Project presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	Colloquium and possible orally improvement
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03 PEU_K01, PEU_K02, PEU_K03	Assessment of project preparation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Rusinski E., Czmochowski J., Smolnicki T.: The advanced finite element method in the construction of load-bearing (in polish), Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000
Rusiński E.: Finite Element Method. COSMOS/M (in Polish) System, WKiŁ, Warszawa 1994
Rusiński E.: Computer analysis of frames and bodies of vehicles and work machines (in Polish), WKiŁ, Warszawa 1990
Rusiński E.: Principles of design of bearing structures of vehicles (in Polish). Oficyna Wyd. PWr Wrocław 2002

SECONDARY LITERATURE
Augustyn J., Śledziewski E.: Technology of steel welded constructions (in Polish), Arkady, Warszawa 1981
Augustyn J.: Welded and spot-welded joints (in Polish), Arkady, Warszawa 1987
Dudczak A.: Excavators. Theory and design (in Polish), PWN, Warszawa 2000
Ferenc K., Ferenc J.: Welded constructions. Designing connections. (in Polish) WNT, Warszawa 2000
Pieczonka K.: Engineering of work machines. Part I. The basics of mining, driving, lifting and turning (in Polish), Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2007
Żmuda J.: Basic design of metal structures (in Polish), Arkady, Warszawa 1997
EN 1993-1 Eurokod 3 Design of steel structures

SUBJECT SUPERVISOR

dr hab. inż. Jerzy Czmochowski tel.: 71 320 42 84 email: jerzy.czmochowski@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Inżynieria pojazdów przemysłowych**
Name of subject in English: **Offroad Vehicles Engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Konstrukcja maszyn, urządzeń i pojazdów**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI1016**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30	15	
Number of hours of total student workload (CNPS)	60		60	30	
Form of crediting	Crediting with grade		Crediting with grade	Crediting with grade	
Group of courses					
Number of ECTS points	2		2	1	
including number of ECTS points for practical (P) classes			2	1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		1.4	0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge of the construction of vehicle drive systems
2. Can cooperate with a group and individually solve complex tasks
3. Has knowledge of mechanics, mathematical analysis and the fundamentals of machine design of vehicle drive systems

SUBJECT OBJECTIVES

C1. The aim of the course is to improve knowledge of the construction and working methods of engineering vehicles in particularly wheeled and tracked vehicles. The scope also includes calculations of resistance to motion, steering of various chassis systems;
C2. The aim of the course is to acquire practical knowledge in the calculation of typical undercarriage components of the wheeled and tracked chassis. The class also extends the knowledge of the use of various systems of vehicle chassis systems
C3. The aim of the course is to gain knowledge of how the tool interacts with the soil, to determine the suitability of tools for
a variety of jobs;
C4. The aim of the class is to gain skills in group work, in developing results.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Can calculate the individual components of suspension systems for wheeled and tracked vehicles as well as the transmission of drive systems.
PEU_W02 - Can identify the correct tool for the task to be carried out. Can estimate traction force. Knows the principle of braking systems of heavy-duty vehicles and calculates the braking distance.
PEU_W03 - He knows the basics of how the tool interacts with the ground and is familiar with the methods to achieve full loading.

II. Relating to skills:
PEU_U01 - can also use foreign language literature, and analyze and interpret the results obtained.
PEU_U02 - is able to analyze and process the results to obtain the characteristics or measured parameters in vehicle and drive systems with different control system settings parameters in vehicle and drive systems with different control system settings.
PEU_U03 - is able to propose its own chassis concepts.

III. Relating to social competences:
PEU_K01 - is able to and understands the need for continuing education and acquiring new information.
PEU_K02 - is responsible for the decisions he takes, both in terms of the environment and in terms of his activities as a mechanical engineer.
PEU_K03 - is able to work in a group and solve tasks assigned to him/her, also in different positions, and takes responsibility for the group achieving the intended purpose.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to off-road locomotion. Locomotion in nature. Overview of methods of movement of animals and vehicles with different chassis systems with examples. The efficiency of movement. Interaction of off-road vehicles with the ground.	2

Lec2	Division of working machinery into earth-moving machinery and transport machinery. Their types of workplaces, and their use distinguish the problems of locomotion of these groups of objects (bucket loaders, bulldozers, excavators, compactors...).	3
Lec3	Tire wheel theory of motion traveling over different terrains. Characteristics and examples of motion resistance calculations. Characteristics and examples of off-road movement resistance calculations. Wheel efficiency, adhesion coefficient, large size wheel, tread types. Tyre wheel test methods.	3
Lec4	Mechanics of movement of a non-automotive vehicle. Resistance to the movement of the trailer, and interaction with the towing vehicle. Distribution of weights acting on the axles during motion. Energy requirements during unsteady motion. Fuel consumption.	2
Lec5	Braking of multi-frame vehicles. Requirements for pneumatic, hydraulic, and combined braking systems. Components of industrial vehicle braking systems. Amount of dissipated energy expended. Sensors to optimize system operation (axle weight, speed...). Trailer-tractor interaction. Redundancy of the braking systems.	3
Lec6	Directional stability of wheeled vehicles. Directional stability during braking of an articulated vehicle. Steering kinematics. Vehicle suspensions and the adaptation of vehicle wheel positions to significant curvatures of the terrain. Use of spring and damping elements in suspension systems.	2
Lec7	Automation in earth-working machinery. Principles of operation of basic position and force, pressure, flow sensors to identify their advantages and disadvantages in process control. Autonomous systems for guiding a vehicle or tool along a set trajectory.	2
Lec8	Advanced control systems: weighing systems and positioning of the working tool. Inspection robots moving e.g. inside tunnels. Industrial vehicle operation in reduced visibility conditions.	2
Lec9	Theory of movement of a tracked vehicle. Examples of steel and elastomeric tracks in use. Comparison and their application. Calculations of track belt tension under internal and external forces. Turning kinematics of tracked vehicles. Resistance to the movement of these vehicles.	3
Lec10	Interaction of tracks with the ground. Influence of tread height, tractive force, number of load-bearing rollers, and determination of track slip on different soils. An unevenness of track pressure versus tractive force. Determination of traction forces.	2
Lec11	Steering and suspension systems of earth-working vehicles. Examples of applications. Selection of air springs. Role of individual suspension components.	2
Lec12	Vehicles for special applications. Theory of hover vehicles. Hover cushion generating methods, application, advantages and disadvantages of this group of vehicles. Construction of screw and walking vehicles. Alternative energy sources.	2
Lec13	Mileage tests for special vehicles. Definition of requirements and verification methods. Arrangement of acquired knowledge. Summary of the course.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Study of basic paragmeters used in terra mechanics to describe soils.	2

Lab2	Investigations into the process of loading the crushed medium with a loader bucket.	2
Lab3	Soil shear resistance tests with the driving element.	2
Lab4	Investigations of the cutting process of compact rocks with various shaped cutters.	2
Lab5	Norm tests on work tool loads and tipping loads of an industrial vehicle.	2
Lab6	Road vehicle resistance tests.	2
Lab7	Testing of dynamic loads on the lifting mechanism of a overhead crane.	2
Lab8	Investigations into the process of digging the crushed medium with an excavator bucket.	2
Lab9	Tracked vehicle resistance tests.	2
Lab10	Testing of steering resistance and torsional stiffness of tire wheels.	2
Lab11	Investigations into the phenomenon of frictional coupling between an elastomer track and a cable.	2
Lab12	Traction tests on a cable vehicle.	2
Lab13	Testing of the multi-purpose wheeled vehicle.	2
Lab14	Turning resistance tests on a wheeled articulated vehicle.	2
Lab15	Driving characteristics of unconventional vehicles.	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	The aim of the project is to develop a drive system for a wheeled or tracked vehicle. The scope of the project includes the calculation of tractive forces, resistance to motion, driving moments, and the preparation of detailed drawings of the selected component. The design may also involve the selection of the boom geometry to maintain the straightness of the tool's movement and a classic or hybrid transmission system. In this case, the resistance to movement during excavation is determined and the individual components are selected. The selection of components should take into account the final efficiency achieved in the operation of the mechanism. 1. discussion of the task to be carried out and definition of the prerequisites; 2. analysis of the Student's literature; 3. proposal by the Student to solve the problem; 4. calculation and selection of components/construction of technical documentation; 5. revising and completing the design; 6. submission of finished project; 7-8 Group presentation of the project.	15
		Total hours: 15

TEACHING TOOLS USED
N1. multimedia presentation N2. laboratory experiment N3. self study - preparation for project class N4. self study - preparation for laboratory class N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01-PEU_W03 PEU_K01-PEU_K03	Written test
P = pozytywna ocena z egzaminu		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03 PEU_K01-PEU_K03	mid-term paper, oral answers, laboratory exercise report
P = pozytywna ocena ze wszystkich ocenionych ćwiczeń laboratoryjnych		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03 PEU_K01-PEU_K03	defending the project, evaluating the calculation part of the project,
P = pozytywnie ocenione wszystkie części składowe projektu		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE 1. Inżynieria maszyn roboczych, K. Pieczonka, OW PWr, 2007 2. Theory of ground vehicles; J. Y. Wong, John Wiley & Sons, New York 3. Tyre and Vehicle Dynamics, H. B. Pacejka, Delft University of Technology 4. Vehicle Dynamisc, Theory and Applicaton, R. N. Jazar, Springer, 2008 5. Automotive Engineering Powertrain, Chassis System and Vehicle Body, A. Crolla, Elsevier, 2009 6. Fundamentals of Vehicle Dynamisc, T. D. Gillespie, Society of Automotive Engeeners, 7. Ciągniki, H. Dajniak, Wydawnictwa Komunikacji i Łączności, 2008 8. Kierowalność i stateczność samochodu, A. Litwinow, WKŁ, 1975 9. Teoria ruchu pojazdu gąsienicowego, Z. Burdziński, WKŁ, 1972 SECONDARY LITERATURE

SUBJECT SUPERVISOR
dr inż. Aleksander Skurjat tel.: 71 320-23-46 email: Aleksander.Skurjat@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Napęd hydrauliczny**
Name of subject in English: **Hydraulic drive systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Konstrukcja maszyn, urządzeń i pojazdów**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI1017**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30	15	
Number of hours of total student workload (CNPS)	60		60	30	
Form of crediting	Examination		Crediting with grade	Crediting with grade	
Group of courses					
Number of ECTS points	2		2	1	
including number of ECTS points for practical (P) classes			2	1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		1.4	0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Students have a basic knowledge of fluid mechanics.
2. Students have a basic knowledge of the construction of hydrostatic drive systems components.
3. Students have a basic knowledge of machine power transmission systems.

SUBJECT OBJECTIVES

C1. Introduce students with the functions of hydraulic elements in hydrostatic systems.
C2. Introduce students with hydraulic drive systems in terms of operation and architecture.
C3. Familiarizing students with the methods of controlling and regulating specific parameters of hydraulic drives and the energy balance of hydrostatic systems.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - As a result of the course a student has the knowledge to describe basic hydraulic systems.
PEU_W02 - As a result of the course a student has the knowledge and ability to explain the principles of designing of hydraulic power systems.
PEU_W03 - As a result of the course a student has the knowledge to characterize the components of hydraulic systems that control the relevant parameters, or regulate them.

II. Relating to skills:
PEU_U01 - As a result of the conducted classes, the student is able to design a hydraulic system with the appropriate control system, conduct technical calculations and based on them, select the proper hydraulic components.
PEU_U02 - As a result of the classes, the student is able to make measurements on hydraulic system components, discuss the results and draw appropriate conclusions.
PEU_U03 - In the results of the course, the student is able to assemble, launch make adjustments to the hydraulic system, analyze the correctness of the operation of hydraulic and electro-hydraulic drive systems.

III. Relating to social competences:
PEU_K01 - A student is able to interact and work in a group during the assembly of hydraulic and electro-hydraulic systems and the preparation of a report.
PEU_K02 - A student can properly plan measurements during the laboratory exercise and plan the execution of the project.
PEU_K03 - A student correctly identifies and solves problems encountered during the assembly of hydraulic and electro-hydraulic systems and the implementation of the project. He draws the appropriate conclusions from the exercises.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, presentation of the content of the course, forms of evaluation and requirements, providing literature on the subject. Features of hydraulic systems.	2
Lec2	Hydrostatic transmission - principle of operation, basic parameters and dependencies.	2
Lec3	Methods of regulating the parameters of the hydraulic energy source and the parameters of the hydrostatic actuators.	4
Lec4	Calculation of the suction system of the hydraulic pump.	2
Lec5	Comparative analysis of multi-pump systems and systems with the main pump with the function of priority power distribution.	2
Lec6	Synchronization of the hydraulic actuators movement speed.	2
Lec7	Functions and examples of the use of hydraulic accumulators in hydrostatic systems.	2
Lec8	Methods of simultaneous control of several hydraulic actuators, sequential, logical and electrohydraulic systems.	2
Lec9	Hydrostatic transmission in drive systems.	2

Lec10	Hydrostatic drive systems of machine work tool systems.	2
Lec11	Hydrostatic braking systems.	2
Lec12	Hydrostatic vehicle steering systems.	2
Lec13	Energy balance and heat energy emission of hydrostatic systems.	2
Lec14	Possibilities of increasing the efficiency of hydrostatic systems, systems with energy recuperation, and architecture of hydrostatic systems in the energy aspect.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Introduction to laboratory, safety regulations, organizational matters.	2
Lab2	Direction control methods in hydraulic systems.	2
Lab3	Pressure valves in hydraulic systems.	2
Lab4	Hydraulic power source unloading methods.	2
Lab5	Pilot operated check valve - safety in hydraulic systems.	2
Lab6	In series throttle – open loop hydraulic acting elements speed control .	2
Lab7	Parallel throttle – open loop hydraulic acting elements speed control .	2
Lab8	Closed loop hydraulic acting elements speed control methods.	2
Lab9	Load sensing hydraulic systems - fixed displacement pump.	2
Lab10	Variable displacement pump - hydraulic characteristics.	2
Lab11	Load sensing hydraulic systems - variable displacement pump.	2
Lab12	Hydraulic flow rectifier.	2
Lab13	Hydraulic accumulators.	2
Lab14	Dynamics of hydraulic systems.	2
Lab15	Final test.	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Introduction to the project. Assignment of project topics.	2
Proj2	Determination of assumed parameters. Design of the hydraulic system structure.	2
Proj3	Preliminary calculations.	2
Proj4	Selection of system components.	2
Proj5	Description of designed hydraulic system, design verification in terms of function, parameters and selected hydraulic components.	2
Proj6	Determination of the final parameters of the designed system, comparison vs preliminary assumptions.	3
Proj7	Final assessment of the project.	2

	Total hours: 15

TEACHING TOOLS USED
N1. informative lecture N2. self study - preparation for laboratory class N3. laboratory experiment N4. self study - preparation for project class N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	exam
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U02, PEU_U03, PEU_K01, PEU_K02	oral answer verifying the practical knowledge acquired during laboratory classes
F2	PEU_U02, PEU_K01, PEU_K02	report on laboratory exercises
F3	PEU_U03, PEU_K01, PEU_K02	student's activity grade
P = 50%F1+35%F2+15%F3		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement

F1	PEU_U01, PEU_K02, PEU_K03	project evaluation
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE Kollek W.: Basics of design of hydraulic drives and control (in polish). Oficyna Wydaw. Polit. Wrocławskiej, 2004 . Szydelski Z.: Hydraulic drive and control (in polish), WKŁ, Warszawa 1999. Stryczek S.: Hydrostatic drive (in polish). WNT, 1992. Osiecki A.: Hydrostatic drive of machines (in polish). WNT, Warszawa 1996. Garbacik A., Szewczyk K.: Hydraulic drive and control. Basics of systems designing (in polish). Skrypt Politechniki Krakowskiej, Kraków 1998. Lambeck R.: Hydraulic pumps and motors. Marcel Dekker INC. New York 1983. Pippenger J.: Hydraulic valves and control. Marcel Dekker INC. New York 1984 SECONDARY LITERATURE Jędrzykiewicz Z.: Design of hydrostatic systems. Basics (in polish). Skrypt 1313. AGH Kraków 1992. Pizoń A.: Hydraulic and electrohydraulic control and regulation system (in polish). WNT, 1987.

SUBJECT SUPERVISOR
dr inż. Tomasz Siwulski tel.: 71 320-28-92 email: tomasz.siwulski@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Silniki spalinowe**
Name of subject in English: **Internal Combustion Engines**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Konstrukcja maszyn, urządzeń i pojazdów**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI1018**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the conservation principle: mass, energy and momentum, and the equation of state of the factor
2. Ability to perform laboratory exercises based on elementary manual skills
3. Awareness of individual and group work and the ability to carry it out

SUBJECT OBJECTIVES

C1. obtaining knowledge on the conversion of energy from chemical to mechanical form in an internal combustion engine
C2. awareness of the design requirements for engines in order to achieve the efficiency of the combustion process
C3. understanding of construction requirements obtained thanks to adequate manufacturing technology

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - has knowledge of chemistry, fluid mechanics and thermodynamics enabling the selection of fuel
PEU_W02 - acquires skills enabling estimation of the charge exchange and the amount of fuel necessary for the combustion process
PEU_W03 - knows the parameters for evaluating the efficiency of a real internal combustion engine

II. Relating to skills:
PEU_U01 - has the ability to perform a dynamometer test of an internal combustion engine
PEU_U02 - has the ability to analyze test results and evaluate thermodynamic parameters
PEU_U03 - has the ability to draw conclusions based on the assessment of specyfik fuel consumption and mechanical efficiency

III. Relating to social competences:
PEU_K01 - understands the need for additional training in the field of drives (powertrains)
PEU_K02 - is aware of the size of the efficiency of energy conversion and the impact on the natural environment
PEU_K03 - is aware of environmental emissions from currently used propulsion systems

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	A history of the industrial age with a detailed description of the development of internal combustion engines	2
Lec2	Classification of internal combustion engines with a description of applications in industries	2
Lec3	Engine fuels	2
Lec4	Thermodynamic cycles, efficiencies and additional performance parameters	2
Lec5	The combustion process in a spark ignition engine	2
Lec6	The combustion process in a self-ignition engine (Diesel)	2
Lec7	Charge exchange loop (breathing)	2
Lec8	Engine characteristics	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Construction of the piston-crank system	2
Lab2	engine timing gear	2
Lab3	Historical injection apparatus	2
Lab4	Common rail fuel systems	2
Lab5	Test bench ISO8178 - descryption and formulas	2
Lab6	Test bench - mesurement	2

Lab7	Specyfic fuel consumption and emission calculation	2
Lab8	fuel cell drive	1
		Total hours: 15

TEACHING TOOLS USED
N1. problem lecture N2. multimedia presentation N3. laboratory experiment N4. calculation exercises N5. problem discussion

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01	test
F2	PEU_W02	test
F3	PEU_W03	test
P = F1+F2+F3		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_K01	report
F2	PEU_U02, PEU_K02	report
F3	PEU_U03, PEU_K03	report
P = F1+F2+F3		

PRIMARY AND SECONDARY LITERATURE
<u>PRIMARY LITERATURE</u> Heywood, J.B. (1988) Internal Combustion Engine Fundamentals, McGraw-Hill, New York. Stone, R. (2005) Introduction to Internal Combustion Engines, SAE International, Warrendale. <u>SECONDARY LITERATURE</u> ISO8178

SUBJECT SUPERVISOR
dr inż. Marcin Tkaczyk tel.: 71 347-79-18 email: Marcin.Tkaczyk@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Modelowanie obciążeń pojazdów samochodowych**
Name of subject in English: **Vehicles Loading Modelling**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Konstrukcja maszyn, urządzeń i pojazdów**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI1020**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. knowledge of the principles of conservation: mass, energy and momentum
2. the ability to work independently with a computer
3. awareness of the need for independent work and the ability to implement it

SUBJECT OBJECTIVES

C1. The concept of the possibility of calculating fields: speed, pressure and temperature based on the laws of conservation rules (energy and momentum) applied with the use of the Finite Volume Method for engineering problems.
C2. Understanding the loads affecting the car vehicle resulting from the vehicle moving in the fluid medium (air) and thermal loads resulting from the presence of heat sources and their impact on the vehicle components.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - He has knowledge of the Finite Volume Method to the extent that allows explaining the application of the integral form of the equations of behavior (mass, energy and momentum) to the selected flow.
PEU_W02 - He can define guidelines on the shaping of car bodies and selected vehicle components depending on the loads they are subjected to

II. Relating to skills:
PEU_U01 - Is able to simulate a selected flow for a motor vehicle or its components.
PEU_U02 - Analyzes simulation results to determine places with maximum load.
PEU_U03 - Based on its own analysis, it is able to design selected components of motor vehicles.

III. Relating to social competences:
PEU_K01 - understands the need and has the possibility of continuous training especially in the field of computer software
PEU_K02 - appreciates the need to raise professional, personal and social competences

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to CFD type calculation systems - definition of terms	2
Lec2	Generalized transport equation - presenting the principles of behavior: mass, energy and momentum (integral form).	2
Lec3	Finite volume method - Turbulence models used.	2
Lec4	Finite Volume Method - presentation of calculation diagrams (explicit, implicit, Cranka-Nicolson).	2
Lec5	Finite Volume Method - applied matrix calculus solutions.	2
Lec6	Types of boundary conditions - mathematical and physical foundations	2
Lec7	Post-processing - Analysis of the speed and pressure field	2
Lec8	Post-processing - Temperature field analysis	1
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Measurement of input values	2
Proj2	Construction of geometry	1
Proj3	Discretization of computing space	1
Proj4	Defining a numerical model	1
Proj5	Definition of boundary conditions and initial conditions	1
Proj6	Carrying out calculations	2

Proj7	Visualization of results	2
Proj8	Analysis of results	1
Proj9	Modernization of the modeled object - change of geometry	1
Proj10	Performing calculations, visualization of results	1
Proj11	Analysis of results and editing of the project report	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - preparation for project class N3. ANSYS Fluent calculation system N4. report preparation N5. project presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01,PEU_W02	test
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03	report
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SECONDARY LITERATURE O. Węgrzyn, Validation of CFD predictions for flow over a full-scale formula student vehicle using PIV in real conditions J.P. Merkel, Development of Multi-element active aerodynamics for the formula student car J. Tu, G-H Yeoh, Ch. Li., Computational Fluid Dynamics A Practical Approach

SUBJECT SUPERVISOR
dr inż. Marcin Tkaczyk tel.: 71 347-79-18 email: Marcin.Tkaczyk@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Uwarunkowania prawne działalności inżyniera**
Name of subject in English: **Legal aspects of engineering activities**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Konstrukcja maszyn, urządzeń i pojazdów**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI1021**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has firm knowledge of fundamentals of machine design, materials science, strength of materials, mechanics and production techniques.
2. Can independently seek information in source texts, catalogues and the Internet.
3. Can read and create mechanical technical documentation.

SUBJECT OBJECTIVES

C1. To gain basic knowledge about legal context of machine manufacturers’ work.
C2. To gain basic knowledge about safety of machine operation.
C3. To gain practical ability to analyze and reduce risk posed by machines.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Has knowledge about basic legal requirements for machine designers.
PEU_W02 - Has basic knowledge about the process of risk reduction.

II. Relating to skills:
PEU_U01 - Can identify risk posed by a machine and propose means of its reduction.
PEU_U02 - Can determine proper norms for given problem.

III. Relating to social competences:
PEU_K01 - Is aware of the threats posed by different types of machines.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to the legal aspects of machine manufacturer's work. Machinery Directive. The role of the designer in the process of risk reduction.	2
Lec2	Harmonized norms of type A, B and C.	2
Lec3	Threats posed by machines – types and identification.	2
Lec4	Risk assessment methods.	2
Lec5	Safety measures used by the designer – design safe in itself.	2
Lec6	Safety measures used by the designer – use of safeguards.	2
Lec7	Safety measures used by the designer – residual risk.	2
Lec8	User instructions – legal requirements.	1
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Presentation of the machine to be analyzed. Definition of requirements for the analyzed machine.	1
Proj2	Development of preliminary concept of machine according to the reuirements. An approach to design machine safe on its own.	4
Proj3	Machine risk assesment.	4
Proj4	Proposal of technical safeguards reducing risk.	4
Proj5	Residual risk assesment.	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. tutorials N3. project presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02	
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01- PEU_U02 PEU_K01	
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SECONDARY LITERATURE

SUBJECT SUPERVISOR
dr inż. Damian Stefanow tel.: 320-27-18 email: damian.stefanow@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Projektowanie elementów z tworzyw sztucznych**
Name of subject in English: **Polymers in Engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Konstrukcja maszyn, urządzeń i pojazdów**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI1022**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	90				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	3				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.8				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge about properties of polymeric materials
2. Basic knowledge about technology of manufacturing plastic elements
3. Basic knowledge about design of machine elements

SUBJECT OBJECTIVES

C1. Acquisitions of skills in applications of plastics for machine elements, taking into account assumptions about working conditions, manufacturing technology, production costs, etc.
C2. Knowledge of issues related to design principles of machine elements made from plastics
C3. Knowledge of issues related to design of plastics element joints

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - The student knows the characteristic properties of plastics and is able to propose a polymeric material for a specific technical application.
PEU_W02 - The student knows the design principles and calculation methods of plastic machine elements.
PEU_W03 - The student knows the methods of joining plastic machine elements

II. Relating to skills:

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Properties of polymeric materials used in machines. Characteristics of mechanical and operational properties of polymeric materials - effect of temperature and time.	2
Lec2	Overview of engineering polymers - properties and technical applications. Polymeric composite materials.	4
Lec3	Modeling of mechanical properties of polymeric materials. Application of models in calculations that take into account viscoelasticity of polymers.	2
Lec4	Design principles for plastic housings and bodies - technology, determining the geometric shape of the product, methods of calculation.	2
Lec5	Methods of joining plastic parts - detachable and non-detachable joints. Joint design, strength calculation methods.	4
Lec6	Friction and wear of plastic machine parts. Plastic plain bearings - calculations and design solutions.	2
Lec7	Plastics gears - design, calculations.	2
Lec8	Use of numerical methods in strength calculations for plastic components	2
Lec9	Polymer materials in bioengineering applications.	2
Lec10	Plastic parts manufactured by 3D printing technology. Design issues.	2
Lec11	Plastics parts of hydraulic equipment - materials selection, design.	2
Lec12	Final test	2
Lec13	Recycling of plastics products. Course summary. Pass grade.	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. problem discussion

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	post-lecture tests (quizzes)
F2	PEU_W01, PEU_W02, PEU_W03	final test
P = 0,1*F1+0,9*F2		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE [1] Gruin I. Materiały polimerowe. Wydawnictwo Naukowe PWN. Warszawa, 2003 [2] Wieleba W. Bezobsługowe łożyska ślizgowe z polimerów termoplastycznych, Oficyna Wydawnicza PWr, Wrocław, 2014. [3] Supporting materials for the lecture - ePortal WUST SECONDARY LITERATURE [1] Łączyński B. Niemetalowe elementy maszyn, WNT, Warszawa 1988. [2] Tutorials and brochures of plastics manufacturers on the websites (links are given at the first lecture) [3] Erhard G.: Designing with Plastics. Hanser Gardner Publications, 2006

SUBJECT SUPERVISOR
Prof. dr hab. inż. Wojciech Wieleba tel.: +4871 320-27-74 email: wojciech.wieleba@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Seminarium dyplomowe**
Name of subject in English: **Diploma seminar**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI1023, W10MBM-SI2027**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					15
Number of hours of total student workload (CNPS)					30
Form of crediting					Crediting with grade
Group of courses					
Number of ECTS points					1
including number of ECTS points for practical (P) classes					1
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)					0.7

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the issues covered by the study program
2. Deficit of ECTS credits not greater than that resulting from the resolution of the Faculty Council

SUBJECT OBJECTIVES

C1. Transfer of knowledge about the requirements for writing an engineering diploma thesis
C2. Acquiring the ability to present one's own work and defend the theses included
C3. Acquisition of the ability to conduct discussions on engineering topics and formulate one's own position

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:
PEU_U01 - Able to prepare a presentation, discuss the purpose and scope of the engineering work and its progress
PEU_U02 - Able to conduct discussions on engineering topics, including presentation of own position
PEU_U03 - Able to formulate the purpose of engineering work and select methods to achieve it

III. Relating to social competences:
PEU_K01 - Understands the need for continuous acquisition of knowledge and professional competence
PEU_K02 - Understands the need for discussions on how to solve engineering problems
PEU_K03 - Has aware of the impact of his decisions on the way companies operate

PROGRAM CONTENT

Form of classes – Seminar		Number of hours
Sem1	Discuss the plan and conduct of the seminar and the schedule of speeches	1
Sem2	Sharing the knowledge on the principles of preparing a presentation and how to conduct it	1
Sem3	Sharing the knowledge about writing an engineering diploma thesis and the course of the diploma exam	2
Sem4	Presentation of own topics of engineering work (substantive discussion)	11
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. tutorials
N3. problem discussion

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01,PEU_U03	Evaluation of preparing and presenting the presentation

F2	PEU_K01, PEU_K02, PEU_U02, PEU_K03	Participation in the discussion
P = F1*0.8+F2*0.2		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE 1. Kowalkowska, A. (2022). Esej naukowy jako trening przed pisaniem pracy dyplomowej. Tutoring Gedanensis, 7 (3) 2. Majchrzak J.:Metodyka pisania prac magisterskich i dyplomowych, Wydawnictwo Uniwersytetu Ekonomicznego, Poznań 2009 2. Brycz B.: Przewodnik dla piszących prace magisterskie w zakresie zarządzania, Polskie Wydawnictwo Ekonomiczne, Warszawa 2011 SECONDARY LITERATURE 1. Wiszniewski A.: Sztuka pisania. Videograf II, Katowice 2003 2. Wiszniewski A.: Sztuka mówienia. Videograf II, Katowice 2003

SUBJECT SUPERVISOR
dr hab. inż. Mirosław Bocian tel.: 320-27-54 email: miroslaw.bocian@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Biomechanika inżynierska**
Name of subject in English: **Biomedical Engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Konstrukcja maszyn, urządzeń i pojazdów**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W10MBM-SI1025**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. He has knowledge of the basics of mechanics and strength of materials.
2. He has knowledge of the basics of materials science.

SUBJECT OBJECTIVES

C1. Mastering the knowledge of modern techniques used to support selected human life functions.
C2. Acquire knowledge of biomaterials used in existing design solutions for implants and artificial organs.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Has knowledge of the mechanical and physical properties of the essential human anatomical elements in terms of the possibility of application of artificial replacements.
PEU_W02 - Has a well-ordered knowledge of the current designs of joint endoprostheses and stabilizers and the principles of their design, taking into account the specific material and strength requirements.

II. Relating to skills:

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Current state and directions of development of medical engineering. The role and function of the engineer in medicine.	2
Lec2	The human body as a complex mechanical system. Biomechanics of the human musculoskeletal system. Load models of the human musculoskeletal system.	2
Lec3	Fundamentals of the strength of tissue materials - biomechanical aspects of overloading of tissue structures.	2
Lec4	Biomaterials, requirements, their mechanical and biophysical properties, modification of implant surfaces. Phenomena at the implant-tissue interface.	2
Lec5	Joint endoprostheses of the lower limbs (hip, knee, ankle) and upper limbs (wrist, elbow, shoulder). Biotribology.	2
Lec6	Implants and systems for stabilizing spinal injuries. Intervertebral disc prosthesis.	2
Lec7	External and internal stabilizers of long bones. Scaffolds as bone tissue support scaffolds.	2
Lec8	Colloquium/credit	1
		Total hours: 15

TEACHING TOOLS USED

N1. informative lecture
N2. multimedia presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02	Colloquium/credit
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SECONDARY LITERATURE

SUBJECT SUPERVISOR
Prof. dr hab. inż. Celina Pezowicz tel.: 71 320-27-13 email: Celina.Pezowicz@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Technika w medycynie**
Name of subject in English: **Technique in Medicine**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Konstrukcja maszyn, urządzeń i pojazdów**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W10MBM-SI1026**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of mechanics and strength of materials.
2. Knowledge of the basics of mechanical design.
3. Knowledge of powertrain.

SUBJECT OBJECTIVES

C1. Discussion of the construction and operation principles of devices and systems supporting surgical procedures and operations.
C2. Discussion of the construction and operation principles of selected artificial organs and controlling their work.
C3. Presentation of technical means supporting human locomotion.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - It formulates and explains the requirements for devices supporting human functioning and robots and manipulators intended for medical applications.
PEU_W02 - Know the principles of selecting technical solutions supporting the functioning of human organs and systems.

II. Relating to skills:

III. Relating to social competences:
PEU_K01 - Is aware of the importance and understands the non-technical aspects and effects of the engineer's activity and understands the related responsibility for the decisions made.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Assisting the locomotion of the disabled: wheelchairs, wheelchairs with verticalization function, exoskeletons. Standards for the design of means of transport for the disabled, drive systems and control methods, directions for the development of structures supporting the mobility of the disabled.	2
Lec2	Upper and lower limb prostheses; functions, classification, discussion of prosthesis construction solutions, drive systems in prostheses, bionic prostheses.	2
Lec3	Technical means used in the rehabilitation of the osteoarticular and muscular systems, devices for active and passive rehabilitation of limbs, standers and parapodia, exoskeletons and rehabilitation systems using biofeedback.	2
Lec4	Manipulators and medical robots, design solutions used in medical manipulators, tools for laparoscopic operations, directions of telemedicine development.	2
Lec5	Navigation systems in the operating room, purpose, classification, principle of operation of optical and magnetic navigation, examples of design solutions for mechanical elements of navigation systems, examples of application in clinical practice.	2
Lec6	Imaging in medicine, construction and operation principle of computer tomographs, types of construction, scope of application, magnetic resonance imaging, intravascular ultrasonography, algorithms forreconstruction of threedimensional images of internal organs.	2
Lec7	Technical support of the circulatory system: artificial heart, construction idea, applied solutions, materials, control, cardiac pacemakers, extracorporeal circulation systems, technique of minimally invasive vascular angioplasty; vascular stents, stent grafts, structure, principle of operation, applied design solutions.	2
Lec8	Final test	1
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_K01	Final test
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE 1) Inżynieria Biomedyczna - podstawy i zastosowania (tomy: I - X); red. Władysław Torbicz, Akademicka Oficyna Wydawnicza EXIT, Warszawa 2013 SECONDARY LITERATURE e-resources of the WUST Library

SUBJECT SUPERVISOR
dr hab. inż. Jarosław Filipiak tel.: 71 320-21-50 email: jaroslaw.filipiak@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Projektowanie procesów wytwarzania - obróbka bezubytkowa I**
Name of subject in English: **Design of manufacturing techniques 1 - chipless forming**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Technologie i systemy wytwórcze**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI2013**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	
Number of hours of total student workload (CNPS)				30	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Ability to read and develop a technical drawing
2. Knowledge of manufacturing techniques in the field of plastic forming
3. Knowledge of the construction and capabilities of basic technological machines in the area of chipless forming

SUBJECT OBJECTIVES

C1. Acquisition of knowledge about designing technological processes in the field of plastic forming
C2. Acquisition of knowledge about designing technological equipment in the processes of chipless forming
C3. Acquisition of skills of economic analysis of the choice of material and technological methods

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:
PEU_U01 - Can use the theoretical knowledge in the field of plastic forming and apply it in practice
PEU_U02 - Can search for information on plastic forming and execute their critical analysis
PEU_U03 - Can properly select data to develop a technological process

III. Relating to social competences:
PEU_K01 - Acquires teamwork abilities
PEU_K02 - Can think and act in a creative way
PEU_K03 - Understands the responsibility of the engineers profession

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction to the course. Discussion of the design task related to plastic forming	1
Proj2	Preparation of a drawing of the finished product. Analysis of the processability of the object's construction in terms of plastic processing	2
Proj3	Determining the shape and dimensions of the starting material (semi-finished product). Development of the concept of the technological process	2
Proj4	Selection of tooling, machines and the way of placing and removing material	2
Proj5	Determination of technical standardization of working time in particular stages of plastic processing	2
Proj6	Calculations and drawings. Development of technological documentation	2
Proj7	Organization of the technological process. Organization of technical control	2
Proj8	Proofing, discussion and acceptance of the project. Final evaluation of the project	2
		Total hours: 15

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. tutorials
N3. project presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02, PEU_K03	Project presentation. Defence of the project
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Gronostajski J., Plastic processing of metals, Wrocław 1974
[2] Dobrzański L., Basics of shaping the structure and properties of metallic materials, Gliwice 2007.
[3] Romanowski P., Guide of plastic processing, Warszawa 1976

SECONDARY LITERATURE

[4] Dobrzański T., Machine technical drawing, Warszawa 2008

SUBJECT SUPERVISOR
dr inż. Karol Jaśkiewicz tel.: 21-72 email: karol.jaskiewicz@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Komputerowa symulacja procesów odlewania**
Name of subject in English: **Computer simulation of casting processes**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Technologie i systemy wytwórcze**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI2014**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of geometric modeling and CAD systems. Demonstrates basic knowledge of manufacturing techniques in the preparation and melting of liquid metal and in the area of casting tooling and casting mold technology.
2. He is able to make a 3D model in CAD environment and knows the basics of process design. Has the ability to select and critically analyze the selected casting technology and basic parameters of the process
3. Can read and interpret the figures and diagrams used in the technical documentation.

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge of casting process design based on environment
3D computer aided design environment
C2. Ability to design the casting process of a simple component. Ability to modify the design of the mold and casting due to the technological nature of the design.
C3. Acquiring the ability to find and use information - effectively solving problems and finding remedies

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Knows the principles of sand mold and casting construction. Knows the principles of geometry construction and model discretization and partitioning into groups in the Flow-3D program
PEU_W02 - Has knowledge of modeling the process of liquid metal flow in a mold and solidification of a casting in Flow-3D software
PEU_W03 - Knows the causes of defects in castings, their types and methods of eliminating them. Knows the principles of designing overflows, overflows and venting systems

II. Relating to skills:
PEU_U01 - Acquired the ability to design casting molds, simulate the mold pouring process and simulate casting solidification in a 3D computer-aided design environment
PEU_U02 - Acquired skills in analyzing casting simulation results and selecting process parameters and modifying mold design to eliminate defects in castings
PEU_U03 - Acquired the ability to use the Flow-3D program to a basic extent

III. Relating to social competences:
PEU_K01 - Can search for information and critically analyze them, rationally explain them and justify the own point of view using the knowledge of foundry branch.
PEU_K02 - Recognizes the importance of team cooperation on ways to choose a strategy to optimally solve problems assigned to a student's group.
PEU_K03 - Understands the need to respect the traditions and rules in academia and society.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Introduction, basic concepts. Discussion of foundry process simulation programs.	1
Lec2	Discuss the principles of casting mold design in the Flow-3D environment. Technologicality of casting design - selection of concepts.	2
Lec3	Discussion of the principles of mold geometry construction in Flow-3D software. Geometry management and discussion of its discretization methods.	2
Lec4	Discussion of boundary conditions established during modeling of casting processes. Characterization of coefficients.	2

Lec5	Methods for modeling the flow of liquid metal and the process of filling the mold With liquid metal.	2
Lec6	Modeling the solidification process of liquid metal in a casting mold.	2
Lec7	Interpretation of casting solidification simulation results. Analysis of the course of the casting solidification process, kinetics of heat transfer in the casting-mold system. Determination of the direction of solidification and establishment of thermal junctions.	2
Lec8	Principles of casting mold design modification: design of overflows, overflows, venting systems based on simulation results. Development of documentation. Credit colloquium.	2
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Organizational matters. Discussion of the structure of the Flow-3D program. Distribution of projects	1
Proj2	Construction of casting mold geometry in CAD environment and import into Flow3D	2
Proj3	Determination of boundary conditions. Discretization of the casting mold model.	2
Proj4	Simulation, visualization and analysis of the process of filling a mold with liquid metal	2
Proj5	Simulation, visualization and analysis of the casting solidification and cooling process	2
Proj6	Identification of thermal junctions, porosity, surface defects in castings. Analysis of the causes of defects in castings based on the results of simulations.	2
Proj7	Elimination of defects in castings by modifying the design of the casting mold: design of overflows, overflows, venting systems.	2
Proj8	Analysis of results, preparation of documentation. Presentation and sentence of projects	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - preparation for project class N3. project presentation N4. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01-PEU_W03, PEU_K01-PEU_K03	colloquium
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03, PEU_K01-PEU_K03	oral replies
F2	PEU_U01-PEU_U03, PEU_K01-PEU_K03	report, presentation of the project
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Perzyk M., Waszkiewicz St., Kaczorowski M.i: Odlewnictwo, WNT, 2009;
2. Perzyk M.: Materiały do projektowania procesów odlewniczych, Warszawa 1981;
3. Longa W.: Krzepnięcie odlewów w formach piaskowych. Katowice, 1973;
4. Tabor A., Rączka J., S.: Projektowanie odlewów i technologii form, Wydawnictwo Fotobit, Kraków 1998;

SECONDARY LITERATURE
1. Poradnik inżyniera - Odlewnictwo, Warszawa, 1986;
2. www.flow3d.com

SUBJECT SUPERVISOR

dr inż. Adam Kurzawa tel.: 42-35 email: adam.kurzawa@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Technologie spajania**
Name of subject in English: **Joining technology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Technologie i systemy wytwórcze**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI2015**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student knows the types of welds, welding positions, can mark welds on a technical drawing, knows the fundamental welding methods and process parameters, and has knowledge of the basics and applications of soldering and brazing, pressure welding as well as thermal cutting methods.
2. Student is able to select the appropriate joining technology adn thermal cutting technology as well as determine the fundamental process parameters.
3. Student has knowledge about the structures and properties of metallic engineering materials, knows the principles of their classification and marking, and has basic knowledge about heat treatment and thermo-mechanical treatment.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge about the methods of designing and joining structures manufactured of various materials
C2. Achievement the ability to develop joining technology
C3. Searching for information and the ability to critically analyze

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Student has knowledge about the manufacturing of various welded structures
PEU_W02 - Student knows the technologies of welding, pressure welding, soldering, brazing and adhesive bonding of ferrous alloys, non-ferrous metals and their alloys, plastics and ceramics
PEU_W03 - Student has knowledge of the use of welding, pressure welding, soldering, brazing and adhesive bonding according to ferrous alloys, non-ferrous metals and their alloys, plastics and ceramics

II. Relating to skills:
PEU_U01 - Student is able to choose the appropriate joining technology
PEU_U02 - Student is able to select the appropriate welding, soldering, brazing, pressure welding and adhesive bonding parameters
PEU_U03 - Student is able to design the process of joining various types of structures

III. Relating to social competences:
PEU_K01 - Student adheres to the rules of team cooperation regarding the improvement of methods of choosing a strategy aimed at optimal solving of the problems entrusted to the group
PEU_K02 - Student is able to objectively evaluate arguments, rationally explain and justify his own point of view using knowledge in the field of bonding engineering
PEU_K03 - Student observes the customs and rules in force in the academic environment

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	The introduction to the issues of welding engineering and a reminder of the basic knowledge in the field of welding.	2
Lec2	The fundamentals of materials science in welding technologies.	2
Lec3	The heat treatment of welded joints	2
Lec4	The coatings deposition by welding methods	2
Lec5	The fundamentals of electrical engineering and selection of welding arc power supplies	2
Lec6	The welding technology of the low-carbon and low-alloy steels	2
Lec7	The welding technology of the high-alloy steels	2
Lec8	The welding technology of the cast steels	2

Lec9	The welding technology of the cast irons	2
Lec10	The methods of the destructive testing of welded joints	2
Lec11	The welding technology of non-ferrous metals and their alloys, part 1: aluminum and copper	2
Lec12	The welding technology of non-ferrous metals and their alloys, part 2: titanium, nickel and magnesium	2
Lec13	The joining technology of the plastic and ceramic materials	2
Lec14	The designing of welded structures, part 1	2
Lec15	The designing of welded structures, part 2 and summary of the content provided during the lectures	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Organization of classes, conditions of passing and health and safety regulations for welding works	1
Lab2	Selection of welding parameters in the manual metal arc welding method	2
Lab3	Selection of welding parameters in the gas metal arc welding and gas tungsten arc welding methods	2
Lab4	Determination of the preheating temperature before welding steel	2
Lab5	Selection of filler materials for welding high-alloy steels	2
Lab6	Selection of pressure welding parameters and assessment of the joints quality	2
Lab7	The advanced soldering and brazing technologies	2
Lab8	The adhesive bonding of fundamental engineering materials	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - preparation for laboratory class N3. report preparation N4. self study - self studies and preparation for examination N5. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement

F1	PEU_W01, PEU_W02, PEU_W03,	colloquium
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02	test, report
P = średnia z F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE 1. Pilarczyk J., Pilarczyk J.: Spawanie i napawanie elektryczne metali, Wyd. Śląsk, Katowice 1996 2. Ferenc K., Spawalnictwo, WNT, Warszawa, 2007 3. Tasak E., Metalurgia spawania, Wydawnictwo JAK, Kraków, 2008 4. Klimpel A., Spawanie, zgrzewanie i cięcie metali. Technologie, WNT, Warszawa, 2009 SECONDARY LITERATURE 1. Pilarczyk J. (ed.), Poradnik inżyniera. Spawalnictwo. T1, WNT, Warszawa, 2017 2. Pilarczyk J. (ed.), Poradnik inżyniera. Spawalnictwo. T2, WNT, Warszawa, 2017 3. Parameters of welding processes standards 4. Welding standards

SUBJECT SUPERVISOR
dr hab. inż. Leszek Łatka tel.: 071-320-21-38 email: leszek.latka@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Projektowanie procesów wytwarzania - obróbka bezubytkowa II**
Name of subject in English: **Design of manufacturing techniques - chipless forming 2**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Technologie i systemy wytwórcze**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI2016**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				90	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				3	
including number of ECTS points for practical (P) classes				3	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				2.1	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has the ability to read and develop a technical drawing
2. Student has knowledge about the manufacturing techniques in the field of foundry and welding
3. Student has knowledge of the construction and capabilities of basic technological machines in the area of the chipless forming

SUBJECT OBJECTIVES

C1. Acquisition of knowledge on the conduct during the design of technological processes in the field of foundry and welding
C2. Acquisition of knowledge in the field of designing technological instrumentation in chipless forming processes
C3. Acquisition of knowledge on the assessment of the construction's manufacturability and economic analysis of the choice of material and technological methods

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:

PEU_U01 - Student is able to obtain information from literature, databases, technical standards and other sources, and to integrate the obtained information, interpret it, and draw conclusions.
PEU_U02 - Student is able to search for information on foundry and welding and carry out their critical analysis. He can also read and interpret drawings and diagrams used in technical documentation and prepare technical documentation.
PEU_U03 - Student is able to apply engineering software and select and design appropriate manufacturing technologies for specific groups of products.

III. Relating to social competences:

PEU_K01 - Student acquires teamwork skills
PEU_K02 - Student is able to think and act creatively
PEU_K03 - Student understands the responsibility associated with the profession of an engineer

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction to the class. Discussion of the casting project assignment.	2
Proj2	Principles of technologically correct construction of castings. Selection of the concept. Determination of the parting line.	2
Proj3	Magnitudes considered in the manufacture of casting tooling.	2
Proj4	Design and calculation of the gating system. Development of raw casting drawing.	2
Proj5	Design of casting models. Development of model and core drawing.	2
Proj6	Selection of molding sand, core sand, sub-model plate and molding boxes.	2
Proj7	Development of an assembly drawing of a casting mold. Compilation of documentation - calculations and drawings. Development of a technological card.	2
Proj8	Checking, discussion and acceptance of the project.	2
Proj9	Discussion of the welding design task. Analysis of the processability of the structure in terms of welding.	2
Proj10	Determination of the weldability of the materials used for the construction. Division of the structure into technological components.	2
Proj11	Selection of welding methods, consumables and welding equipment. Determination of weld quality requirements and selection of the method of their control.	2
Proj12	Preparation of the idea of technological set-up	2

Proj13	Determination of requirements for welding personnel performing and supervising welding works and selection of welding equipment.	2
Proj14	Preparation of drawing documentation and technological instructions for pWPS welding.	2
Proj15	Checking, discussion and acceptance of the project	2
		Total hours: 30

TEACHING TOOLS USED
N1. self study - preparation for project class N2. tutorials N3. project presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02, PEU_K03	Foundry project presentation. Defence of the foundry project.
F2	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02, PEU_K03	Welding project presentation. Defence of the welding project.
P = (F1+F2/2		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE 1. Chorzępa St., Projektowanie procesów technologicznych, cz. I Odlewnictwo, Oficyna Wydawnicza Politechniki Wrocławskiej, 1982 2. Błaszkowski K., Technologia formy i rdzenia, Państwowe Wydawnictwa Szkolnictwa Zawodowego, Warszawa, 1990 3. Perzyk M. i inni, Materiały do projektowania procesów odlewniczych, PWN, Warszawa, 1990 4. Pilarczyk J. (ed.), Poradnik inżyniera. Spawalnictwo. T1, WNT, Warszawa, 2017 5. Pilarczyk J. (ed.), Poradnik inżyniera. Spawalnictwo. T2, WNT, Warszawa, 2017 6. Ferenc K., Ferenc J., Konstrukcje spawane: połączenia, WNT, Warszawa, 2006 7. Słania J., Plany spawania – teoria i praktyka, Wydawnictwo SIMP, Warszawa, 2013 SECONDARY LITERATURE 1. Perzyk M i inni, Odlewnictwo, WNT, Warszawa, 2012 2. Holtzer M., Procesy metalurgiczne i odlewnicze stopów żelaza, PWN, Warszawa, 2013 3. Klimpel A., Spawanie, zgrzewanie i cięcie metali, WNT Warszawa, 2009

SUBJECT SUPERVISOR
dr hab. inż. Leszek Łatka tel.: 071-320-21-38 email: leszek.latka@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Komputerowa symulacja procesów kształtowania plastycznego**
Name of subject in English: **Computer simulation of plastic forming processes**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Technologie i systemy wytwórcze**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI2017**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic understanding of the processes and machinery for plastic forming.
2. It has a basic understanding of the foundations of the theory of finite element methods.
3. It has a basic understanding of the strength of materials, mechanics and the theory of machines and mechanisms.

SUBJECT OBJECTIVES

C1. To gain insight into the field of modern engineering tools for analysis and optimization of plastic forming processes.
C2. To gain basic knowledge and skills to build mathematical models of forming processes.
C3. To know the influence of the process parameters on the forming forces.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - It knows the construction of mathematical models of plastic forming processes.
PEU_W02 - It has a basic knowledge of the possible applications of the finite element method to the process analysis and optimization of forming processes.
PEU_W03 - It knows the basic relationships between material properties and parameters of forming process.

II. Relating to skills:
PEU_U01 - It gain the skills necessary to build mathematical models of plastic forming processes.
PEU_U02 - Is able to perform the calculation and initial optimization of the plastic forming process.
PEU_U03 - Is able to identify which of the process parameters significantly affect the forming forces.

III. Relating to social competences:
PEU_K01 - It acquires beliefs about the responsibility for the work.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Plastic forming - types of processes, the basic process parameters.	3
Lec2	Fundamentals of plastic deformation.	2
Lec3	Models of materials, stress-strain curves, yield criterion.	2
Lec4	Modelling of bulk metal forming processes - rolling, forging.	2
Lec5	Modelling of bulk metal forming processes - extrusion, drawing.	2
Lec6	Modelling of sheet metal forming.	4
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Introduction to computer simulation of the plastic forming processes in the computing environment.	3
Proj2	Modelling of selected examples of plastic forming processes.	2
Proj3	Analysis and determination of the influence of process parameters on the forming forces (friction, temperature, speed).	2
Proj4	Preparation of design assumptions for the selected item shaped by forming processes.	2
Proj5	Development of computational models in the FEM program for selected process.	2
Proj6	Making calculations for the various process parameters and/or the geometry of the process.	4
		Total hours: 15

TEACHING TOOLS USED
N1. multimedia presentation N2. problem exercises N3. self study - preparation for project class N4. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	final test
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01	project rating
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Joseph R. Davis: Metals handbook. Vol. 14, Forming and forging ASM International Handbook Committee.
Altan, Taylan; Tekkaya, A. Erman: Sheet Metal Forming - Processes and Applications, ASM International.
Hosford, William F.; Caddell, Robert M.: Metal Forming - Mechanics and Metallurgy, Cambridge University Press

SECONDARY LITERATURE
Pater Z., Samołyk G.: „Podstawy technologii obróbki plastycznej metali” Politechnika Lubelska Lublin 2013
Gronostajski Z.: Badania stosowane w zaawansowanych procesach kształtowania plastycznego. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2003
Morawiecki M., Sadok L., Wosiek E.: Przeróbka plastyczna- podstawy teoretyczne. Wydawnictwo Śląsk 1986
Gabryszewski Z., Gronostajski J.: Mechanika procesów obróbki plastycznej, PWN, Warszawa 1991

SUBJECT SUPERVISOR
dr inż. Sławomir Polak tel.: 21-72 email: slawomir.polak@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Narzędzia skrawające**
Name of subject in English: **Cutting tools**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Technologie i systemy wytwórcze**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI2018**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic knowledge of manufacturing in machining.
2. He has skills in measurement methods, techniques for measuring and evaluating the results of measurement.
3. Can obtain information from literature, databases and other sources, and to draw conclusions and formulate and justify opinions.

SUBJECT OBJECTIVES

C1. Expanding knowledge of modern cutting tools, cutting edge geometry, tools materials and coatings used on the cutting
edge.
C2. Knowing the rules of proper tool selection, due to working conditions, treatment efficiency and manufacturing costs.
C3. Gaining knowledge of wear and regeneration blunted cutting tools.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Student is able to correctly classify cutting tools, know their structure and geometry.
PEU_W02 - Student can choose the modern technological processes cutting tools due to the efficiency and cost of production.
PEU_W03 - The student is able to explain the physical and chemical phenomena occurring at the cutting edge during machining.

II. Relating to skills:
PEU_U01 - Students can choose the tool materials due to optimal cutting.
PEU_U02 - Student can determine what is the influence of cutting edge geometry on the effects of machining technology.
PEU_U03 - Students should be able to use the computer programs used for the selection of tools set machining conditions.

III. Relating to social competences:
PEU_K01 - Is aware of the importance of behavior in a professional way, well-defined and resolve dilemmas.
PEU_K02 - Recognize the effects of the impact of technology on the environment and related social responsibility of science and technology.
PEU_K03 - Is aware of the necessity of individual and group activities that go beyond the activities of engineering.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	The role of cutting tools and technological equipment in the production of machine parts	2
Lec2	Tool materials, anti-wear coatings and methods of their selection depending on machining conditions	2
Lec3	The geometry of the cutting edge. Reference systems and dimensioning of the blade. The role and importance of the angles of the blades in the cutting process.	2
Lec4	Construction of folding, combined and modular tools. Possibilities of using vibration dampers in cutting tools.	2
Lec5	Characteristics and application of tools	2
Lec6	Cutters and cutter heads. Thread Tools and gears	2
Lec7	Modular and multifunction tool	2
Lec8	Colloquium	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Measurement and tool setting in flexible production system	2
Lab2	Regeneration of cutting tools	2

Lab3	Turning with inserts WIPER type.	2
Lab4	Mechatronic tools with compensation of elastic deformations of the OUPN system	2
Lab5	The choice of cutting tools with the use of computer programs	2
Lab6	Analysis and evaluation of the topography of coated diamond tools	2
Lab7	Machinability determination for choosen tools	2
Lab8	Grading	1
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - preparation for laboratory class N3. report preparation N4. self study - self studies and preparation for examination N5. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	Colloquium
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03 PEU_K01, PEU_K02, PEU_K03	report on laboratory exercises
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE Piotr Cichosz: Narzędzia skrawające, WNT , 2006 Piotr Cichosz: Sterowane i mechatroniczne narzędzia skrawające, PWN , 2016 SECONDARY LITERATURE Piotr Cichosz: Nowoczesne procesy obróbki skrawaniem, PWN , 2022

SUBJECT SUPERVISOR
dr inż. Marek Kołodziej tel.: 41-81 email: marek.kolodziej@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Planowanie wytwarzania CAD/CAM**
Name of subject in English: **Manufacturing planning CAD/CAM**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Technologie i systemy wytwórcze**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI2019**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			30	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of geometric modeling in CAD 3D systems.
2. Fundamentals on technology designing.
3. Basic knowledge about numerically controlled machine tools.

SUBJECT OBJECTIVES

C1. Gaining knowledge in the field of technology design for CNC machine tools using CAD/CAM systems.
C2. Presentation of modern tools supporting manufacturing. CAD/CAM systems integration.
C3. Discussion of issues related to project management in the field of structural design and technology.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - The student is able to characterize modern IT solutions supporting structural and technological design.
PEU_W02 - The student is able to describe the process of designing technological machining processes in the CAD /CAM system.
PEU_W03 - The student has knowledge about the selection, integration and implementation of CAD/CAM systems in enterprises.

II. Relating to skills:
PEU_U01 - The student should be able to analyze parts taking into account that will be manufactured on CNC machine tools. Analysis of the structure manufacturability.
PEU_U02 - The student should be able to prepare geometric data necessary to carry out project work.
PEU_U03 - The student should be able to develop a technological process for a CNC machine tool using selected CAD/CAM systems.

III. Relating to social competences:
PEU_K01 - Ability to work in a project team.
PEU_K02 - Ability to critically evaluate the results and their impact on the functioning of the company.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to CAD/CAM. A review of available systems.	3
Lec2	Integration of CAD/CAM systems.	2
Lec3	Project management in an environment of CAD/CAM system. Relationship between documents. Data exchange between CAD/CAM systems.	2
Lec4	OSN programming methods. Technological design in CAM systems. Stages and performed tasks.	2
Lec5	Processes verification through computer simulation. Virtual Machining.	2
Lec6	Discussion of selected functions of CAM systems.	2
Lec7	Final test.	2
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Introduction. Presentation of the selected environment of CAD/CAM system.	2
Proj2	Solid modeling in a CAD system. Preparation of exemplary geometric models needed to plan machining in the CAM system.	6
Proj3	Technological design in the CAM system - milling module. 2.5D machining.	8
Proj4	Project management. Processes verification through computer simulation. G-code generation.	4

Proj5	Technological design in the CAM system - milling module. 3D machining in 3 axis.	4
Proj6	Technological design in the CAM system - milling module. Multi-axis machining. Technological design in the CAM system - turning module.	4
Proj7	Crediting.	2
		Total hours: 30

TEACHING TOOLS USED
N1. multimedia presentation N2. self study - preparation for project class N3. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03, PEU_K01, PEU_K02	final test
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02	Evaluation of a project
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE Grzesik, Wit., Programowanie obrabiarek NC/CNC / Warszawa: Wydawnictwa Naukowo-Techniczne, 2010. Honczarenko, Jerzy., Obrabiarki sterowane numerycznie / Warszawa : Wydawnictwa Naukowo-Techniczne, 2008. SECONDARY LITERATURE Augustyn, Krzysztof. NX CAM: programowanie ścieżek dla obrabiarek CNC / Gliwice : Helion, 2010. Kacprzyk, Zbigniew. Komputerowe wspomaganie projektowania : podstawy i przykłady / Warszawa: Oficyna Wydawnicza Politechniki Warszawskiej, 2012.

SUBJECT SUPERVISOR
dr inż. Jacek Czajka tel.: 31-37 email: jacek.czajka@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Projektowanie procesów technologicznych**
Name of subject in English: **Technological designe processes**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Technologie i systemy wytwórcze**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI2020**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			30	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Ability to read and develop a technical drawing at a basic level.
2. Basic knowledge about possibility of manufacturing various machine parts (casting, plastic forming, bonding, machining).
3. Knowledge about construction and capabilities of basic technological machines.

SUBJECT OBJECTIVES

C1. Acquiring of knowledge about technological documentation and determinants of technical documentation range.
C2. Acquiring of producibility analysis ability.
C3. Acquiring of knowledge about proper manufacturing technology matching for production size and work piece shape.
C4. Acquiring knowledge about proper order of operations in the process.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Selects the correct type of working piece (casting, forging, welded, plastics or rolled profile) due to: the type of material, the size of production, the complexity of the finished product, and so on.
PEU_W02 - Possesion of knowledge of the develope of technological process of elements like body and axially symmetric. Knows the basic rules for determining and fixing the workpiece on the machine.
PEU_W03 - Possesion of knowledge of the capabilities and limitations of the use of different processing technologies.

II. Relating to skills:
PEU_U01 - Skill in selecting the proper process execution semi-fabricated product (casting, forging, plastic working) depending on: the type of material, size, production, etc.
PEU_U02 - Skill in improve the producibility, in order to enable or simplify the processing.
PEU_U03 - Skill in choose the appropriate cutting tool and machining parameters calculated on the basis of catalog data and dimensions of the workpiece.

III. Relating to social competences:
PEU_K01 - Searching for commercial information about materials that may facilitate the development of technological process.
PEU_K02 - Presentation of proposals of technological process. Ability to communicate.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Information on the manufacturing process. Phases of development and product life. The general structure of manufacturing, operations and procedures. Method of processing.	2
Lec2	Development of technological process, producibility and type of production.	2
Lec3	Selection of materials and semi-finished products, producibility.	2
Lec4	Basing on processing and obtained accuracy.	2
Lec5	Heat treatment in the technological process.	2
Lec6	Examples of machining selected surface shapes.	2
Lec7	Standardization of working time.	2
Lec8	Final test.	1
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Discussion of the course, edition of topics.	2
Proj2	Updating a technical drawings of objects in current standards, the definition of production type.	2
Proj3	Calculating the semi-finished products on account of technological limitations.	2

Proj4	Realization of the project of semifinished product.	2
Proj5	Realization of semi-products documentation.	2
Proj6	Development a framework of technological process for specific parts.	2
Proj7	Filling the technological cards.	2
Proj8	Developing instruction of machining.	2
Proj9	The selection of tools and cutting parameters.	2
Proj10	Selection and characterization of machine tools.	2
Proj11	The calculation of the treatments time execution.	2
Proj12	The calculation of cycle times, auxiliary times and setuptimes.	2
Proj13	Organization of the technological process.	2
Proj14	Summary and verification of the developed project.	2
Proj15	Presentation of completed projects.	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - preparation for project class N3. tutorials N4. project presentation N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	Written test.
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement

F1	PEU_U01, PEU_U02, PEU_U03	Assessment of realised project.
F2	PEU_U01, PEU_U02, PEU_U03,	Defense of realised project.
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE 1. Feld M.: Podstawy projektowania procesów technologicznych typowych części maszyn, WNT Warszawa 2003. 2. Choroszy B.: Technologia maszyn, Oficyna Wydawnicza PWr, Wrocław 2000. SECONDARY LITERATURE 1. Helmi A. Youssef, Hassan El-Hofy: Machining technology Machine Tools and Operations, 2008 by Taylor & Francis Group.

SUBJECT SUPERVISOR
dr inż. Andrzej Roszkowski tel.: (71) 320 2781 email: andrzej.roszkowski@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Technologia i materiały stosowane w wytwarzaniu konstrukcji lekkich**
Name of subject in English: **Technology and materials used in the manufacturing of lightweight structures**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Technologie i systemy wytwórcze**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI2021**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15	15	
Number of hours of total student workload (CNPS)	30		30	30	
Form of crediting	Crediting with grade		Crediting with grade	Crediting with grade	
Group of courses					
Number of ECTS points	1		1	1	
including number of ECTS points for practical (P) classes			1	1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6		0.7	0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of materials science
2. Fundamentals of mechanics
3. Fundamentals of manufacturing technology

SUBJECT OBJECTIVES

C1. Understanding the properties of lightweight materials
C2. Understanding the technology of manufacturing light materials
C3. Designing a manufacturing technology for a selected element of lightweight construction

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Distinguish lightweight materials
PEU_W02 - Choose technology for a given product
PEU_W03 - Describe the manufacturing technology of a given product

II. Relating to skills:
PEU_U01 - Present the methods of obtaining light materials
PEU_U02 - Carry out research on the properties of lightweight materials
PEU_U03 - Develop a technological process

III. Relating to social competences:
PEU_K01 - Environment protection

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Lightweight structures - idea, types	2
Lec2	Properties of light metals and their alloys	2
Lec3	Manufacture of lightweight materials	2
Lec4	Manufacturing and forming of magnesium and its alloys	2
Lec5	Manufacturing and forming of aluminum and its alloys	2
Lec6	Manufacturing and forming of titanium and its alloys	2
Lec7	Composites	3
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Organizational classes - introduction and discussion of the rules concerning laboratory classes	1
Lab2	Determination of mechanical and technological properties of light alloys. Influence of heat treatment on their properties	2
Lab3	Foam aluminum casting part 1	2
Lab4	Foam aluminum casting part 2	2
Lab5	Microforming of titanium alloys	2
Lab6	Production of lightweight construction elements in metal forming processes	2
Lab7	Fabrication of lightweight constructions using casting methods	2
Lab8	Testing the energy consumption of light alloy structures	2
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Introduction to classes. Discussion of the project task	1
Proj2	Making a drawing of a selected structural element. Analysis of the technology and construction of the object. Determination of the strength properties of the analyzed element made of conventional HSS steels	2
Proj3	Overview and comparison of construction materials - properties and applications. Light construction materials. High-strength construction materials from the AHSS group	2
Proj4	Redesign of the selected structural element, taking into account: weight reduction, functional properties, mechanical and physical properties	2
Proj5	Strength calculations	2
Proj6	Selection of the manufacturing method from plastic forming processes enabling the production of the selected element	2
Proj7	Project analysis and verification	2
Proj8	Checking, discussing and accepting the project. Final evaluation of the course	2
		Total hours: 15

TEACHING TOOLS USED
N1. self study - self studies and preparation for examination N2. traditional lecture with the use of transparencies and slides N3. tutorials N4. project presentation N5. report preparation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	test
P = P		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03	raport, short test
P = P		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03	Project defense
P = P		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SECONDARY LITERATURE

SUBJECT SUPERVISOR
Prof. dr hab. inż. Zbigniew Gronostajski tel.: 21-73 email: zbigniew.gronostajski@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Utrzymanie ruchu maszyn i urządzeń wytwórczych**
Name of subject in English: **Maintenance of machinery and manufacturing equipment**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Technologie i systemy wytwórcze**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI2023**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of the construction and operation of machine elements and assemblies and the principles of their selection and construction.
2. Has basic knowledge in the field of operation, reliability and safety of machines.
3. He has a solid knowledge of basic manufacturing techniques and the role of technological machines.

SUBJECT OBJECTIVES

C1. Getting acquainted with principles of the Total Productive Maintenance (TPM) concept.
C2. Getting acquainted with basic TPM tools and methods allowing to increase efficiency of machine stock maintenance. Getting acquainted with principles of determining indices describing progress at implementing the TPM methodology.
C3. Getting acquainted with possibilities of CMMS-class computer systems to support planning operation and repair tasks, stock management and managing the operation/repair personel.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Student knows the scope of activities and the principles of choosing a strategy for the maintenance of machines and manufacturing equipment.
PEU_W02 - Student knows the basic tools and indicators of TPM.
PEU_W03 - He knows the role of the organization and its structure in terms of maintenance

II. Relating to skills:

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Manufacturing machinery and equipment - current development trends. Basic operational requirements (flexibility, productivity, efficiency, accuracy and others). Cause and effect analysis of machine failures	4
Lec2	Basic issues of machine operation (operation, exploitation, operational requirements). Definitions and definitions of reliability	2
Lec3	Exploitation models and principles of exploitation control. Exploitation strategies. A set of rules governing the operation of machines	2
Lec4	The role and importance of the organization in planning maintenance.	4
Lec5	The essence of the Total Productive Maintenance (TPM) system - scope, pillars, indicators.	3
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	Test

P = F1

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE Szymaniec S., Kacperak M.. "Utrzymanie ruchu w przemyśle", Wydawnictwo Naukowe PWN, 2021 Legutko S.: Podstawy eksploatacji maszyn i urządzeń. Wyd. WSiP. Warszawa, 2007. Słowiński B.: Inżynieria eksploatacji maszyn. Wyd. Pol. Koszalińskiej. Koszalin, 2011. SECONDARY LITERATURE Żółtowski B.: Podstawy diagnostyki maszyn. Wyd. ATR Bydgoszcz, 1996.

SUBJECT SUPERVISOR
dr hab. inż. Tomasz Kurzynowski tel.: 713202190 email: tomasz.kurzynowski@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Technologie przyrostowe w budowie maszyn**
Name of subject in English: **Additive manufacturing in machine building**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Technologie i systemy wytwórcze**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI2024**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge and skills in the field of 3D modeling in CAD systems - knowledge of the principles of computer-aided structural and technological design
2. Basic knowledge of engineering materials, including the ability to determine the relationship between the type of material and its properties

SUBJECT OBJECTIVES

C1. To provide students with knowledge in the field of additive manufacturing technologies, especially in mechanical engineering
C2. Transfer of knowledge and skills necessary to solve mechanical engineering issues in the field of modeling materials and elements and their production using additive technologies

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - The student should distinguish various devices in the field of additive technologies and characterize their most important features
PEU_W02 - The student should optimally select and propose an appropriate device based on additive technology for the production of parts and assemblies, taking into account the requirements for new products in terms of physical and operational verification

II. Relating to skills:
PEU_U01 - The student should be able to properly conduct the product development process in terms of its physical verification, usability and quality assessment
PEU_U02 - The student should be able to propose design assumptions for a new product, design and use appropriate engineering tools in terms of manufacturing technology

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to additive manufacturing technologies. Basic principles and terminology.	1
Lec2	Preparation of geometric data for the additive process: CAD models, Reverse engineering, 3D data processing, STL and AMF formats	2
Lec3	Possibilities of additive technologies and product design	2
Lec4	Additive manufacturing processes - polymers. Materials used, characteristics of manufacturing processes, post-processing, examples of applications.	2
Lec5	Additive manufacturing processes - metals. Materials used, characteristics of manufacturing processes, post-processing, examples of applications.	2
Lec6	Additive manufacturing processes - composites and ceramics. Materials used, characteristics of manufacturing processes, examples of applications.	2
Lec7	Additive manufacturing processes - production of tools, devices and small series of products. Materials used, characteristics of manufacturing processes, examples of applications.	2
Lec8	Colloquium credit.	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction, discussion of the method of passing the classes. Safety rules in the laboratory.	1
Lab2	Additive technologies for polymers (SLA, SLS) - functional models and finished products	2

Lab3	Additive technologies for polymers (3DP, DoD, FDM, PolyJet) - functional models, patterns and finished products	2
Lab4	Additive technologies for metals (SLM, EBM) - prototypes and finished products	2
Lab5	Hybrid manufacturing - Laser cladding + CNC - prototypes, regeneration and production of finished products	2
Lab6	Technologies for the production of tools, devices and small production series (Rapid Tooling)	2
Lab7	Characterization of materials and parts - mechanical tests, optical and electron microscopy, computed tomography	2
Lab8	Work in teams - structural and technological design of a selected product	2
		Total hours: 15

TEACHING TOOLS USED
N1. informative lecture N2. multimedia presentation N3. case study N4. self study - preparation for laboratory class

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01 PEU_W02	Written checks
F2	PEU_W01 PEU_W02	Colloquium credit
P = 0,25*F1 + 0,75*F2		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02	Average grades from lab tests
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SECONDARY LITERATURE

SUBJECT SUPERVISOR
dr inż. Tomasz Boratyński tel.: 28-40 email: tomasz.boratynski@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Technologie laserowe w wytwarzaniu**
Name of subject in English: **Laser Technologies in Manufacturing**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Technologie i systemy wytwórcze**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI2025**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of the physics of optics and the influence of optical systems on the path of the light beam
2. Basic knowledge of thermodynamics - methods of heat energy transfer
3. Knowledge of the issues of heat treatment and its impact on the transformations taking place in the material

SUBJECT OBJECTIVES

C1. Acquisition of knowledge in the field of construction and operation of laser processing systems and the impact of parameters on the process.
C2. Acquisition of the ability to select the appropriate laser system for the assigned task.
C3. Independent acquisition of information and its use to solve engineering problems.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Understands the principle of operation and construction of high power lasers
PEU_W02 - Has knowledge of laser beam forming systems and the interaction of radiation with material
PEU_W03 - Knows the scope of application of lasers in manufacturing

II. Relating to skills:
PEU_U01 - Able to select the right laser system for the processing task at hand
PEU_U02 - Handles specialised laser equipment appropriately
PEU_U03 - Depending on the process required, he can select the appropriate beam-forming system

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Laser safety, Operation of high power lasers, different types of laser generators.	3
Lec2	Radiation absorption. Shaping, guiding and measuring the laser beam	3
Lec3	Laser hardening. Laser welding.	3
Lec4	Laser Generative Technologies (LC, SLM, SLS). laser cutting.	3
Lec5	Other laser technologies (peening, surface cleaning, engraving, drilling). Laser micromachining	2
Lec6	Assessment of passing the subject	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Laser safety. Laser generators.	3
Lab2	Laser beam forming and delivering (optics).	3
Lab3	Laser beam material interaction. Laser Hardening. Laser welding.	3
Lab4	Laser cladding; Laser cutting.	3
Lab5	Laser engraving; Measurement of laser beam.	3
		Total hours: 15

TEACHING TOOLS USED
N1. multimedia presentation N2. self study - preparation for laboratory class N3. laser processes demonstrations N4. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01 - PEU_W03	test
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01 - PEU_U03,	quizzes
P = średnia(F1)		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Reinhart Poprawe, Tailored Light 2. Laser Application Technology, Springer 2010
Elijah Kannatey-Asibu, Jr. Principles of laser materials processing, Wiley, 2008
Jyotirmoy Mazumder, Laser Material Processing, Springer 2010
E. Kannatey-Asibu: “Principles of Laser Materials Processing”, Wiley, 2009
J.C. Ion: „Laser Processing of Engineering Materials”, Elsevier, 2005

SECONDARY LITERATURE

J. Kusiński: ”Lasery i ich zastosowanie w inżynierii materiałowej”, Wydawnictwo Naukowe Akapit, 2000; A. Klimpel: "Technologie laserowe w spawalnictwie" Wydawnictwo Politechniki Śląskiej, 2011.

SUBJECT SUPERVISOR
dr hab. inż. Jacek Reiner tel.: 29-81 email: jacek.reiner@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Technologie wytwarzania wyrobów z tworzyw sztucznych**
Name of subject in English: **Technologies of plastics parts manufacturing**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Technologie i systemy wytwórcze**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI2026**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has knowledge about: the structure of polymeric materials, mechanical properties of materials, changes in their structure and properties under the influence of temperature and deformation
2. The student is able to: read a technical drawing, analyze the changes occurring in the material subjected to heating and deformation
3. The student is able to cooperate with the group to solve the task

SUBJECT OBJECTIVES

C1. Familiarize with industrial methods of manufacturing plastic products
C2. Give the ability to link technological parameters with the quality of the product
C3. Give the ability to solve technological and tool problems in plastics processing technologies

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - After the lecture, the student should: know the most important technologies for the production of plastic products, know the machines and tools necessary for this
PEU_W02 - The student knows the construction of: injection molding machines, extruders, thermoforming machines, tools for basic plastics processing technologies
PEU_W03 - He knows the behavior of the material during processing and the influence of technological parameters on this behavior

II. Relating to skills:
PEU_U01 - The student knows how to: select the appropriate manufacturing technology for the type of product
PEU_U02 - The student is able to set the basic parameters of the plastics processing technology and perform simple preparatory operations
PEU_U03 - The student is able to recognize product defects and relate them to processing parameters

III. Relating to social competences:
PEU_K01 - They gain the ability to objectively evaluate arguments, rationally explain and justify their own point of view
PEU_K02 - The student is able to cooperate with others in pursuit of the goal

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Injection molding technology and optimization of the injection molding process	3
Lec2	Defects of injection molded products	2
Lec3	Extrusion and blow molding technology and optimization of the extrusion process	2
Lec4	Defects of extruded products	2
Lec5	Vacuum forming technology	2
Lec6	Duroplastics processing technologies and niche technologies	3
Lec7	Test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	The influence of heating parameters on the temperature of the material in the thermoforming process and on the distribution of product thickness after thermoforming	2
Lab2	Influence of forming parameters and pattern shape on product thickness distribution after thermoforming	2
Lab3	Optimization of the injection process	4
Lab4	Optimization of the extrusion process	4

Lab5	Production of polymer coatings	3
		Total hours: 15

TEACHING TOOLS USED
N1. problem lecture N2. multimedia presentation N3. laboratory experiment N4. self study - preparation for laboratory class

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02	
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE - Henryk Zawistowski, Daniel Frenkler; Construction of injection molds for thermoplastics; PLASTECH 2003; - Izabela Hyla; Plastics: properties, processing, application; ed. Silesian University of Technology 2004 SECONDARY LITERATURE - H. Saechtling; Plastics: A guide; WNT 2007; - Peter Eyerer, Thomas Hirth, Peter Elsner; Polymer Engineering. Technologien und Praxis; SPRINGER 2008

SUBJECT SUPERVISOR
dr inż. Oliwia Trzaska tel.: 4642 email: oliwia.trzaska@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Metrologia w procesach wytwarzania**
Name of subject in English: **Metrology in manufacturing techniques**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Technologie i systemy wytwórcze**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W10MBM-SI2029**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has basic knowledge in the design of machine elements. It has a basic knowledge of manufacturing techniques of machine parts.
2. Student has the ability to read drawings and diagrams contained in the technical documentation.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge about the types and characteristics of equipment for the measurement of geometrical quantities.
C2. Gaining the knowledge to analyze the results of measurements, measurement errors and expressing measurement uncertainty in dependence of production lot scale.
C3. Searching for information and its critical analysis

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Able to identify and define the quantity of the measuring machine parts. He knows and is able to determine the arrangements for ensuring the measurement integrity.
PEU_W02 - Can name the elements of the measurement system and define its functional characteristics. He knows the characteristic values measured in different types of machines.
PEU_W03 - He knows the principles governing the creation of tools, components and measuring systems in dependence of production lot scale.

II. Relating to skills:

III. Relating to social competences:
PEU_K01 - Search for information and its critical analysis
PEU_K02 - Team collaboration on improving the method of selection of strategies aimed at optimal solution entrusted of problems to a group.
PEU_K03 - Objective evaluation of arguments, the rational explanation of his own point of view using the knowledge of metrology.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Elements of measurenment systems and their properties.	2
Lec2	Distribution of the variability of dimensions for typical processes.	2
Lec3	Toleration of machines in various technological processes.	2
Lec4	Designing of measuring devices's heads . Design and control tests for checking the geometry of the product.	2
Lec5	Integration of measuring stands.	2
Lec6	Mechanization and automation of measurement processes.	2
Lec7	Methods of measurement systems analysis.	2
Lec8	Test	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01; PEU_W02; PEU_W03; PEU_K01; PEU_K02; PEU_K03;	test
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SECONDARY LITERATURE

SUBJECT SUPERVISOR
dr inż. Marek Kuran tel.: 27-28 email: marek.kuran@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Badanie jakości wyrobów**
Name of subject in English: **Research of qualities of products**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Technologie i systemy wytwórcze**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W10MBM-SI2030**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a structured knowledge about the types of engineering materials and their fundamental mechanical properties.
2. Student has a detailed knowledge about the metallic engineering materials (its structure, properties, applications and selection rules), as well as is able to classify and mark steels, cast steels, cast irons and basic non-ferrous metals and their alloys. Student has also basic knowledge about the heat treatment and thermo-chemical treatment.
3. Student has a basic knowledge about the manufacturing processes of the metal products by casting, plastic forming, welding and removal treatment technologies. Student has also a basic knowledge about the geometircal metrology.

SUBJECT OBJECTIVES

C1. Introduction and presentation methods of assessing the quality of metal products manufactured by casting, plastic forming, welding and material removal technologies.
C2. Acquisition of knowledge about the basic methods of testing the quality of castings, forgings, extrusions, rolled products, drawn products, welded, pressure welded and brazed products, glue bonded, twisted products, sintered metal powders products, products manufactured by machining, heat-treated products and plastic products.
C3. Acquisition and consolidation of social competences including emotional intelligence consisting in the ability to cooperate in a student group aimed at effective problem solving. Responsibility, honesty and reliability in the proceedings; adherence to customs in the academic environment and society.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Student knows the basic methods of testing the quality of castings and products manufactured by plastic forming.
PEU_W02 - Student knows the basic methods of testing the quality of products manufactured in welding, glue-bonding, boltinf and sintered metal powders products.
PEU_W03 - Student knows the basic methods of testing the quality of products manufactured by machining, heat treated and plastic products.

II. Relating to skills:

III. Relating to social competences:
PEU_K01 - Student is able to search for information and subject it to critical analysis.
PEU_K02 - Student is able to objectively evaluate arguments, rationally explain and justify his own point of view using knowledge in the field of foundry, plastic forming, welding, machining and plastics.
PEU_K03 - Student observes good manners and rules in force in the academic environment.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organization issues. Basic definitions and terminology in product quality assurance systems. Applied techniques in product quality control. Coordinate measuring technique in assessing the quality of products. Geometric measurements of products.	3
Lec2	Methods and rules for assessing the quality of castings, bonded and screwed products and plastic products.	3
Lec3	Methods of assessing the quality of rolled, drawn and stamped products as well as forged products, sintered products and products after thermo-chemical treatment.	3
Lec4	Methods of testing and quality control of welded products, pressure welded as well as brazed and soldered products.	3

Lec5	Methods of assessing the quality of products manufactured by machining. Aspects of certification and accreditation. Summary of the content provided in the lectures.	3
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - self studies and preparation for examination

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03,	colloquium
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE 1. Łabanowski, J., Ocena jakości wyrobów hutniczych, Wydawnictwo PWSZ w Elblągu, 2012 2. Krajewski, A., Hudycz, M., Zapewnienie jakości i kontrola złączy spajanych, Oficyna Wydawnicza Politechniki Warszawskiej, 2015 3. Kubiński, W., Wybrane metody badań materiałów, PWN, Warszawa, 2016 4. Sobczak J.J. (red.), Poradnik Odlewnika, Wyd. STOP, Kraków, 2013 5. Pater Z., Samołyk G., Podstawy technologii obróbki plastycznej metali, Wydawnictwo Politechniki Lubelskiej, Lublin, 2013 SECONDARY LITERATURE 1. Zymonik J., Zymonik Z., Systemy jakości w wytwarzaniu maszyn. SIMPRESS, Wrocław, 1997 2. Hamrol A., Zarządzanie jakością z przykładami, PWN, Warszawa, 2010 3. Łunarski J., Zarządzanie jakością, standardy i zasady, WNT, Warszawa, 2008

SUBJECT SUPERVISOR
dr hab. inż. Leszek Łatka tel.: 071-320-21-38 email: leszek.latka@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Essential of Management (Podstawy zarządzania)**
Name of subject in English: **Essential of Management**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3071**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. No preliminary requirements.

SUBJECT OBJECTIVES

C1. Acquiring knowledge management process and its elements.
C2. Acquiring knowledge about the nature and mechanisms of building and functioning organizations.
C3. Acquiring knowledge about basic instruments and tools of management, using them in organizations and the analysis of management problems.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Student is able to define the basic mechanisms of functioning of organizations, distinguishes types of organizations, their components and recognizes elements of the environment that affects functioning of respective subsystems in organizations.
PEU_W02 - The student is able to define the management process and its elements and knows the basic management methods and techniques within the each of the management functions of planning, organizing, leading and controlling.
PEU_W03 - The student is able to formulate the scope and areas of organization's impact on the environment depending on the identified decisions made by managers in organizations

II. Relating to skills:

III. Relating to social competences:
PEU_K01 - The student is aware of the impact of the environment on decisions made in the organization and decisions made in the organization on the environment.
PEU_K02 - The student is aware of the role of planning, organizing, leading and controlling as well as the techniques and tools used in each of these management functions for the efficient and effective functioning of the organization as a whole.
PEU_K03 - The student is aware of the importance of innovation and entrepreneurship for the environment.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organization and its resources. The concept of management. Management process and its elements. Manager and his work.	2
Lec2	Organization's environment and its elements. Influence of environment on organization. Methods of analysis of the environment.	2
Lec3	Planning in organization. Setting goals. Hierarchy of goals. Types of plans. Decision making process. Strategy and strategic management. Marketing and marketing planning.	2
Lec4	The function of organizing. Organizational structures. Human resources management and its elements. Tools and techniques of human resources management.	2
Lec5	The function of leading. Human behaviors in organizations. Leadership and power. Managing styles. Motivating. Selected motivating techniques.	2
Lec6	The function of controlling. Steps and levels of control. Creativity, innovation, knowledge. The concept of innovation and types of innovation.	2
Lec7	Entrepreneurship. The role of entrepreneurship in the economy. Knowledge based economy.	2
Lec8	Test / On-line test	1
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01-W03	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Griffin R.W., Management. 13h Edition, South-Western Cengage Learning, 2022.
2. Coulter M, Robbins S.P., DeCenzo D., Fundamentals of Management. Global Edition. 11th EditionPearson, 2019. 3. DuBrin A.J., Essentials Of Management. 10th Edition, South-Western Cengage Learning, 2016.
4. Kinicki A., Williams B.K., Management. A practical introduction. 9h Edition, McGraw-Hill Education, 2019.

SECONDARY LITERATURE

1. McKee A., Management. A Focus On Leaders, Prentice Hall, 2012.
2. Hatch M.J., Cunliffe A.L., Organization Theory. Modern, Symbolic, And Postmodern Perspectives, Oxford University Press, 2013.
3. Bygrave W., Zacharakis A., Entrepreneurship, 4rd Edition, Wiley, 2016.
4. Aulet B., Disciplined Entrepreneurship: 24 Steps to a Successful Startup, Wiley, 2013.
5. Press and portals about management and entrepreneurship.

SUBJECT SUPERVISOR
dr inż. Mateusz Molasy tel.: 713202662 email: mateusz.molasy@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Ergonomy and Safety (Ergonomia i BHP)**
Name of subject in English: **Ergonomy and Safety**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3072**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. has basic knowledge from range of characteristic and properties of hazardous physical agents (electric energy, mechanical vibrations, lighting, electromagnetic field, dusts), chemical and biological agents
2. has systematical knowledge from range of mathematics, physics, chemistry and informatics

SUBJECT OBJECTIVES

C1. Acquirement of basic knowledge in the field of labor law, as well as work accidents and occupational diseases
C2. Acquirement of basic knowledge in the field of ergonomics and biomechanics
C3. Acquirement of basic knowledge in the field of protection before dangerous, harmful and strenuous factors in work environment

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - knows basic regulations and standards of work safety
PEU_W02 - has basic knowledge of ergonomics and consciousness for capability of its practical application in designing and manufacturing of products
PEU_W03 - knows basic threats at work positions and methods of protection before them

II. Relating to skills:

III. Relating to social competences:
PEU_K01 - understands the legal and environmental aspects and effects of engineering activities, has local and global environmental consciousness
PEU_K02 - is able to make responsible decisions as an engineer, taking into account their impact on non-technical aspects of engineering activities, is able to work independently and in a team, and correctly assesses task priorities

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Occupational health and safety (OHS), work safety regulations and principles	2
Lec2	Accidents at work and occupational diseases	2
Lec3	Ergonomics as an interdisciplinary science	2
Lec4	Biomechanics - science for discovering of threats for employee health, being result of executable work	2
Lec5	Hazardous and harmful agents in work environment - mechanical agents and electric power	3
Lec6	Hazardous and harmful agents in work environment - noise, vibrations and lighting	3
Lec7	Summary, test	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem discussion
N3. tutorials
N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01 - PEU_W03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE Monika Blaszczok - Ergonomics of safe and hygienic work, Silesian University of Technology, Gliwice 2018 SECONDARY LITERATURE B. Rączkowski - Industrial Safety in practice, ODDK, Gdansk 2022

SUBJECT SUPERVISOR
dr inż. Jacek Iwko tel.: 42-54 email: jacek.iwko@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Fundamentals of metrology (Podstawy metrologii)**
Name of subject in English: **Fundamentals of metrology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3073**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of mathematics and physics at secondary school level.

SUBJECT OBJECTIVES

C1. Understanding the essence of measurement to recognize true state and relations between physical quantities
C2. Gaining knowledge of basic metrological concepts, unit system SI, rules of making measurements of physical quantities and basic properties of measurements sensors and apparatus.
C3. Gaining knowledge about signal processing, measurements systems, rules and properties of measurement process.
C4. Gaining basic knowledge about measurement interferences factors.
C5. Gaining basic knowledge about experiment planning and results elaboration and uncertainty analysis.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Has basic knowledge of metrology, understands essence of measurements and knows measurements methods
PEU_W02 - Knows basic properties of measurements apparatus and measurements systems.
PEU_W03 - Has basic knowledge of accuracy and measurement uncertainty.

II. Relating to skills:

III. Relating to social competences:
PEU_K01 - Search for information and its critical analysis
PEU_K02 - Objective evaluation of arguments, the rational explanation of his own point of view using the knowledge of fundamentals of metrology.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Basic concepts of metrology.	1
Lec2	Quantities and units of measurement. Integrated measurement units. SI units, measurement standards, a hierarchical system of measurement standards.	2
Lec3	Measurement method, types and classification. Examples.	2
Lec4	Analog and digital measurement instruments: types, components, I/O elements, A/C converters, microprocessor role; metrological properties; influence of interferences.	4
Lec5	Measurement uncertainty and results elaboration: sources of uncertainty; division and rules of estimation, calculation of A-type uncertainty.	2
Lec6	Calculation of B-type standard uncertainty and enhanced uncertainty with proper trust level. Methods for results elaboration and presentation.	2
Lec7	Test	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01 - PEU_W02, PEU_K01-PEU_K02	test
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SECONDARY LITERATURE

SUBJECT SUPERVISOR
dr inż. Marek Kuran tel.: 27-28 email: marek.kuran@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Engineering Graphics: Descriptive Geometry (Grafika inżynierska - geometria wykreślna)**
Name of subject in English: **Engineering Graphics: Descriptive Geometry**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3074**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	30			
Number of hours of total student workload (CNPS)	30	60			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	1	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has knowledge of the fundamental theorems of Euclidean geometry
2. Student has ability to use of the drawing utensils.
3. Student has ability to draw basic geometric structures, such as division of a line's segment into n equal parts, plotting a regular hexagon

SUBJECT OBJECTIVES

C1. Knowledge of the theoretical and practical basis of the Monge descriptive projection method of the geometric structures on the drawing's plane as the basis for design recording (engineering drawing).
C2. Knowledge in the field of the geometric structures restitution based on Monge's projections.
C3. Preparation for the design recording (engineering drawing) application

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Student has ordered knowledge on geometric structure mapping onto drawing's plane using Monge's projection method and elementary knowledge in the field of axonometry.
PEU_W02 - PEU_W02 - Student knows an appropriate solution algorithm of mapping of the position and the relationship of the
geometric formations in the space, as well as identifying the measures relationship.
PEU_W03 - PEU_W03 - Student knows the rules for drawing, using Monge's method, showing localization of the element or
geometric structure in the space.

II. Relating to skills:
PEU_U01 - Student can practically apply the principles of the Monge's projection method to map the elements and geometric structures (including solids) on the drawing plane.
PEU_U02 - Student can set the size of the dimensions characterized measuring tasks of geometry.
PEU_U03 - Student can provide restitution of the geometric structure on the basis of Monge's projection and submit the result by axonometric projection

III. Relating to social competences:

PROGRAM CONTENT		
Form of classes – Lecture		Number of hours
Lec1	Basic definitions and principles of the parallel, rectangular projection by Monge's projection, the mapping of basic geometric elements (points, line, plane).	1
Lec2	Common elements - edges and breakdown points; parallel and perpendicular elements.	2
Lec3	Transformation of the position (rotation, revolved section, increasing of the revolved section) and the reference system transformation (additional projection plane).	2
Lec4	Solids - definitions; solid section as a set of common elements of the solid cutting plane, solid's breakdown points by a straight line.	2
Lec5	Cutting of the solids with projecting planes set - a modification of the initial solid's view, developed views.	2
Lec6	Penetration of the solids - transmission lines definition, the use of auxiliary cutting planes and reference system transformation.	2
Lec7	Projection in the three orthogonal planes; axonometry basis; completion of the missing solid projection - use of the axonometric projection.	2
Lec8	Final test.	2
		Total hours: 15
Form of classes – Classes		Number of hours

Cl1	Information on the drawing utensils and principles of the geometric structures drawing. Projection of a point and straight line, the mapping of a plane using her traces, identification of the basic elements localization in space using two orthogonal projection planes.	2
Cl2	Belonging of the basic geometric elements, completion of the missing projection; particular localization of the geometric elements.	2
Cl3	Edge as common element of two planes. Breakdown point as common element of straight line and plane. Particular cases of a common elements.	2
Cl4	Edge between flat figures (auxiliary projection planes application); breakdown point of the flat figure by straight line. Identification and construction of the parallel and orthogonal relationship between basic geometrical elements.	2
Cl5	Rotation and revolved section of the basic geometrical elements (rotation of a line's segment and plane); application of the localization transformation for measuring tasks (determination of the real size of a line's segment, angle, flat figure).	2
Cl6	Determination of the projections of plane geometrical structures with selected parameters and the desired position in space (increasing of revolved section of a plane figure). Application of the reference system transformation in measuring tasks and identification of the position (angle relative to the projecting plane, distance of the point from the plane, setting the points projections at a set distance from the plane).	2
Cl7	Test K1 (includes classes's 1 - 6 material)	2
Cl8	The mapping of the elementary solids using Monge's projection, points and lin's segments belonging to the solid's walls identification; determination of the cross sections of polyhedra with projection planes.	2
Cl9	Determination of the polyhedra cross sections cutted by arbitrary planes. Determination of the cross section of the solids with surfaces. Solid's breakdown points by lines (use of auxiliary cutting planes containing penetrating straight line) determination.	2
Cl10	Developed view of a polyhedron and solid containing ruled surface. Cutting of the solid with projection planes as a modification of the initial form of solid - cutting of the polyhedron.	2
Cl11	Cutting of a solid of revolution. Polyhedra transmission lines determination.	2
Cl12	Solids (containing surfaces) transmission lines determination.	2
Cl13	Solid mapping onto three orthogonal projectionl planes. Solid modification using projection plane.	2
Cl14	Solid mapping using axonometric projection. Determination of the missing solid projection modified by cutting planes. Relationship between Monge's projection and axonometric projection.	2
Cl15	Test K2 (includes classes's 8 - 14 material)	2
		Total hours: 30

TEACHING TOOLS USED
N1. problem lecture N2. problem exercises N3. tutorials N4. self study - preparation for project class

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W03	final test
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02	test no. 1, good rating is nedeed (min. 3.0)
F2	PEU_U01, PEU_U02, PEU_U03	test no. 1, good rating is nedeed (min. 3.0)
P = F3		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE [1] Lewandowski Z., Geometria wykreślna, PWN, Warszawa 1980 (i późniejsze wydania), [2] Otto F., Otto E., Podręcznik geometrii wykreślnej, PWN, Warszawa 1998, [3] Zbiór zadań z geometrii wykreślnej, red. Nowakowski T., Oficyna Wyd. Politechniki Wrocławskiej, Wrocław 2001, [4] Bieliński A., Geometria wykreślna, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2005. SECONDARY LITERATURE [1] Szerszeń S., Nauka o rzutach, PWN, Warszawa 1974 (i późniejsze wydania), [2] Przewłocki S., Geometria wykreślna w budownictwie, Wyd. Arkady, Warszawa 1997, [3] Bogaczyk T., Romaszkiewicz-Białas T., 13 wykładów z geometrii wykreślnej, Oficyna Wyd. Politechniki Wrocławskiej, Wrocław 1997, [4] Błach A., Geometria. Przegląd wybranych zagadnień dla uczniów i studentów. Arkady, Warszawa 1998.

SUBJECT SUPERVISOR
dr inż. Marta Kozuń tel.: 320-27-13 email: marta.kozun@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Information Technologies (Technologie informacyjne)**
Name of subject in English: **Information Technologies**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3075**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge about the functioning of computers taken from high school

SUBJECT OBJECTIVES

C1. Presentation of the history of counting and computers in an accessible way.
C2. Description of the internal structure of computers and basic algorithms for performing calculations on integers and floating point numbers; discussion of the causes and nature of errors arising during arithmetic operations
C3. Presentation of the essence of the algorithm, ways of notating algorithms, presentation of the basic methods of creating algorithms. Discussion of the essence of software errors and the basics of computational complexity of algorithms.
C4. Presentation of basic concepts in the field of intellectual property protection, copyright, patent law and trademarks

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

PEU_W01 - As a result of the course, the student should be able to define the basic concepts related to information and its processing

PEU_W02 - After completing the course, the student should be able to describe and explain algorithms and the basic ways of constructing them, as well as define various causes of errors and ways to remove them.

PEU_W03 - He has elementary knowledge in the field of intellectual property protection and patent law.

II. Relating to skills:

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Syllabus. Requirements. How to pass. Information.	2
Lec2	A brief history of mathematics and the history of the development of computer systems.	2
Lec3	Computer arithmetic	2
Lec4	Non-integer arithmetic; absolute errors	2
Lec5	Computer architecture	2
Lec6	Introduction to algorithms	2
Lec7	Algorithms (part I)	2
Lec8	Method of notation of algorithms (Algorithms part II)	2
Lec9	Turing machine (Algorithms part III)	2
Lec10	Algorithmic methods (Algorithms part IV)	2
Lec11	Can computers be wrong?	1
Lec12	Computational complexity	1
Lec13	Copyright law outline	2
Lec14	Patent law outline	2
Lec15	Trademarks	2
Lec16	Final test	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01-PEU_W03, PEU_K01	final test
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE 1. Harel D., Feldman Y.A.: Rzecz O Istocie Informatyki: Algorytmika Wydawnictwa Naukowo-Techniczne 2. Gleick J.: Informacja. Bit, wszechświat, rewolucja, Znak SECONDARY LITERATURE 1. Rockman H.B., Intellectual Property Law for Engineers, Scientists, and Entrepreneurs, Willey

SUBJECT SUPERVISOR
dr inż. Wojciech Myszka tel.: +48(71)3203269 email: Wojciech.Myszka@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Chemistry (Chemia)**
Name of subject in English: **Chemistry**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3076**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. A Range of Chemistry and Physics of Secondary School

SUBJECT OBJECTIVES

C1. Introduction to the divisions of chemistry usable over related courses study (material science, metallurgy, polymers)
C2. Study of basic chemical knowledge allowing for understanding ofchemical rules and physicochemical properties of
technical materials particularly metals, alloys and polymers
C3. Acquired skills of learning through bringing together knowledge from different fields of science, with particular reference to chemistry, physics, material science, ecology.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - The student should have basic chemical knowledge associated with structure of matter, states of matter.
PEU_W02 - The student should have basic inorganic knowledge associated with the structure of metals, alloys, electron conductivity as well as basic organic knowledge associated with fuels and polymers
PEU_W03 - The student should have basic knowledge associated wit optics and nanotechnology

II. Relating to skills:

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	The structure of the atom, the criteria for division and the structure of matter, elements, compounds.	2
Lec2	Periodic table of elements, structure, groups of elements, electron configuration, allotropic varieties, isotopes.	4
Lec3	Mechanisms of chemical bonding (ionic, atomic, metallic), characteristics of exemplary ionic, covalent and metallic materials, the reasons for their properties.	2
Lec4	Characteristics of basic states of matter; analysis of causes and effects of quantities such as pressure, diffusion, density, viscosity, surface tension, wettability; preliminary characterization of amorphous and crystalline structures	4
Lec5	Metals - causes of plasticity, electron and thermal conductivity, gloss and opacity; characteristics of alloys - division criteria, construction, application of basic alloys	4
Lec6	Conductivity - band theory, superconductors, current conduction mechanism in semiconductors "p" and "n"	2
Lec7	Mixtures - partition criteria, characteristics of specific solutions (solubility mechanisms), colloids and suspensions, light scattering mechanism, concentrations	2
Lec8	Elements of crystallography, unit cell, centering, elements of symmetry, structural defects.	4
Lec9	Basics of organic chemistry: hydrocarbons, isomers, natural gas, petroleum - products; introduction to polymers, characteristics of selected polymeric materials	4
Lec10	Qualifying class –test	2
		Total hours: 30

TEACHING TOOLS USED
N1. informative lecture N2. traditional lecture with the use of transparencies and slides N3. tutorials N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01 - PEU_W03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE Reliable websites, lecture notes SECONDARY LITERATURE thematic studies on the issues presented at the Lecture

SUBJECT SUPERVISOR
dr hab. Marek Jasiorski tel.: 320-32-21 email: marek.jasiorski@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Theory of Machines (Maszynoznawstwo)**
Name of subject in English: **Theory of Machines**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3077**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. A student has knowledge about physical and chemical processes at the high school level.
2. A student has the elementary ability to associate the principles of operation of selected machines and vehicles with the known laws of physics and chemistry.
3. A student is able to use knowledge to analyze the methods of operation of simple mechanical systems.

SUBJECT OBJECTIVES

C1. Learning the general principles of the operation of machines and devices and their role in the modern world.
C2. Acquisition of knowledge and skills in material and functional analysis of the machine's structure. Determining the relationship between the engine, work tool system components, and drive system. Getting acquainted with the EU machinery directive and its requirements.
C3. Acquisition of basic knowledge in the field of relationships between the machine and the technical environment, which are the basis for the machine construction process.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - A student understands the role of machines and devices in modern technology. A student knows the basic principles of operation and construction of working machines and vehicles as well as engines as sources of mechanical energy.
PEU_W02 - As a result of the course a student is aware of the division of machines in terms of their function and construction, while at the same time being able to identify individual components of machines and machine systems.

II. Relating to skills:

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Discussion on the lecture content and final course requirements. The role of technology in the development of civilization.	1
Lec2	The concept of technique and technical system. Matter, energy and information transformation matrix. Machine definitions: classic, functional and EU.	2
Lec3	Analogies between physical environments.	1
Lec4	Machine classification. Examples of machines and machine systems.	2
Lec5	Construction, principles of operation and basic parameters of motors/engines used in machine drives.	2
Lec6	The concept of the drive system. Functions implemented by drive systems of machines and devices and their structure. Examples of load characteristics.	2
Lec7	Typical elements used in the construction of machines.	2
Lec8	Fundamentals of machine control systems, automatic control systems, and the concept of mechatronics systems. Basic definitions and structure of mechatronic systems.	2
Lec9	Written final test.	1
		Total hours: 15

TEACHING TOOLS USED

N1. informative lecture
N2. multimedia presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02	final test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Biały W.: Maszynoznawstwo. WNT, Warszawa 2003.
[2] Chwiej M. Maszynoznawstwo ogólne. PWN, Warszawa 1983 (IV wyd.).
[3] Wołek M.: Maszynoznawstwo ogólne. PWN, Warszawa 1978.
[4] Orlik Z.: Maszynoznawstwo. WSziP, Warszawa 1989.
[5] Gnutek Z., Kordylewski W.: Maszynoznawstwo energetyczne. Wyd. Politechniki Wrocławskiej, Wrocław 2003.
[6] Mille A., Kijewski J., Pawlik K., Szolc T.: Maszynoznawstwo. WSziP, Warszawa 2003.
[7] Olszewska M. (red.): Podstawy mechatroniki. Wyd. REA. Warszawa 2006.
[8] Schmid D. (red.): Mechatronika. Wyd. REA. Warszawa 2002.

SECONDARY LITERATURE
[1]Hryniewicz A.: Energia. Wyzwanie XXI wieku. Wyd. Uniwersytetu Jagielońskiego, Kraków 2002.
[2]Krick E.U.: Wprowadzenie do techniki i projektowania technicznego. WNT, Warszawa 1975.
[3]Szumanowski A.: Czas energii. WKiŁ, Warszawa 1988.
[4]Charles Panati: Niezwykłe dzieje zwykłych rzeczy. Książka i Wiedza, Warszawa 2004.
[5]Encyklopedia Techniki. MUZA SA.
[6] Pritschow G.: Techika sterowania obrabiarkami i robotami przemysłowymi. Oficyna Wyd. Politechniki Wrocławskiej 1993.
[7] Ochoa G., Corey M.: Kalendarium nauki i techniki. Wyd. Zysk i S-ka, Poznań.

SUBJECT SUPERVISOR

dr inż. Tomasz Siwulski tel.: 71 320-28-92 email: tomasz.siwulski@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Engineering Graphics: Engineering Drawing (Grafika inżynierska - zapis konstrukcji)**

Name of subject in English: **Engineering Graphics: Engineering Drawing**

Main field of study (if applicable): **Mechanical Engineering and Machine Building**

Specialization (if applicable): **Mechanical engineering design**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **W10MBM-SI3078**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			30	
Number of hours of total student workload (CNPS)	30			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of descriptive geometry.
2. Basic drawing skills and use of computer equipment.
3. The skill to use the Internet digital resources

SUBJECT OBJECTIVES

C1. The acquisition of knowledge and skills in rectangular projection of elements of space on the plane with the use of views and sections, as well as the principles for engineering drawing.
C2. The acquisition of knowledge and skills in the dimensioning and tolerancing of dimensions of machine parts, as well as the identification of their surface features and shape and position tolerances
C3. The acquisition of knowledge and skills in the field of graphic representation of connections of machines and rules for standardization in constructions drawings, as well as elements drawings (manufacturing drawings) and complex systems (assembly drawings) and the principles of schematization.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - The student knows and is able to explain the rules of constructions drawings and creating the technical documentation of elements and mechanical components.
PEU_W02 - The student knows how to call the basic parameters characterizing the geometric features of a product and propose how to save these information.
PEU_W03 - The student knows the principles of graphic representation of joint of machine elements and drawing the standard machine elements.

II. Relating to skills:
PEU_U01 - The student is able to draw technical documentation and schematics of technical systems by hand and by computer (CAD).
PEU_U02 - The student is able to read the technical documentation of a machine component and complex technical systems as well as the schematic drawing.
PEU_U03 - The student is able to identify and draw the basic connections of machine parts.

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Rules of technical drawings. Standardization in technical documentation. Orthogonal and axonometric projections. Drawing composition.	2
Lec2	Types of views in the technical drawing. The application of sections, revolved and removed sections. Details presentation.	2
Lec3	Dimensioning. The rules of dimensioning of machine elements. Methods of tolerancing dimensions and fits in drawings.	2
Lec4	Presentation of surface roughness. Form or position tolerances and complex tolerances.	2
Lec5	Drawing of the basic machine joints - separable and inseparable joints. Drawing of the standardized machine elements.	2

Lec6	Types of drawings in the technical documentation. Detail drawings, assembly drawings, general arrangement drawings. Schematic drawings.	2
Lec7	Final test	2
Lec8	Discussion of the final test results and the course summary.	1
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Introduction. Basic principles of drawing using computer technology. Simple drawings using a computer program (CAD): organization of a graphic editor, basic drawing functions (line, circle, arc, etc.)	2
Proj2	Basic techniques of freehand drawing - line, arc, circle, ellipse. Drawings of simple machine elements.	2
Proj3	Views of machine elements based on axonometric drawings. Technical sketch - freehand made. Drawing composition. Computer drawing (editing and modification functions of drawings)	2
Proj4	Views of more complex machine elements. Computer drawing (editing and modification functions - continuation)	2
Proj5	Sections of simple machine elements. Drawing of symmetrical elements (half view and half section).	2
Proj6	Drawing of rotary machine elements (shafts, sleeves). Sections, revolved and removed sections.	2
Proj7	Detail drawings. Dimensioning rules. Tolerances. Surface roughness description.	2
Proj8	Drawing of welded joints and glued joints. Drawing of a frame, body or support element containing parts, that are connected by welding or gluing.	2
Proj9	Thread fits in drawings. Drawing of machine assembly containing a thread fits.	2
Proj10	Final test	2
Proj11	Design exercise - topic overview. The draft sketch of machine assembly as the content of the exercise.	2
Proj12	Design exercise. The general arrangement drawing of the machine assembly.	2
Proj13	Design exercise. Detail drawings of the machine assembly.	2
Proj14	Design exercise. The detail drawings of the machine assembly. Schematic drawing.	2
Proj15	Evaluation of the design exercise. Course grade.	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of multimedia techniques. N2. self study - preparation for project class N3. problem discussion N4. individual solving the drawing exercises with the tutor.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	post-lecture tests (quizzes)
F2	PEU_W01, PEU_W02, PEU_W03	final test
P = 0.1*F1+0.9*F2		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03	final test
F2	PEU_U01-PEU_U03	Assessment of the design exercise
F3	PEU_U01-PEU_U03	Assessment of tasks solved in class
P = 0.6*F1+0.3*F2+0.1*F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Giesecke F. et al. Technical Drawing with Engineering Graphics. 15th Edition. — Prentice Hall, 2016
[2] Stefano Tornincasa. Technical Drawing for Product Design. Springer Nature Switzerland AG, 2021
[3] David Madsen. Engineering Drawing and Design. Cengage Learning, Inc; Edycja 6, 2016
[4] Supporting materials for the lecture, e.g. ePortal WUST

SECONDARY LITERATURE
[1] Websites for AutoCAD learning eg.
https://autocad-beginners.blogspot.com/2018/01/content-of-autocad-tutorials.html

SUBJECT SUPERVISOR

Prof. dr hab. inż. Wojciech Wieleba tel.: +4871 320-27-74 email: wojciech.wieleba@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Engineering Materials Technology (Technologia materiałów inżynierskich)**
Name of subject in English: **Engineering Materials Technology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3079**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of physics and mathematics. He can use basic measuring instruments, e.g. calipers.
2. Ability to analyze information included in laboratory instructions.
3. Ability to work in a team.

SUBJECT OBJECTIVES

C1. Familiarization with metallurgical processes of ore conversion, production of steel and non-ferrous metals.
C2. Familiarization with basic methods of testing of mechanical properties of steel and non-ferrous metals and principles of forming of items with use of powder metallurgy.
C3. Obtaining and reinforcement of social competences connected with a teamwork with a goal to solve problems effectively.
C4. Familiarization with knowledge about basic mechanical properties of engineer materials like: tensile strength, compressive strength, impact strength, hardness by participation in testing of selected materials.
C5. Familiarization with methods of conducting of non-destructive testing like: visual inspection, dye-penetrant examination, magnetic particle testing, radiographic and ultrasonic testing by participation in testing selected parts.
C6. Familiarization with technological tests and forming of items with use of powder metallurgy by participation in an experiment.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - As a result of conducted lecture the student should be able to define the basic physical properties of engineering materials, to quote and to describe the ways of processing of ores the metals, to characterize the metallurgical processes of receiving the metals and the alloys of metals.
PEU_W02 - As a result of conducted laboratory the student should be able to define the mechanical properties of metals and the alloys, to describe the method of tests destructive and non-destructive, to characterize the method of carrying out the technological tests.
PEU_W03 - As a result of conducted classes the student should be able to distinguish basic engineering materials, to characterize their physical and mechanical properties, to identify method investigations of properties of engineering materials.

II. Relating to skills:
PEU_U01 - As a result of the lecture the student should be able to analyze processes metallurgical obtaining metal, compare the properties of engineering materials.
PEU_U02 - As a result of laboratory classes student should be able to carry out in a limited range the basic test of tensile strength, compressive strength, impact tests, hardness tests and technological tests.
PEU_U03 - As a result of the course the student should be able to obtain information from the literature, have the ability to self-learning, carry out measurements, determine the value and to evaluate certainty basic mechanical properties.

III. Relating to social competences:
PEU_K01 - Demonstrates skills needed in teamwork on improving methods of choice of a strategy to optimally solve problems assigned group.
PEU_K02 - Is able objectively evaluate the arguments rationally explain and justify his own point of view using the knowledge of the basics of engineering materials.
PEU_K03 - Respects the customs and rules of the academic community.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters.	1

Lec2	General information about properties of engineer materials. Refractory materials and fuels in pyrometallurgy.	2
Lec3	Metallurgy of iron. Ore treatment, blast furnace process.	2
Lec4	Steel production, influence of admixtures on steel properties.	2
Lec5	Metallurgy of copper. Ore treatment, pyrometallurgical and hydrometallurgical processes of production of copper and its alloys.	2
Lec6	Metallurgy of aluminum. Treatment of ores, production of aluminum oxide and refining of aluminum.	2
Lec7	Metallurgy of zinc. Ore treatment, pyrometallurgical and hydrometallurgical processes of production of zinc and its alloys.	2
Lec8	Production of high melting metals with use of powder metallurgy and methods of production of parts with use of metallic powders.	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Organizational matters, health and safety conditions.	1
Lab2	General information about metals and alloys - alloys fabrication.	2
Lab3	Tensile test of metals.	2
Lab4	Compression test and impact test.	2
Lab5	Hardness measurement of metal alloys.	2
Lab6	Non-destructive tests.	2
Lab7	Technological tests.	2
Lab8	Production of machine elements from metal powders.	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - preparation for laboratory class N3. laboratory experiment N4. report preparation N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement

F1	PEU_W01, PEU_W02, PEU_W03	Final test
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03, PEU_K01-PEU_K03	Oral answers, short tests
P = średnia z F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE 1. Z. Mirski. Technology and engineering materials testing, laboratory. Wrocław University of Technology Publishing House, 2010. 2. Krynicki L., L. Sozański. Technology of metals. Publisher University of Technology, 1994. SECONDARY LITERATURE Supplementary materials for exercises No. 1-5. W10 library (building B4, III floor).

SUBJECT SUPERVISOR
dr inż. Tomasz Wojdat tel.: (71) 320 40 68 email: tomasz.wojdat@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Thermodynamics (Termodynamika techniczna)**
Name of subject in English: **Applied thermodynamics**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3080**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of problems covered by the field of Physics
2. The ability to independently perform laboratory exercises, supported by elementary manual dexterity
3. Awareness of the necessity of group work and the ability to implement it

SUBJECT OBJECTIVES

C1. Based on the laws of thermodynamics, understanding the principles of gas transformations and the possibilities of their use in technology
C2. Knowledge of the basics of the operation of power machines and the ability to determine their efficiency.
C3. Knowledge of the basics of compressor operation and the ability to determine their efficiency
C4. Knowledge of the basics of operation of flow machines and the basics of supersonic flow thermodynamics

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Has basic knowledge of physics enabling explanation of facts and phenomena occurring in the natural world and technology
PEU_W02 - Can interpret and analyze the cycles of energy machines

II. Relating to skills:
PEU_U01 - Is able to solve tasks and problems based on acquired knowledge and information obtained from scientific and technical literature in Polish and English, databases and other sources
PEU_U02 - Can carry out calculations of power machines based on variable thermodynamic parameters

III. Relating to social competences:
PEU_K01 - Understands the importance of using mathematical methods in the represented engineering discipline

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic definitions: local parameters, global parameters, specific parameters, pressure, temperature, zero law of thermodynamics	2
Lec2	Perfect gas state equation. The real gas state equation	2
Lec3	Thermodynamic processes. The heat of a process. The work of a process - absolute, technical and useful work	2
Lec4	Heat capacity of the body at constant pressure and constant volume. Change of internal energy. Change of enthalpy.	2
Lec5	Energy balance. The first law of thermodynamics for open and closed systems.	2
Lec6	Polytropic equation. Work and heat of polytropic process. Characteristic transformations – work and heat of characteristic processes	3
Lec7	The second law of thermodynamics. Entropy. Basics of thermodynamic cycles and their efficiency. Carnot cycle.	3
Lec8	Air standard cycles of power machines. The efficiency of air standard cycles	4
Lec9	Reciprocating and rotodynamic compressors, indicator chart and compressor operation.	2
Lec10	Thermodynamics of compressible flows. Energy balance for compressible flows. The first law of thermodynamics for compressible flows	2
Lec11	The flow of gases through nozzles, the Bernoulli equation, dynamic jet action, determination of the local speed of sound	2
Lec12	Basic laws concerning heat transfer by convection, radiation, conduction	2
Lec13	Examination	2
		Total hours: 30
Form of classes – Laboratory		Number of hours

Lab1	Determination of specific heat of gas for polytropic process	2
Lab2	Determination of the correction factor for the adiabatic process	2
Lab3	Determination of volumetric efficiency of the reciprocating compressor	2
Lab4	Study of the adiabatic process of nozzle outflow. Determination of the Bendemann ellipse	3
Lab5	Isothermal process. Practical implementation of Boyle Mariotte's law	2
Lab6	Examination of the heat transfer process through a flat partition at: a) the occurrence of convection and radiation, b) the use of a radiation-attenuating screen	2
Lab7	Isobaric heating using heat regeneration	2
		Total hours: 15

TEACHING TOOLS USED
N1. informative lecture N2. problem lecture N3. self study - self studies and preparation for examination N4. tutorials N5. self study - preparation for laboratory class

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_K01	Examination
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_K01, PEU_U01, PEU_U02	quiz, report on laboratory exercises
F2	PEU_K01, PEU_U01, PEU_U022	quiz, report on laboratory exercises
F3	PEU_K01, PEU_U01, PEU_U02	quiz, report on laboratory exercises

F4	PEU_K01, PEU_U01, PEU_U02	quiz, report on laboratory exercises
F5	PEU_K01, PEU_U01, PEU_U02	quiz, report on laboratory exercises
F6	PEU_K01, PEU_U01, PEU_U02	quiz, report on laboratory exercises
F7	PEU_K01, PEU_U01, PEU_U02	quiz, report on laboratory exercises
P = (F1+F2+F3+F4+F5+F6+F7)/7		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Szargut, Jan and Termodynamika Techniczna. Wydawnictwo Politechniki Śląskiej. Gliwice, 2009.
[2] Wiśniewski, Stefan. Termodynamika Techniczna. Wydawnictwa Naukowo-Techniczne, 1993.

SECONDARY LITERATURE

[1] Tuliszka, E. and Z. Koszla-Olachowska. Termodynamika Techniczna: Zbiór Zadań : Praca Zbiorowa. Wydaw. Politechniki Poznańskiej, 1980.
[2] Teodorczyk, A. Zbiór Zadań Z Termodynamiki Technicznej. Wydawnictwa Szkolne i Pedagogiczne, 1992.

SUBJECT SUPERVISOR

dr inż. Aleksander Górniak email: aleksander.gorniak@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Fundamentals of Materials Science (Podstawy materiałoznawstwa)**
Name of subject in English: **Fundamentals of Materials Science**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3081**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic of physic at the high school level.
2. The basic knowledge of chemistry, ability to use of chemical terminology.
3. The basic knowledge of mathematic, ability of creation and interpretation equations and graphs.

SUBJECT OBJECTIVES

C1. Students' familiarization with criteria of engineering materials types and kinds of such materials.
C2. Knowledge of basic crystallography and cristalline structures properties.
C3. Learning of interpretation and usage of equilibrium phase graphs in planning of properties of engineering materials.
C4. Knowledge of structures and properties of iron-cementite system alloys
C5. Acknowledgements with state, properties and applications of ceramics, polymers and composites.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Knows groups of engineering materials and criteria of their clasiffication.
PEU_W02 - Knows types of iron alloys, can interprete their microstructures and specify their properties.
PEU_W03 - Can specify the basis properties and fields of usage and kinds of ceramics, polymers and composites.

II. Relating to skills:
PEU_U01 - Ability to interpret microstructures of products after various manufacturing processes and to relate them to properties.
PEU_U02 - Ability – at the design stage – to select unalloyed steel and cast iron, as well as to consciously select a manufacturing method and chemical composition.

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Mechanical and physical properties of metallic materials. Relationships between the manufacturing process, structure and properties of materials.	2
Lec2	Elements of crystallography, metallic bond, crystal lattices of metals.	2
Lec3	Defects of crystalline structures.	2
Lec4	Balance and criteria of balance. Nucleation and crystallization.	2
Lec5	Metal alloys. Structure and types of alloys. Intermetallic phases. Characteristic of phases presented in alloys of metals.	2
Lec6	Pfase equilibrium diagrams of binary systems. Phase rule.	2
Lec7	Iron-cementite equilibrium diagram. Analysis of diagram.	2
Lec8	Influence of carbon content on microstructures and properties of iron alloys.	2
Lec9	Classification and natation rules of non-alloyed steels.	2
Lec10	Classification and natation rules of cast irons.	2
Lec11	Polymers – classification, properties and application.	2
Lec12	Ceramics – classification, properties and application.	2
Lec13	Composites – classification, properties and application.	2
Lec14	Test	2
Lec15	Test	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Introduction.The aim and methods of materials investigation. Construction and operation of metallographic microscope.	2

Lab2	Macroscopic investigation of materials and investigation of technological defects.	2
Lab3	Analysis of phase balance diagrams of two-component systems.	2
Lab4	Microstructural investigation of mono- and multiphase alloys at etched and non-etched state.	2
Lab5	Diagram and microstructures of iron-cementite diagram analysis.	2
Lab6	Effect of carbon content on microstructure and properties of steel and steel.	2
Lab7	Cast iron - classification, microstructure in the untreated and digested state, properties, application.	2
Lab8	Laboratory summary.	1
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - self studies and preparation for examination N3. laboratory experiment N4. self study - preparation for laboratory class N5. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	test
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02	quiz
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE [1] Haimann.R; Metaloznawstwo; Wyd.PWr; 2000 [2] Dobrzański.L.A, Materiały inżynierskie i projektowanie materiałowe. Podstawy nauki o materiałach i metaloznawstwo, WNT, 2006 [3] Blicharski M., Wstęp do inżynierii materiałowej, WNT, 2012 [4] Dudziński W., Widanka K., Ćwiczenia laboratoryjne z materiałoznawstwa, Oficyna Wydawnicza PWr, 2012 SECONDARY LITERATURE [1] Dudziński W., Materiały konstrukcyjne w budowie maszyn, Wyd.PWr; 1994 [2] Ashby M. F., Jones D.R.H., Materiały inżynierskie, t. 1 i 2, WNT; 1996

SUBJECT SUPERVISOR
dr hab. inż. Dominika Grygier tel.: 320-38-45 email: dominika.grygier@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Mechanics I (Mechanika I)**
Name of subject in English: **Mechanics I**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3082**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	30			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	2	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematical analysis (differentiation, integration)
2. Algebra (at secondary level) + linear algebra (matrices, determinants)
3. Euclidean geometry and trigonometry

SUBJECT OBJECTIVES

C1. Solving of practical static and kinematic problems based on the laws of classical mechanics
C2. Implementing of static analysis of strength of machine elements

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - is able to define the basic concepts in mechanics (force, moment of force). He knows the classical mechanics equations in statics. He knows some selected methods of solving trusses, beams and frames
PEU_W02 - has a knowledge of the geometry of the masses (static moments, moments of inertia and deviation)
PEU_W03 - has a knowledge of the basic concepts of particle kinematics and the kinematics of a rigid body (speed, acceleration, number of degrees of freedom, the trajectory and motion equations)

II. Relating to skills:
PEU_U01 - is able to solve typical engineering structures (trusses, beams, frames) under static load: reactions at the supports, the internal forces (as an analytic functions and their graphs)
PEU_U02 - is able to determine the position of center masses, static moments and moments of inertia of basic mechanical systems and the principal axes and moments of inertia in coplanar system
PEU_U03 - can calculate the velocity and acceleration of any points of typical mechanical systems and their components

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Program, requirements, literature. Outline of vector algebra	2
Lec2	Force, moment of force, the main vector and main moment of forces, equilibrium conditions, the axioms of statics. Changing of the moment’s pole	2
Lec3	Concurrent force system. Trusses. Method of separated nodes	2
Lec4	Determination of the reaction forces in the case of coplanar force systems (applying in the beams, trusses, plane frames, etc.)	2
Lec5	Ritter’s method to determining the forces in selected truss members. The reduction of coplanar force system. Culmann’s method.	2
Lec6	The internal forces in statically determinate beams (analytical method)	2
Lec7	Determination of internal forces in the frames	2
Lec8	Centre of masses in discrete and continuous systems. Static moments	2
Lec9	Moments of inertia, parallel and rotational transformation	2
Lec10	Principal axes and moments of inertia in coplanar system	2
Lec11	Particle kinematics (trajectory, velocity, acceleration). Curvilinear motion, tangential and normal acceleration. Kinematics in the natural and polar coordinate system	2
Lec12	The motion of a rigid body. Degrees of freedom. Classification of the motion of a rigid body. Formulas for calculation the velocity and acceleration in the general motion case.	2

Lec13	Kinematics of rigid body rotation. Rotational velocity and acceleration. Plane motion. Methods for determining the velocity of the plane motion (instantaneous center of rotation, centroid)	2
Lec14	Test 1	2
Lec15	Test 2	2
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Basic operations on vectors: analytical and graphical summation, scalar and vector multiplication, etc.	2
Cl2	Determination of forces in the bars of planar systems (trusses) by separated nodes method using equilibrium equations and polygon of forces	2
Cl3	Determination of reaction forces in bearings of any planar systems by analytical methods	2
Cl4	Determination of reaction forces in bearings of spatial systems (one example)	1
Cl5	Determination of forces in freely selected truss rods (by Ritter's method)	1
Cl6	Determination of internal forces in beams	2
Cl7	Determination of internal forces in beams (cont.). Articulated beams.	2
Cl8	Determination of internal forces in frames (simple planar frames at most with one node)	2
Cl9	Determination centers of masses and static moments.	2
Cl10	Determination of the moments of inertia in planar discrete-continuous systems and deviation moments relative to any axis by application Steiner's law.	2
Cl11	Determination of the position of the principal central axis of inertia and values of the principal inertial central moments for planar systems (one example).	2
Cl12	Solving the problems of particle kinematics in the Cartesian coordinate system.	2
Cl13	Solving the kinematic problems of rotation and translatory motion of rigid body.	2
Cl14	Determination of velocity in plane motion of a rigid body. Superposition method and instantaneous center of rotation for velocity.	2
Cl15	Test 1	2
Cl16	Test 2	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. calculation exercises N3. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. B. Gabryszewska, A. Pszonka: "Mechanics", Part 1: Statics, WUT, 1988
2. J. Leyko :"General Mechanics", Part 1 Statics and kinematics, PWN 2022
3. J. Zawadzki, W. Siuta: "General Mechanics", PWN, Warsaw 1971
4. J. Misiak: "General Mechanics. Statics and Kinematics ". Volume I, WNT, Warsaw, 1993
5. C. Witkowski, "Exercises in mechanics." Part I. "Kinematics". WUT. 1999
6. Z. Jaśniewicz , "Exercises in statics “ WUT. 1996
7. J. Nizioł: "Methodology of solving problems in mechanics", PWN 2023

SECONDARY LITERATURE

1. J. Giergiel: "General Mechanics", WNT, Warsaw, 1980
2. B. Skalmierski: "Mechanics" PWN, Warsaw, 1977
3. S. Piasecki, J. Rżysko: "Mechanics" WNT, Warsaw, 1977,
4. W. Siuta: "Engineering Mechanics", WNT, Warsaw, 1968

SUBJECT SUPERVISOR

dr hab. inż. Daniel Lewandowski tel.: 320-28-99 email: daniel.lewandowski@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Ecology (Ekologia)**
Name of subject in English: **Ecology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3083**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has the basic knowledge of chemistry, biology and ecology.
2. Makes use of reference literaturę, exploits available sources, both via the Internet and in print form.

SUBJECT OBJECTIVES

C1. To get the student acquainted with the basic problems of ecology and environmental protection.
C2. To get to know threats resulting from human activity.
C3. Familiarisation with modern solutions serving environmental protection.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Has the basic knowledge of the hazards arising from the industrial activities.
PEU_W02 - Has the knowledge of the international conventions and Polish environmental regulations.
PEU_W03 - Can characterize modern solution for environmental protection.

II. Relating to skills:

III. Relating to social competences:
PEU_K01 - Has the awareness regarding the importance of non-technical impacts of anthropogenic activity.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to the course - Ecological problems of the modern world.	1
Lec2	Conventional energy sources (coal, crude oil and natural gas) and their impact on the environment.	2
Lec3	Renewable energy sources (solar, wind, water, geothermal).	2
Lec4	Ways of energy storage.	1
Lec5	Biomass and biofuels.	1
Lec6	Causes and effects of air pollution (greenhouse effect, ozone hole, smog, acid rain).	2
Lec7	Ecological solutions used in cars (catalyst, DPF, EGR, lambda probe). Zero emission cars.	1
Lec8	Water pollution. Wastewater treatment and water treatment.	2
Lec9	Soil pollution and degradation. Loss of biodiversity.	1
Lec10	Final test.	2
		Total hours: 15

TEACHING TOOLS USED

N1. tutorials
N2. multimedia presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01 ÷ PEU_W03	Written final test
F2	PEU_K01	
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE Reliable internet sources SECONDARY LITERATURE

SUBJECT SUPERVISOR
dr hab. Agnieszka Baszczuk tel.: 320-32-21 email: agnieszka.baszczuk@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Programming in MATLAB (Informatyka podstawy programowania Matlab)**
Name of subject in English: **Programming in MATLAB**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3084**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				60	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge about structure of a computer and its components, as well as on operating systems and principles of algorithm structure.
2. Knowledge of mathematics, covering basic problems of geometry, algebra and analysis.
3. Basic knowledge in the filed of CAE instruments.

SUBJECT OBJECTIVES

C1. Familiarize with Matlab programming principles, as applied to performing engineering and scientific calculations.
C2. To understand the principles of statistical analysis of experimental results and their visualization (2-D and 3-D graphics) in the Matlab environment.
C3. Getting acquainted with principles of modelling simple technical systems using the Simulink module.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:

PEU_U01 - Students will be capable of performing mathematical calculations in the Matlab environment including: matrix calculus and issues related to solving systems of algebraic equations.
PEU_U02 - The student is able to use the two-dimensional and three-dimensional graphics to visualize experimental data and
calculation results.
PEU_U03 - Students are able to identify and construct a simple object model and run a simulation in Matlab /Simulink.

III. Relating to social competences:

PEU_K01 - The student is able to analyze problems and solve them creatively using modern IT tools.
PEU_K02 - The student is able to use the literature recommended for the course and independently search and expand the acquired knowledge.
PEU_K03 - The student understands the need for systematic and independent work to master the necessary skills of the course.

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction to programming in the Matlab.	2
Proj2	Basics of algebraic and logical calculations.	2
Proj3	Vector and matrices calculus in Matlab.	2
Proj4	M-scripts programming.	2
Proj5	Function programming in Matlab.	2
Proj6	Experimental data visualization using 2D and 3D graphics.	2
Proj7	Mathematical instructions polyfit, polyval type. Curve fitting box.	2
Proj8	Data statistics.	2
Proj9	Linear equation solving.	2
Proj10	Introduction to Slimulink library of blocks.	2
Proj11	The basics of the application of Simulink in the field of automation.	2
Proj12	Construction of models and simulation of physical phenomena in the Simulink environment.	2
Proj13	Cruise modeling and control.	2
Proj14	PID controller in Simulink	2
Proj15	Evaluation of acquired skills.	2
		Total hours: 30

TEACHING TOOLS USED
N1. calculation exercises N2. tutorials N3. self study - preparation for project class N4. problem exercises

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02, PEU_K03	report, test
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE MATLAB: an introduction with applications, Amos Gilat 2017 SECONDARY LITERATURE www.mathworks.com

SUBJECT SUPERVISOR
dr inż. Dariusz Poroś tel.: 27-91 email: dariusz.poros@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Statistics for Engineers (Statystyka inżynierska)**
Name of subject in English: **Statistics for Engineers**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3085**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic knowledge of mathematics confirmed positive marks on the upper secondary school leaving certificate

SUBJECT OBJECTIVES

C1. To introduce students to statistical models and their possible applications
C2. To introduce students to statistical methods and their possible applications
C3. To introduce students to probability distributions and their possible applications

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - knows basic concepts and facts about mathematical statistics
PEU_W02 - knows the basic probability distributions, their parameters and methods for estimating them

II. Relating to skills:
PEU_U01 - able to apply statistical analysis to the data obtained and draw conclusions from the analysis carried out
PEU_U02 - able to use basic tools to determine the type of probability distribution and to estimate its parameters

III. Relating to social competences:
PEU_K01 - acquisition and consolidation of competence to understand the need for self-study, including the ability to improve attention and focus on what's important and to develop the ability to independently apply their knowledge and skills and to find the information and its critical analysis

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Statistical methods of data analysis - the essence of statistical modeling. Descriptive analysis of data: forms of representation of statistical data, measures of association, variability, asymmetry and concentration.	2
Lec2	Preparation and presentation of statistical material. The grouping of data - ranks easy and distribution. Histogram and empirical cumulative distribution.	2
Lec3	Random variables and their distributions. Numerical characteristics of the distribution. Selected discrete and continuous distributions.	2
Lec4	Interval estimation. Confidence intervals for mean, variance, coefficient of structure.	2
Lec5	Parametric statistical hypothesis. Testing hypotheses about the mean value, of the equality of two average values. Testing hypotheses about the rate structure and the equality of two indicators structure. Testing hypotheses about the variance and the equality of two variances.	2
Lec6	Nonparametric hypothesis testing. Chi-squared test, Kolmogorov-Smirnov. Test of independence Pearson chi-square. Depending measures based on chi-square.	2
Lec7	Correlation and regression analysis. Method of least squares. Linear regression function. Estimation of regression function parameters. Confidence intervals of linear regression parameters.	2
Lec8	Colloquium	1
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Organisational matters. Introduction to using a spreadsheet. Excel's mathematical and statistical functions. Descriptive statistics - calculating measures of location, variability, asymmetry and concentration.	2

Proj2	Construction of distribution series. Determination of parameters of a distribution series (mean, standard deviation, etc.). Graphical presentation of a data set - histogram and empirical distribution and box plot.	2
Proj3	Basic distributions found in mathematical statistics: normal distribution, exponential distribution, Weibull distribution, etc. Determination of distribution parameters. Determining the type of distribution from the histogram and the distribution.	2
Proj4	Calculations in point and interval estimation of expected value, structure index (fraction), variance and standard deviation.	2
Proj5	Statistical hypothesis verification calculations. Parametric significance tests for the expected value and for the variance of the general population. Test for two variances, for two means and two structure indices.	2
Proj6	Calculations for non-parametric significance tests - Pearson's chi-square2 consistency test, Kolmogorov's lambda consistency test.	2
Proj7	Calculations in correlation and regression analysis. Method of least squares. Linear regression function. Estimation of regression function parameters. Confidence intervals of linear regression parameters.	2
Proj8	Colloquium	1
		Total hours: 15

TEACHING TOOLS USED
N1. calculation exercises N2. traditional lecture with the use of transparencies and slides N3. problem discussion

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02	Colloquium
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement

F1	PEU_U01, PEU_U02, PEU_K01	Colloquium
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE [1] Bobrowski D: Probabilistyka w zastosowaniach technicznych. Warszawa 1986, WNT[2] Nowak R.: Statystyka dla fizyków. Warszawa 2002, Wydawnictwo Naukowe PWN[3] Ostasiewicz W. (red.): Statystyczne metody analizy danych. Wrocław 1999, Wydawnictwo AE we Wrocławiu[4] Zeliaś A., Pawełek B., Wanat S.: Metody statystyczne. Zadania i sprawdziany. Warszawa 2002, PWE SECONDARY LITERATURE [1] Bąk I., Markowicz I., Mojsiewicz M., Wawrzyniak K.: Statystyka w zadaniach. Część I i II. Warszawa 2001. Wydawnictwo Naukowo-Techniczne[2] Cieciura M., Zacharski J.: Metody probabilistyczne w ujęciu praktycznym. Warszawa 2007, VIZJA PRESS&IT Sp. z o. o.[3] Dobosz M.: Wspomagana komputerowo statystyczna analiza wyników badań. Warszawa 2001, Akademicka Oficyna Wydawnicza EXIT.[4] Frątczak E., Gach-Ciepiela U., Babiker H.: Analiza historii zdarzeń. Elementy teorii, wybrane przykłady zastosowań. Warszawa 2005, Szkoła Główna Handlowa w Warszawie.[5] Kukiełka L: Podstawy badań inżynierskich. Warszawa 2002, Wydawnictwo Naukowe PWN. [6] Maliński M.: Statystyka matematyczna wspomagana komputerowo. Gliwice 2000, Wydawnictwo Politechniki Śląskiej [7] Paleczek W.: Metody analizy danych na przykładach. Częstochowa 2004, Politechnika Częstochowska[8] Turzeniecka D.: Ocena niepewności wyniku pomiarów. Poznań 1997, Wydawnictwo Politechniki Poznańskiej

SUBJECT SUPERVISOR
dr hab. inż. Artur Kierzkowski tel.: 71 320-20-04 email: artur.kierzkowski@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Engineering Graphics 3D (Grafika inżynierska 3D)**
Name of subject in English: **Engineering Graphics 3D**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3086**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				60	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Requirement of knowledge of the course "Engineering Graphics - Descriptive Geometry"
2. Requirement of knowledge of the course "Engineering Graphics: Engineering Drawing "
3. Requirement of handling skills of computer hardware

SUBJECT OBJECTIVES

C1. Knowledge and skills in the field of 3D modeling of the machines parts and assemblies
C2. Knowledge and skills in range of machinery and equipment research and analysis on the virtual models (virtual prototyping)
C3. Knowledge and skills in range of technical drawing based on 3D models

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:
PEU_U01 - Students should be able to build 3D models of machine parts
PEU_U02 - Students should be able to build 3D models of the machines parts and assemblies and verify models and their parameters
PEU_U03 - Students should be able to make 2D technical drawing based on a 3D model

III. Relating to social competences:
PEU_K01 - Student gains the skills to take responsibility for their work

PROGRAM CONTENT		
Form of classes – Project		Number of hours
Proj1	Introduction to solid modeling - basic solid modeling operations, the rules of creation of a 2D sketch, fittings in the sketch (geometric and dimensional fittings)	2
Proj2	Basic solid modeling - Advanced operations on 2D sketches, solid modeling with extrude methods	2
Proj3	Solid Modeling Basics - operations on solids: chamfering, rounding, tilting walls, constructions (point, axis, plane), the creation of the ribs, the holes wizard, duplication of the solid operations	2
Proj4	Basic solid modeling - Advanced operations on 2D sketches - function relationships of parameters, solid modeling with rotation, solid editing - shell models	2
Proj5	Basic solid modeling - solid modeling with rotation, one and multibody modeling	2
Proj6	Advanced solid operations - sweep, loft, split, scroll	2
Proj7	The project of assembly: the concept, the construction of the parts by using the known solid modeling methods	2
Proj8	The project of assembly: preparing to create an assembly- parts assembling, bonds and relationships in the assembly	2
Proj9	The project of assembly: parts assembling, parts editing in an assembly, a library of standard parts	2
Proj10	The project of assembly: parts modeling in the assembly environment, the adaptability of the parts	2
Proj11	The project of assembly: analysis of the functional correctness of the assembly (parameters analysis, kinematic analysis, analysis of collision) rectify design faults, loads analysis	2
Proj12	The project of assembly: loads analysis, reactions and forces at the nodes, the presentation of the model	2

Proj13	The project of assembly: 2D technical drawings of parts - manufacturing parts drawings	2
Proj14	The project of assembly: 2D technical drawings of assembly - assembly drawings	2
Proj15	Completion of the course: work during classes	2
		Total hours: 30

TEACHING TOOLS USED
N1. project presentation N2. problem discussion N3. self study - preparation for project class N4. independent work on the computer under the tutor supervision

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03 PEU_K01	test, participate in problem discussions
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE https://knowledge.autodesk.com/support/inventor/ SECONDARY LITERATURE Zbiór ćwiczeń Autodesk Inventor 2020 Kurs podstawowy Fabian Stasiak

SUBJECT SUPERVISOR
dr inż. Tadeusz Lewandowski tel.: 71 320-24-65 email: tadeusz.lewandowski@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Fluid Mechanics (Mechanika płynów)**
Name of subject in English: **Fluid Mechanics**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3087**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	60	30			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	2	1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has a structured knowledge of mathematics, including algebra and mathematical analysis - vector analysis
2. Structured knowledge of classical physics and mechanics.
3. Structured knowledge of the basics of machine design.

SUBJECT OBJECTIVES

C1. Learning the basic laws of mechanics in relation to the flow of liquids and gases.
C2. Ability to use the basic laws of fluid mechanics in the construction and design of machines.
C3. Ability to use the basic laws of fluid mechanics in the operation of machines.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Be able to define the basic laws in fluid mechanics
PEU_W02 - Explain the principles of operation of machines and phenomena occurring in their construction and operation.
PEU_W03 - Indicate the connections between the basic laws of fluid mechanics and the principles of operation machine accessories.

II. Relating to skills:
PEU_U01 - Analyze the course of phenomena related to flows in the operation of machines.
PEU_U02 - Structured knowledge in the theory of machine construction.
PEU_U03 - Can combine the laws of fluid mechanics with the issues of design and operation of machines.

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, properties of liquids and gases, forces and stresses in fluids, Fluids Newtonian and non-Newtonian.	2
Lec2	Methods of fluid motion analysis, streamlines, potential and vortex flows. Flow visualization methods. Fluid kinematics	2
Lec3	Basic equations of fluid mechanics, continuity equation, equation conservation of momentum for ideal and real fluids (Euler equation and Navier-Stokes)	2
Lec4	Hydrostatic equations, connected vessels, pressure of liquid on walls, buoyancy and stability of floating bodies. Fluid balance.	3
Lec5	Inviscid fluid dynamics, Bernoulli equation, examples of applications: measurements speed, flow of liquid through holes, suction action of the jet.	2
Lec6	The principle of angular momentum and angular momentum, hydrodynamic reaction, basic theory flow machines.	2
Lec7	Dynamics of viscous fluids. Flow classification, laminar flow. basics of the boundary layer theory. Navier-Stockes equation	2
Lec8	Examples of solutions to N-S equations, flows in axisymmetric ducts.	2
Lec9	The transition from laminar to turbulent flow. Reynolds experiment. Elements of the theory of turbulent flows. Methods of calculating turbulent flows. Detachment of the boundary layer.	4
Lec10	Hydrodynamic theory of lubrication in bearings, flows through gaps.	1
Lec11	Flow around bodies, flow resistance, hydrodynamic buoyancy, airfoil, characteristics hydrodynamic profiles.	2
Lec12	Fluid flow in pressurized lines. Flow in a closed conduit with a circular crosssection. Hydraulic losses due to friction. Hydraulic losses caused by local resistances.	2

Lec13	Steady flow of fluids in hydraulic systems. Unsteady flow of fluids in lines.	2
Lec14	Numerical methods in fluid mechanics.	2
		Total hours: 30

Form of classes – Classes		Number of hours
Cl1	Introduction to fluid mechanics exercises. Solving tasks in the field of basic properties of fluids.	1
Cl2	Tasks illustrating the application of Euler's equation and Pascal's law. Calculation hydrostatic forces. Connected dishes. Manometric measurements.	2
Cl3	Fluid statics. Pressure force on straight and curved surfaces.	2
Cl4	Fluid statics. Buoyancy issues. Fluid in equilibrium.	2
Cl5	Application of the Bernoulli equation and the continuity equation for liquid flow calculation and measurement flow rate. Local velocity measurement.	3
Cl6	Calculation of pressure losses in closed pipes. Designation pipeline characteristics.	2
Cl7	Calculation of flows through fractures.	2
Cl8	test	1
		Total hours: 15

TEACHING TOOLS USED
N1. problem lecture N2. traditional lecture with the use of transparencies and slides N3. calculation exercises

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01 - PEU_W03	test
P = 0.5*F1+0.5*FC		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03	test
P = F1=FC		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE B. R. MUNSON, D. F. YOUNG, T. H. OKIISHI: Fundamentals of Fluid Mechanics, SECONDARY LITERATURE Fluid Mechanics, 9th Edition ISBN10: 1260258319 | ISBN13: 9781260258318 By Frank White

SUBJECT SUPERVISOR
dr inż. Krzysztof Patralski tel.: 2667 email: krzysztof.patralski@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Materials Science (Materiałoznawstwo)**

Name of subject in English: **Materials Science**

Main field of study (if applicable): **Mechanical Engineering and Machine Building**

Specialization (if applicable): **Mechanical engineering design**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **W10MBM-SI3088**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	90		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	3		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.8		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The basic knowledge of physics and chemistry.
2. The passed lecture of Fundamentals of materials science (the requirement does not have formal character - it is related with knowledge and abilities given in course card - Fundamentals of materials science)
3. Basic knowledge in the fields of classical mechanics and thermodynamics.

SUBJECT OBJECTIVES

C1. Acquiring knowledge about technically important groups of metal alloys, their designation systems and their application criteria in specific service conditions.
C2. Gaining ability to understand the balance between strength and plasticity of metallic materials, as well as possibility to control these properties by chemical composition and microstructure formed in manufacturing process of finished products.
C3. Acquisition of knowledge about the basics of heat, termo-chemical and plastic teratment of iron alloys.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Elementary knowledge of basic construction materials, their properties and possible applications in the construction of machines, devices and vehicles.
PEU_W02 - Understanding of phase transitions occurring in metal alloys and knowledge about their effect on selection of thermal and thermochemical treatment parameters.
PEU_W03 - Understanding of information given in material standards concerning delivery conditions, recommended heat treatment and achievable properties.

II. Relating to skills:
PEU_U01 - Ability to select kind and parameters of heat treatment for specific alloys in order to obtain preset properties.
PEU_U02 - Ability to interpret microstructures of products after various manufacturing processes and to relate them to properties.

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Phase transformations in iron-carbon alloys during heating and cooling.	2
Lec2	Basic kinds of annealing iron-carbon alloys. Quench hardening and tempering.	2
Lec3	CTP diagrams and their interpretation.	2
Lec4	Surface treatment: surface hardening, carburizing, nitriding.	2
Lec5	Plastic deformation and recrystallizations annealing of metals.	2
Lec6	Influence of alloying elements for phase transitions in iron-carbon alloys.	2
Lec7	Constructional alloyed steels.	2
Lec8	Steels with special properties, corrosion-resisting steel.	2
Lec9	Steels with special properties, creep-resisting and heat-resisting.	2
Lec10	Cold forming steels. New generation multiphase steels.	2
Lec11	Alloyed tool stels.	2
Lec12	Casting iron alloys.	2
Lec13	Aluminum alloys – classification, designation, structures and properties, heat treatment, selection criteria	2
Lec14	Heavy and light metal alloys (zinc, lead, nickel, cobalt, magnesium, titanium, beryllium) – classification, designation, structures and properties, heat treatment, selection criteria.	2
Lec15	Copper alloys - classification, structures and properties, application.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Plastic deformation and recrystallizations annealing of steels.	2
Lab2	Influence of thermal treatment on microstructure and properties of steels.	2
Lab3	Microstructure of surface-hardened steel products.	2
Lab4	Microstructure and properties of tool alloyed steels.	2
Lab5	Microstructure and properties of corrosion-resisting steel.	2
Lab6	Microstructure and properties of aluminium alloys.	2
Lab7	Microstructure and properties of copper alloys.	2
Lab8	Summary and passing of laboratory classes.	1
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - self studies and preparation for examination N3. self study - preparation for laboratory class N4. laboratory experiment N5. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	Test
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02	quiz
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE [1] Haimann.R; Metaloznawstwo; Wyd.PWr; 2000 [2] Dobrzański.L.A, Materiały inżynierskie i projektowanie materiałowe. Podstawy nauki o materiałach i metaloznawstwo, WNT, 2006 [3] Blicharski M., Wstęp do inżynierii materiałowej, WNT, 2012. SECONDARY LITERATURE [1] Dudziński W., Materiały konstrukcyjne w budowie maszyn, Wyd.PWr; 1994 [2] Ashby M. F., Jones D.R.H., Materiały inżynierskie, t. 1 i 2, WNT; 1996

SUBJECT SUPERVISOR
dr hab. inż. Dominika Grygier tel.: 320-38-45 email: dominika.grygier@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Mechanics II (Mechanika II)**
Name of subject in English: **Mechanics II**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3089**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	30			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	2	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematical analysis (differentiation, integration), linear algebra, trigonometry
2. Differential equations (ordinary, linear) in the variables separation methods and the characteristic equation areas
3. Mechanics in range of statics and kinematics

SUBJECT OBJECTIVES

C1. Solving technical problems of mechanisms in the field of kinematics - acceleration and velocity.
C2. Knowledge of analytical methods for the application of the principles of classical dynamics for typical mechanical systems (discrete systems: mass particle, system of masses particles with holonomic constrains, rigid body).
C3. Resolving some technical problems of structure and mechanical systems under dynamic loads.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

PEU_W01 - Is able to define key concepts in the dynamics of mechanical systems (momentum, angular momentum, force of inertia, work, kinetic and potential energy)

PEU_W02 - Knows the basic concepts in the field of free and forced vibration of mechanical system with one degree of freedom (natural frequency, frequency characteristics, resonance)

PEU_W03 - Knows the basic principles of dynamic (move of the center of mass, momentum, angular momentum, d'Alembert’s principle). He is familiar with the term of conservative system and with energy conservation law. He knows the dynamics equations of rotational motion and plane motion of a rigid body. Dynamics of the rigid body rotation about a fixed point

II. Relating to skills:

PEU_U01 - Can calculate the velocity and acceleration in plane motion of a rigid body and in the relative motion and in the rotation about a fixed point. He can derive the equations of motion of a free and constrained material point for time-varying dynamic loads using the Newton's second principle.

PEU_U02 - Can calculate the frequency of free vibration for systems with one degree of freedom of the linear viscous damping and without damping. He can derive the equations of motion and calculate its parameters (angular velocity and acceleration) for rigid body loaded by torque and moves rotation.

PEU_U03 - Can determine the reaction force constraints under dynamic loads. It can calculate the kinetic and potential energy for complex mechanical systems. He is able to apply the energy conservation law to determine the differential equations of conservative system.

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Program, requirements, literature. Reminder of the basics of kinematics. Velocity in planar motion.	2
Lec2	Acceleration in a planar motion of rigid body.	2
Lec3	Relative motion. Kinematics in a general motion of rigid body. The Coriolis' acceleration.	2
Lec4	The basic principles of classical mechanics. Kinematics and dynamics. Models of discrete and continuous dynamical systems in mechanics.	2
Lec5	The Newton's second law (applicable in the dynamics of the free and constrained point). The concept of inertia force and d'Alembert's principle. The principle of kinetostatics.	2
Lec6	The vibrations of the one-mass single degree of freedom system with the linear viscous damping and without damping. Complex notation. Free vibrations.	2
Lec7	Harmonically forced vibration, frequency characteristics, resonance. Dynamic and kinematic excitations.	2
Lec8	Momentum, and momentum principle. Angular momentum and angular momentum principle.	2

Lec9	The definition of work. Elementary work. The kinetic and potential energy. The principle of work and kinetic energy equivalence.	2
Lec10	Multi-mass systems. Constraints, degrees of freedom. The use of second Newton's laws in multi-mass constrained material systems.	2
Lec11	The principle of the center of mass motion and the principle of momentum in multi-mass systems.	2
Lec12	Total angular momentum and angular momentum principle in the multi-mass systems. Introduction to the dynamics of a rigid body. The equation of the dynamics of a rigid body rotation.	2
Lec13	Using the principle of angular momentum and the equation of rotational dynamics in determining the frequency of free vibration of complex systems. Equivalent mass and stiffness.	2
Lec14	Determination of the dynamic response in a rotating motion. The method of reduction of inertial forces.	2
Lec15	Angular momentum in the plane motion of a rigid body and dynamics of plane motion. The kinetic energy of rigid body in a general motion. The König's theorem.	2
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Kinematics of particle in orthogonal coordinates. Kinematics of rigid body. Plane motion and rotation over permanent axis. Velocity in a plane motion.	2
Cl2	Solving tasks - accelerations in plane motion for mechanisms. The method of superposition and the method of the instantaneous center of accelerations.	2
Cl3	Solving tasks - the kinematics of complex motion. relative motion. Coriolis acceleration.	2
Cl4	Solving examples of tasks with dynamic free mass particle using The Newton's second law (rectilinear and curvilinear motion).	2
Cl5	Solving point dynamics problems using d'Alembert's principle and kinetostatics method.	2
Cl6	The Newton's second law (applicable in the dynamics of the constrained mass particle).	2
Cl7	Solving tasks - dynamics of relative motion of a material point.	2
Cl8	Solving tasks - free vibrations of simple mechanical systems with one degree of freedom (determination of free vibration frequencies and the motion equations) with and without damping.	2
Cl9	Rozwiązywanie zadań z drgań wymuszonych punktu materialnego o jednym stopniu swobody. Wyznaczanie częstości rezonansowej.	2
Cl10	Examples of the tasks of the dynamics of particle (momentum principle, the principle of conservation of energy).	2
Cl11	Examples of the tasks of the dynamics and rotational motion of the rigid body using momentum principle, angular momentum principle and mass center movement rule.	2
Cl12	Solving tasks - dynamic force responses in the supports of rotated body.	2

Cl13	Solving tasks - equations of motion for rigid body in plane movement.	2
Cl14	Test 1	2
Cl15	Test 2	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. calculation exercises N3. tutorials N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01,PEU_U02,PEU_U03	
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE 1. B. Gabryszewska, A. Pszonka: „Mechanics”, cz. II „Kinematics and Dynamics”, PWr, 1998 2. J. Zawadzki, W. Siuta: „General Mechanics”, PWN, Warszawa 19713. 3. J. Misiak : „General Mechanics. Dynamics”. Tom II, WNT, Warszawa 1993 4. J. Leyko :"General Mechanics", Part 1 Statics and Kinematics, PWN 2022 5. J. Leyko :"General Mechanics", Part 2 Dynamics, PWN 2022 6. J. Nizioł: " Methodology of solving problems in mechanics", PWN 2023 7. I. W. Mieszczerski, "Sets of problems to solving - Mechanics", PWN 1971 SECONDARY LITERATURE 1. J. Giergiel : „General Mechanics”, WNT, Warszawa 1980 2. B. Skalmierski: „Mechanics” PWN, Warszawa 19773. 3. M. Klasztorny: „Mechanics” Dolnośląskie Wyd. Edukacyjne, Wrocław 2000 4. W. Krysicki, L. Włodarski, "Mathematical analysis in problems - Part 2", PWN 2000

SUBJECT SUPERVISOR
dr hab. inż. Daniel Lewandowski tel.: 320-28-99 email: daniel.lewandowski@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Polymers (Tworzywa sztuczne)**
Name of subject in English: **Polymers**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3090**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has got a basic knowledge in the field of materials science and chemistry.

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge on the structure, preparation, modification and properties of polymeric materials.
C2. Acquisition of basic knowledge of technologies used in the processing of polymeric materials.
C3. Gaining the ability to select polymer materials in basicapplications.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - The student knows the basic groups of polymers, their structure, properties.
PEU_W02 - The student knows the technology used for the processing of polymeric materials.
PEU_W03 - The student knows the basic applications of polymeric materials.

II. Relating to skills:
PEU_U01 - Student is able to identify polymeric materials.
PEU_U02 - Student can indicate the processing technology for the production of a selected plastic product.
PEU_U03 - Student can select polymeric materials for specific applications.

III. Relating to social competences:
PEU_K01 - Searches of information and its critical analysis.
PEU_K02 - Team cooperation on improving methods for the selection of a strategy to optimally solve problems assigned to the group.
PEU_K03 - Compliance with the customs and rules of the academic community.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic knowledge, history of polymeric materials, nomenclature, advantages and disadvantages of polymeric materials.	2
Lec2	Comparison of selected properties of polymeric materials with metals.	2
Lec3	Classification and division of polymeric materials. Processes of polymerization and production of plastics.	2
Lec4	Mechanical models of polymer behavior. Behavior of plastics during processing. Polymer rheology.	2
Lec5	Modification of polymers, mixing with additives. Preparation of plastics for processing.	2
Lec6	Technologies and techniques of joining products made of polymeric materials	2
Lec7	Injection technology and its variants	2
Lec8	Practical aspects of injection molding technology	2
Lec9	Extrusion technology and its varieties	2
Lec10	Thermoforming technology	2
Lec11	Tools in plastics processing technologies	2
Lec12	Resin processing and composites production, niche technologies	2
Lec13	Plastics application	2
Lec14	Biodegradation of polymers	2
Lec15	Final test	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Introduction to the laboratory, discussion of the rules of passing the laboratory	1
Lab2	Polymer materials - properties, applications and methods of identification	2
Lab3	Technologies of plastics joining	2
Lab4	Mechanical properties of polymers	2
Lab5	Friction and wear of polymeric materials	2
Lab6	Primary processing technology - extrusion	2
Lab7	Primary processing technology - injection molding	2
Lab8	Secondary processing technologies - Vacuum thermoforming	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - preparation for laboratory class N3. laboratory experiment N4. report preparation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	final test
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01	quiz
F2	PEU_U02	test, oral answer
F3	PEU_U03	quiz, oral answer

F4	PEU_K01, PEU_K02, PEU_K03	oral answer, report
P = (F1+F2+F3+F4)/4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Processing of polymers; Defonseka Chris.; Boston : De Gruyter; 2020;
2. INTRODUCTION TO POLYMERS; Young Robert; LONDON : CHAPMAN AND HALL; 1991;
3. An introduction to plastics; Elias Hans-Georg; Weinheim : Wiley-VCH; 2003;

SECONDARY LITERATURE
1. Physical properties of polymers; Mark James; Cambridge University Press; 2004;

SUBJECT SUPERVISOR

dr inż. Roman Wróblewski tel.: 320-21-70 email: r.m.wroblewski@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Chipless Processes - Casting (Techniki wytwarzania - odlewnictwo)**
Name of subject in English: **Chipless Processes - Casting**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3091**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge about the metallurgical process of metal ores and receiving ferrous alloys and nonferrous metals. Has a basic knowledge about the types of engineering materials - their properties, applications and principles of their selection. Has a basic knowledge about the structure of metals and alloys as well as the principles of their classification and labeling.
2. Can determine the characteristics of the materials microstructure, identify occurring in material phases. Also is able to differentiate: the microstructure of ferrous alloys (in terms of carbon content), non-ferrous alloys and the effect of the heat treatment.
3. Can read and interpret the figures and diagrams used in the technical documentation.

SUBJECT OBJECTIVES

C1. The acquisition of general knowledge about the basic techniques of foundry manufacturing methods.
C2. Acquiring the selection skills and a critical analysis of chosen casting technology and basic parameters of that process.
C3. Acquisition and consolidation of social skills like the ability of working in a group to solve the problems effectively. The acquisition of sense of responsibility and respect for traditions existing in academia and society.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Has a basic knowledge of the manual and machine manufacturing technologies of foundry moulds and cores.
PEU_W02 - Has a knowledge of the basic methods of melting and treatment of metallurgical alloys.
PEU_W03 - Has a basic knowledge about designing the casting products and the processes for their production with principles of technology of their selection dependent on the type of casting and the type of alloy.

II. Relating to skills:
PEU_U01 - Can analyze and design the process of production casting equipment to a simple product.
PEU_U02 - Can choose the right technology for casting and define the basic parameters of that process.
PEU_U03 - Can choose the right method of treatment of the casting alloy and define its basic parameters.

III. Relating to social competences:
PEU_K01 - Can search for information and critically analyze them, rationally explain them and justify the own point of view using the knowledge of foundry branch.
PEU_K02 - Recognizes the importance of team cooperation on ways to choose a strategy to optimally solve problems assigned to a student's group.
PEU_K03 - Understands the need to respect the traditions and rules in academia and society.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational issues. Discussion about the specific shape of the statethe from liquid metal, fundamental concepts and algorithms for casting production.	1
Lec2	Principles for design and construction of casting equipment.	2
Lec3	Materials and equipment used for the preparation of the moulding and core sands and the methods of their manufacturing and testing their properties.	2
Lec4	Methods for manual and automatic manufacturing of foundry moulds and cores.	2
Lec5	Production of moulds and cores from selfsetting and thermosetting moulding sands.	2
Lec6	Manufacturing the castings using a precise technique of lost models. Manufacturing the castings in metal molds.	2

Lec7	Melting the casting alloys. Metallurgical treatment of casting alloys and heat treatment of castings	2
Lec8	Discussion of the basic causes of casting defects. Course summary. Test of knowledge.	2
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Organizational issues. Introduction to the foundry. Health and safety at foundry laboratory work. The specificity of shaping products from the liquid metal state. Basic concepts and algorithms of casting production.	1
Lab2	Research the materials and molding sands.	2
Lab3	Construction of casting models and core boxes. Full mould technology.	2
Lab4	Manual production of foundry moulds and cores.	2
Lab5	Machine production of foundry moulds and cores.	2
Lab6	Production of moulds and cores from self- and thermosetting moulding sands.	2
Lab7	Manufacturing the castings in metal molds.	2
Lab8	Testing the properties of casting alloys.	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - preparation for laboratory class N3. self study - self studies and preparation for examination N4. report preparation N5. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03,	colloquium
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02, PEU_K03,	quiz, report
P = average F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE [1] Granat K. Laboratorium z odlewnictwa, skrypt PWr, Wrocław 2007; [2] Perzyk M. i inni; Odlewnictwo WNT Warszawa 2000; [3] Murza-Mucha P., Techniki wytwarzania – Odlewnictwo. PWN, Warszawa 1978; [4] Tabor A. Odlewnictwo wyd. „Akapit” Kraków 1996; SECONDARY LITERATURE [1] Lewandowski J. L.; Tworzywa na formy odlewnicze, wyd.: „Akapit” Kraków 1997; [2] Błaszkowski K. Technologia formy i rdzenia, Warszawa 1990; [3] Poradnik inżyniera – Odlewnictwo WNT Warszawa 1986; [4] Perzyk M. i inni: Materiały do projektowania procesów odlewniczych, skr. P. Warsz. Warszawa 1981; [5] Jaworski R. Ćwiczenia laboratoryjne z Budowy Maszyn, cz. I Odlewnictwo, skrypt PWr, Wrocław 1981;

SUBJECT SUPERVISOR
dr inż. Mateusz Stachowicz tel.: 713204235 email: mateusz.stachowicz@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Fundamentals of Materials Strength (Podstawy wytrzymałości materiałów)**
Name of subject in English: **Fundamentals of Materials Strength**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3092**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	60	30			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	2	1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of higher mathematics - in particular, vector algebra, integral and differential equations calculation
2. Knowledge of the fundamentals of materials science engineering
3. Knowledge of rigid body mechanics in particular in the principles of statics of bar systems, beams and mass geometry

SUBJECT OBJECTIVES

C1. Understanding of the basics and applications of deformable body mechanics in homogeneous and heterogeneous bodies
C2. Performing strength analysis of machine components and calculating stresses and strains
C3. Students are able to experimentally determine the mechanical properties of materials and calculate permissible stresses

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Knows the generalized Hook's law and can use it to calculate stresses and strains in structural elements subjected to a complex stress state
PEU_W02 - Student is able to formulate strength conditions for a variety of bar and beam structures and has the knowledge necessary to design cross-sections of structural elements
PEU_W03 - Students know the most useful failure criteria and their application and possess the knowledge necessary to solve the classic tasks of mechanics

II. Relating to skills:
PEU_U01 - Know how to apply Hooke's law to stress and strain calculations
PEU_U02 - Ability to perform strength analysis of bar and beam structures
PEU_U03 - Students can design a rod under compression that is resistant to loss of stability

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Basic assumptions and concepts. Experimental determination of strength properties. Allowable stresses and safety factor	2
Lec2	Tension and compression. Static and hyperstatic cases. Thermally stressed rods systems. Stress concentration	2
Lec3	Stress theory. Mohr's circle for a state of plane stress. Physical relationships in spatial stress	2
Lec4	Theory of strain. Engineering measurements of strain	2
Lec5	Torsion of circular shafts	2
Lec6	Torsion of shafts with arbitrary cross-section. Torsion of thin-walled members	2
Lec7	Pure shearing. Technical shearing. Calculation of detachable and nondetachable joints - examples	2
Lec8	General case of beam bending. Symmetrical bending. Beams with uniform bending strength	2
Lec9	Unsymmetrical bending. Bending with shear force. Shear centre	2
Lec10	Beam displacements. The differential equation for the elastic curve of a beam	2
Lec11	Buckling of rods under compression	2
Lec12	Combined loading: bending and tension or compression. Cross-section core	2
Lec13	Elastic strain energy of volumetric and non-dilatational strain. Distortion energy theory. Relations between distortion energy, stress and deformation.	2
Lec14	Material strength hypotheses in a complex stress state. Equivalent stress.	2
Lec15	Written test	2

		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Structures of statically determinable and indeterminate bar systems in tension and compression	2
Cl2	Transformation of plane state of stress and strain state. Generalized Hooke's law.	3
Cl3	Torsion of circular shafts. Torsion of thin-walled members	2
Cl4	Determination of stresses in a bended beam	2
Cl5	Determination of the beam deflection line	2
Cl6	Buckling of bars - calculations	2
Cl7	colloquium	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. calculation exercises

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	written test
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03	colloquium
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Zielnica J., Wytrzymałość Materiałów, WPP, wyd. III, Poznań 2000, str. 554.
Niezgodziński M. E., Niezgodziński T.: Wytrzymałość materiałów. PWN, Warszawa 1998.
Niezgodziński M. E., Niezgodziński T.: Wzory, wykresy i tablice wytrzymałościowe. WNT, Warszawa 1996.
Niezgodziński M. E., Niezgodziński T.: Zadania z wytrzymałości materiałów. WNT, Warszawa 1997.
M. Ostwald: Podstawy wytrzymałości materiałów. Wydawnictwo Politechniki Poznańskiej, Poznań 1997
Jakubowicz A., Orłoś Z., Wytrzymałość materiałów, WNT, Warszawa, 1984
Magnucki K., Szyc W., Wytrzymałość materiałów w zadaniach: pręty, płyty i powłoki obrotowe, Wydawnictwo Naukowe PWN, 2000.

SECONDARY LITERATURE

Broek D.: Elementary engineering - fracture mechanics. Noordhoff Int. Publishing, Leyden, 1974.
Ashby M. F.: Jones D. R.: Materiały inżynierskie. Własności i zastosowania. WNT, Warszawa 1995.
R. C. Hibbeler - Mechanics of Materials, Pearson Prentice Hall
S. Timoshenko, Strength of Materials Part 1, Elementary Theory and Problems, D. Van Nostrand Company, Inc
Willems N., Easley T. J., Rolfe S. T., Strength of Materials, Mc GrawHill Book Company, 1981.
Gere M., Timoshenko S., Mechanics of Materials, PWS-Kent Publishing Company, Boston, 1984.

SUBJECT SUPERVISOR

dr hab. inż. Grzegorz Lesiuk tel.: 713204216 email: grzegorz.lesiuk@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Ordinary Differential Equations (Równania różniczkowe zwyczajne)**
Name of subject in English: **Ordinary Differential Equations**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3093**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	15			
Number of hours of total student workload (CNPS)	30	30			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	1	1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student knows the differential and integral calculus of function of one variable and other branches of mathematics used in this calculus, particularly linear algebra.
2. Student is able to calculate derivatives of functions of one variable, indefinite and definite integrals using methods by parts and by substitution.
3. Student is able to calculate determinants, eigenvalues and eigenvectors of matrix.

SUBJECT OBJECTIVES

C1. Gain basic knowledge about first-order and second-order ordinary differential equations, and systems of differential equations.
C2. Learn how to choose the appropriate method of solving ordinary differential equations and systems of differential equations.
C3. Develop and consolidate the ability to access information and its analysis.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Student has theoretical knowledge of differential equations and knows methods of their solving.
PEU_W02 - Student has knowledge of methods of solving of systems of differential equations.
PEU_W03 - Student has knowledge about applying differential equations as the mathematical model for a physical phenomenon.

II. Relating to skills:
PEU_U01 - Student is able to solve the first-order differential equations.
PEU_U02 - Student is able to solve the second-order differential equations.
PEU_U03 - Student is able to solve systems of differential equations.

III. Relating to social competences:
PEU_K01 - Student understands the necessity of systematical work on all tasks and can estimate time needed for solving the exercise.
PEU_K02 - Student knows the scope of his/her knowledge and abilities, is able to identify lack of knowledge and complete it using the literature.
PEU_K03 - Student acts ethically and understands the importance of intellectual honesty.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	First-order differential equations: the basic definitions. First-order differential equations: the equations with separated variables.	1
Lec2	First-order homogeneous equations. First-order linear inhomogeneous differential equations. Method of variation of constant.	2
Lec3	Orthogonal trajectories. Geometric vmethod of finding integral curves with isoclines.	2
Lec4	Reducible second-order equations. Second-order linear homogeneous differential equations with constant coefficients.	2
Lec5	Second-order linear homogeneous differential equations. Wronskian.	2
Lec6	Second-order linear Inhomogeneous differential equations with constant coefficients. Method of undetermined coefficients. Method of variation of constants.	2
Lec7	Systems of differential equations. Method of elimination.	2
Lec8	Test	2
		Total hours: 15

Form of classes – Classes		Number of hours
Cl1	Solving first-order differential equations with separated variables.	1
Cl2	Solving homogeneous equations. Solving first-order linear inhomogeneous differential equations - the variation of constant method.	2

Cl3	Finding orthogonal trajectories. Solving reducible second-order differential equations.	2
Cl4	Solving second-order linear homogeneous and inhomogeneous differential equations with constant coefficients. The undeterminated coefficients method,	2
Cl5	Solving second-order linear inhomogeneous differential equations with constant coefficients with the variation of constants method.	2
Cl6	Solving second-order linear homogeneous differential equations with usage of Liouville'a formula.	2
Cl7	Solving systems of equations with elimination method.	2
Cl8	Test	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. calculation exercises N3. tutorials N4. work on preparing for classes and tests

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01 + PEU_W02 + PEU_W03	Test
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01 +PEU_U02 + PEU_U03, PEU_K01	Test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. M. D. Greenberg, Ordinary differential equations, John Wiley & Sons, 2012.
2. R. Carlson, Linear ordinary differential equations, Society for Industrial and Applied Mathematics, Philadelphia, 1997.
3. R. E. O'Malley, Thinking about ordinary differential equations, Cambridge University Press, 1997.
4. A. Jeffrey, Linear algebra and ordinary differential equations, CRC Press, 1993.
5. G. Birkhoff, G. C. Rota, Ordinary differential equations, John Wiley & Sons, 1989.
6. R. M. M. Mattheij, J. Molenaar, Ordinary differential equations in theory and practice, John Wiley and Sons, 1996.
7. R. K. Miller, A. N. Michel, Ordinary differential equations, Academic Press, 1982.

SECONDARY LITERATURE
J. H. Hubbard, B. H. West, Differential equations: a dynamical systems approach, Cambridge University Press, Cambridge 2003.
2. N. Finizio, G. Ladas, Ordinary differential equations with modern applications, Wadsworth Publ. Co., 1989.

SUBJECT SUPERVISOR

dr inż. Dorota Aniszewska tel.: 320-27-90 email: dorota.aniszewska@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Fundamentals of Materials Strength (Podstawy wytrzymałości materiałów)**
Name of subject in English: **Fundamentals of Materials Strength**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3094**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			15		
Number of hours of total student workload (CNPS)			30		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)			0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of higher mathematics - in particular, vector algebra, integral and differential equations calculation
2. Knowledge of the fundamentals of materials science engineering
3. Knowledge of rigid body mechanics in particular in the principles of statics of bar systems, beams and mass geometry

SUBJECT OBJECTIVES

C1. Understanding of the basics and applications of deformable body mechanics in homogeneous and heterogeneous bodies
C2. Performing strength analysis of machine components and calculating stresses and strains
C3. Students are able to experimentally determine the mechanical properties of materials and calculate permissible stresses

SUBJECT LEARNING OUTCOMES
I. Relating to knowledge: **II. Relating to skills:** PEU_U01 - Know how to apply Hooke's law to stress and strain calculations PEU_U02 - Ability to perform strength analysis of bar and beam structures PEU_U03 - Student can design a rod under compression that is resistant to loss of stability **III. Relating to social competences:**

PROGRAM CONTENT		
Form of classes – Laboratory		Number of hours
Lab1	Introduction; health and safety rules and organization of measurement methods in the laboratory	1
Lab2	Investigation of mechanical properties of metals. Tensile test	2
Lab3	Strain gauge analysis	2
Lab4	Fatigue testing of metals	2
Lab5	Combined loading - torsion + bending. Strength hypotheses testing - torsion and bending. Determination of Kirchohoff modulus - pure torsion test	2
Lab6	Loss of rod stability - buckling. Compression test	2
Lab7	Symmetrical and unsymmetrical bending - model tests	2
Lab8	Summary of laboratories and examination	2
		Total hours: 15

TEACHING TOOLS USED
N1. laboratory experiment N2. self study - preparation for laboratory class

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02	Oral answers, laboratory reports

P = F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Zielnica J., Wytrzymałość Materiałów, WPP, wyd. III, Poznań 2000, str. 554.
Niezgodziński M. E., Niezgodziński T.: Wytrzymałość materiałów. PWN, Warszawa 1998.
Niezgodziński M. E., Niezgodziński T.: Wzory, wykresy i tablice wytrzymałościowe. WNT, Warszawa 1996.
Niezgodziński M. E., Niezgodziński T.: Zadania z wytrzymałości materiałów. WNT, Warszawa 1997.
M. Ostwald: Podstawy wytrzymałości materiałów. Wydawnictwo Politechniki Poznańskiej, Poznań 1997
Jakubowicz A., Orłoś Z., Wytrzymałość materiałów, WNT, Warszawa, 1984
Magnucki K., Szyc W., Wytrzymałość materiałów w zadaniach: pręty, płyty i powłoki obrotowe, Wydawnictwo Naukowe PWN, 2000.

SECONDARY LITERATURE
Broek D.: Elementary engineering - fracture mechanics. Noordhoff Int. Publishing, Leyden, 1974.
Ashby M. F.: Jones D. R.: Materiały inżynierskie. Własności i zastosowania. WNT, Warszawa 1995.
R. C. Hibbeler - Mechanics of Materials, Pearson Prentice Hall
S. Timoshenko, Strength of Materials Part 1, Elementary Theory and Problems, D. Van Nostrand Company, Inc
Willems N., Easley T. J., Rolfe S. T., Strength of Materials, Mc GrawHill Book Company, 1981.
Gere M., Timoshenko S., Mechanics of Materials, PWS-Kent Publishing Company, Boston, 1984.

SUBJECT SUPERVISOR

dr hab. inż. Grzegorz Lesiuk tel.: 713204216 email: grzegorz.lesiuk@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Industrial Metrology (Metrologia przemysłowa)**
Name of subject in English: **Industrial Metrology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3095**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			15		
Number of hours of total student workload (CNPS)			30		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)			0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of mathematics and physics at secondary school level
2. Student has the ability to read drawings and diagrams contained in the technical documentation.
3. Student has basic knowledge in the design of machine elements. It has a basic knowledge of manufacturing techniques of machine parts.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge on the implementation of measurement and test processes in industrial conditions
C2. Acquisition of knowledge about the types and properties of equipment for measuring geometrical quantities used in industrial manufacturing processes
C3. Searching for relevant information and its critical analysis.
C4. Gaining knowledge and skills in the selection of test equipment, analyze test results, evaluation of measurement errors and the expression of measurement uncertainty.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:

PEU_U01 - Understands the dimensional requirements imposed to products included in the technical documentation. Can use standards for tolerances and fits linear and geometric tolerances. It can calculate the value of measurement errors, estimated measurement uncertainty for the different measurements.
PEU_U02 - He can make the selection of appropriate test equipment and set it up depending on the task measuring. Can use measuring equipment used in engineering to measure the geometrical quantities.
PEU_U03 - Able to solve the basic problems of the practical use of the tools and of measuring. Able to recognize sources of error, their values, and estimate the uncertainty of measurement.

III. Relating to social competences:

PEU_K01 - Search for information and its critical analysis
PEU_K02 - Objective evaluation of arguments, the rational explanation of his own point of view using the knowledge of metrology.

PROGRAM CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Organizational matters.	1
Lab2	Study of the influence of the metrological characteristics of measurement systems on their measurement properties	2
Lab3	Design and verification of the correctness of the dimensional control gauge	2
Lab4	Wzorcowanie wybranych przyrządów pomiarowych	2
Lab5	Determination of measurement uncertainty. Building an uncertainty budget.	2
Lab6	2D coordinate measurements on a measuring microscope using QM Data 200	2
Lab7	2D coordinate measurements on a measuring microscope of rotating elements in a polar coordinate system	2
Lab8	3D coordinate measurements on a coordinate measuring machine	2
		Total hours: 15

TEACHING TOOLS USED

N1. laboratory experiment
N2. self study - preparation for laboratory class
N3. report preparation
N4. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01; PEU_U02; PEU_U03; PEU_K01; PEU_K02;	lab report, oral answer, quiz
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SECONDARY LITERATURE

SUBJECT SUPERVISOR
dr inż. Marek Kuran tel.: 27-28 email: marek.kuran@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Drive Systems (Układy napędowe pojazdów)**
Name of subject in English: **Drive Systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3096**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. positive marks of mechanics, mathematical analysis and construction of foundations
2. basic knowledge of working various systems or machines devices
3. basic ability to work in groups

SUBJECT OBJECTIVES

C1. The aim of the course is to broaden the knowledge of the construction vehicle drive systems and their components. The student gets acquainted with the methods of developing and preparing the characteristics of individual components of drive systems, traction characteristics and primary energy sources.
C2. The aim of the course is to acquire practical knowledge of the methods of calculation and selection of individual drive components and determine how to prevent undesirable phenomena such as the cruise power, etc. He knows the need for further professional development.
C3. The aim of the course is the acquisition of practical skills experiment planning, conducting it and interpreting the results. The student is aware of the impact of selected environmental solutions and is able to use the correct terminology. Student is responsible for own work and group work.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - primary energy sources can be selected and the characteristics are known; Student can describe the power flow through the various elements of the powertrain, hydrostatic, hydrodynamic and mechanical, drivetrain components are selected on the basis of calculations and characteristics.
PEU_W02 - can point out already used drive systems and improve them to suit the needs based on the development of technology
PEU_W03 - is able to describe and explain the principles of operation of the various components of driving systems, indicate the potential for adverse effects and identify methods for their elimination.

II. Relating to skills:
PEU_U01 - can also use foreign literature to interpret the results obtained in the laboratory experiments and can use of catalogs;
PEU_U02 - is able to analyze and develop the results in order to obtain the characteristics or parameters measured in the driving system of vehicles and machinery at different settings of the control system
PEU_U03 - is able to offer own ideas and design own driving control systems performing similar functions.

III. Relating to social competences:
PEU_K01 - is capable and understands the need for continuous updating of skills and acquire new kwowledge;
PEU_K02 - is responsible for the decisions both in terms of environmental and mechanical engineering activities;
PEU_K03 - is able to work in a team and solve the tasks assigned to the various positions and is responsible for the group to achieve its intended purpose.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Conventional and non-conventional energy sources. Storage methods for mechanical, electrical and hydraulic energy. Characteristics of energy sources - control principles. Non-conventional energy sources (e.g. fuel cells and others) - examples of applications and development trends.	2

Lec2	Systematics of drive systems (single-source, multi-source, series, parallel, hybrid systems) - application examples. Basic functions performed by drive systems. Construction and principle of operation of the various components downstream of the energy source to the ground (gears, various types of wheel speed differential mechanisms, decelerators, tire wheel theory).	2
Lec3	Drive systems with "rigid" and "flexible" kinematic coupling. The issue of kinematic incompatibility and circulating power in drive systems - physical basis, technical effects, ways to eliminate - examples. The efficiency of mechanical transmissions.	2
Lec4	Fundamentals of drivetrain structure selection and primary energy source selection issues: a) typical mechanical drivetrain b) typical hydrokinetic drivetrain. Resistance to the motion of vehicles and energy requirements of machinery and vehicles. Tire wheel theory, rolling resistance, coefficient of adhesion. Traction characteristics of on-road and off-road vehicles.	2
Lec5	Electric vehicles and their classification. Parameters determine the electric motor's suitability for use in electric and hybrid vehicle drive systems. Design, speed, and torque control methods strategies, efficiency maps. Calculation of reduced drive torque and moment of inertia to the motor shaft. Selection of motoreducers and determination of transmission system dynamics.	2
Lec6	Hybrid series and parallel drive systems. Methods of calculating power requirements during movement and selection of both energy sources, secondary energy source capacities, urban, non-urban cyclograms.	2
Lec7	Basics of vehicle recuperative braking. Energy recovery, braking system control strategies. 45 minuts exam.	3
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Experimental testing of a hydrostatic vehicle driving system	2
Lab2	Experimental study of the hydrostatic boom lift drive system of a vehicle	2
Lab3	Determination of the external characteristics of a self-ignition combustion engine	2
Lab4	Experimental determination of the characteristics of a selected energy consumer and determination of transmission efficiency.	2
Lab5	Study of the influence of the stiffness of the elastic bond in the drive train on its dynamic loads	2
Lab6	Experimental testing of elastomeric tracks hybrid drive	2
Lab7	Comparison of the start-up process of a drive system with an asynchronous motor	2
Lab8	Preparatory activities. Presentation of the rules of the course, plan, health, and safety. General information about the implemented course.	1
		Total hours: 15

TEACHING TOOLS USED
N1. multimedia presentation N2. laboratory experiment N3. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01 PEU_W02 PEU_W03	written exam
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03 PEU_K01-PEU_K03	mid-term test, exercise report, oral answer
P = pozytywne oceny z wszystkich ćwiczeń laboratoryjnych		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SECONDARY LITERATURE

SUBJECT SUPERVISOR
dr inż. Aleksander Skurjat tel.: 71 320-23-46 email: Aleksander.Skurjat@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Fundamentals of Machine Design I (Podstawy konstrukcji maszyn I)**
Name of subject in English: **Fundamentals of Machine Design I**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3097**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15	30	
Number of hours of total student workload (CNPS)	90		60	60	
Form of crediting	Examination		Crediting with grade	Crediting with grade	
Group of courses					
Number of ECTS points	3		2	2	
including number of ECTS points for practical (P) classes			2	2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.8		1.4	1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge: 1 It has a basic understanding of the types of engineering materials, their structure, properties and properties, processing, applications and selection rules. 2 It has a basic knowledge of mechanics, strength of materials and manufacturing techniques. 3 He has knowledge of the methods of mapping geometric formations on the plane and the principles of saving design of machine elements and the performance of their schemes.
2. Skills: 1 Able to read and interpret drawings and diagrams used in the technical ability to perform the technical documentation. 2 It has self-learning ability, and is able to retrieve information from various sources, to make their interpretation, and to draw conclusions and formulate and justify opinions. 3 It can be used in the process of constructing knowledge gained on subjects: Metallurgy, Mechanics, Strength of materials, Engineering Graphics.
3. Competencies: 1 He can think and act in an entrepreneurial manner. 2. Is aware of the seriousness and impact of activities in mechanical engineering, and understands the need for professional activities (both individually and collectively).

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge about the process of design and engineering.
C2. Gaining knowledge of the construction, operation and use of the major machine components (connections) and the rules for their selection and construction.
C3. Gain practical skills to make a simple construction task through a typical solution to the problem, the content of which is to construct a simple device with screw drive (for example, a screw press, bearing puller, scissor lift, car jack, etc.) while using the knowledge of the connections, used in mechanical engineering (screw, bolt, dowel, keyways, spline, serrated, snap-fitting, welded and spring).

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - He has knowledge in the design, principles of design, design features, and knows the algorithm design and construction.
PEU_W02 - It has a basic knowledge of connections in the construction of machines, their design and strength calculations and applications.
PEU_W03 - He has knowledge of the factors affecting the fatigue strength of machine elements and how they are taken into account in the design calculations.

II. Relating to skills:
PEU_U01 - Able to independently formulate and solve simple technical tasks.
PEU_U02 - He can choose and calculate the basic connection used in mechanical engineering.
PEU_U03 - He can choose the optimal (in light of the criteria used) machine parts and know their limitations.

III. Relating to social competences:
PEU_K01 - Can search information and carry out their critical analysis.
PEU_K02 - Able to work independently and in a team.
PEU_K03 - Objectively evaluate the task, conceptual design, and they can justify the chosen solution and the method of its implementation.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Syllabus and requirements. Defined notions of technical product and design. Design features, principles of design. Rationale for the existence of a product.	2
Lec2	Design and construction - differences. Description of the process of design - examples.	2
Lec3	Algorithmical and heuristic methods of generating of conceptions (method of elementary questions, morphology boards and boxes, biological analogy, brainstorming, 635 method, Delphic method).	2
Lec4	Criteria of conception rating. Methods of selection of the best conception: method of balancing positive and negative features, weighting of criteria method, etc.. Examples.	2

Lec5	Stress, fatigue, fatigue strength and method of its determination. Smith's and Haighe's graphes.	2
Lec6	Stress raisers and possible impacts on strength calculations. Processes resulting in the increased fatigue life of machine elements. β - fatigue stress concentration factor.	2
Lec7	Methods for increasing the fatigue strength. Allowable stress k - means for their appointment. Factor of safety and actual safety factor.	2
Lec8	The actual safety factor in the case of complex stress state. Stages of strength calculations for machine elements loaded forces variables. Calculation example (the roller gear).	2
Lec9	Joints in mechanical engineering, classification and characteristics. Bolted connections, thread specifications. Determination of the forces and moments on the thread.	2
Lec10	Efficiency and self-locking of a power screw. The minimum height of the nut in the screw.	2
Lec11	The notion of preload. Method for the calculation of bolted connections with preload. Calculations of thread forms.	2
Lec12	Shaft-hub connections: keys, splines, serrated joints. Dowel connections. Main features and calculation rules.	2
Lec13	Welded and pin connections. Specifications, principles of design and calculations.	2
Lec14	Pressed connections. Analytical bases of geometry selection, elements fit.	2
Lec15	Steel elastic connectors. Fundamentals of strength calculations of selected types of springs. Forming of cylindrical coil springs.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Introduction. Health and Safety Training. Recognizing of standard machine elements.	1
Lab2	Determination of static stiffness, energy dissipated and acquired in elastic-damping elements.	2
Lab3	Determination of the frictional characteristics of the cross slide bearing.	2
Lab4	Determining of resistance to motion of angular bearing.	2
Lab5	Theoretical and practical identification of phenomenon of the resonance in shaft with one non-balanced mass.	2
Lab6	Research of the pressed connections.	2
Lab7	Investigation of belt transmission with V-belt – elastic slip and efficiency.	2
Lab8	Estimation of efficiency of power screw.	2
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Preparation of design specifications for the designed device.	3

Proj2	Possible solutions of the problem, a draft drawing (without details) of one selected solution (acceptance criteria included).	5
Proj3	Calculations and analysis of designed elements (power screw, bearings, bolts, etc..).	12
Proj4	Performance of assembly drawing designed device and working drawings of elements selected by lecturer.	10
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. calculation exercises N3. tutorials N4. laboratory experiment N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01 - PEU_W03	exam, quiz
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01 - PEU_U03, PEU_K01 - PEU_K03	Quizzes, oral response, the report of the laboratory
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01 - PEU_U03, PEU_K01 - PEU_K03	defense of project, quizzes, evaluation of computational design review, review of project preparation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1) Robert Mott, Edward Vavrek, Jyhwen Wang, Machine elements in mechanical design, Pearson, 2017
2) Norton, Robert L., Machine Design: An Integrated Approach, Pearson, 2019
3) Shigley, Joseph Edward. Red., Standard Handbook Of Machine Design, McGraw-Hill Education Ltd, 2004

SECONDARY LITERATURE

1) Erik Oberg, Franklin D. Jones, Holbrook Horton, Machinery's Handbook: Large Print, INDUSTRIAL PR INC, 2020
2) Ajeet Singh, Fundamentals of Machine Design: Volume 1, Cambridge University Press, 2017
3) Jack A. Collins, Henry R. Busby, George H. Staab, Mechanical Design of Machine Elements and Machines: A Failure Prevention Perspective, John Wiley & Sons, 2009

SUBJECT SUPERVISOR
dr inż. Tadeusz Leśniewski tel.: 71 320-40-31 email: Tadeusz.Lesniewski@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Theory of Mechanisms and Manipulators (Teoria mechanizmów i manipulatorów)**

Name of subject in English: **Theory of Mechanisms and Manipulators**

Main field of study (if applicable): **Mechanical Engineering and Machine Building**

Specialization (if applicable): **Mechanical engineering design**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **W10MBM-SI3098**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			30	
Number of hours of total student workload (CNPS)	60			90	
Form of crediting	Examination			Crediting with grade	
Group of courses					
Number of ECTS points	2			3	
including number of ECTS points for practical (P) classes				3	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2			2.1	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of mathematical analysis, matrix algebra
2. Knowledge of fundamental laws in statics, kinematics and dynamics
3. Skill in fuction analysis, derivatives, basic matrix and vector operations

SUBJECT OBJECTIVES

C1. Acquire knowledge in topology, kinematics and dynamics of mechanisms and manipulators
C2. Acquire and understanding of basic mechanisms and manipulators
C3. Getting skills in determining kinematic and dynamic parameters

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Understands theoretical fundamentals of mechanism and robot topology
PEU_W02 - Has the knowledge of kinematic and dynamic analysis methods
PEU_W03 - Is able to commentate results of analysis, evaluate their correctness

II. Relating to skills:
PEU_U01 - Is able to evaluate topological carrectness of kinematic systems
PEU_U02 - Is able to determine kinematic and dynamic properties
PEU_U03 - Is able to create models of simple planar mechanisms and manipulators

III. Relating to social competences:
PEU_K01 - Has a conviction of responsibility for the work done

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Topology of mechanisms, movable properties, redundant constraints	3
Lec2	Kinematics of mechanisms - graphic-analytical methods	3
Lec3	Analytical methods in kinematics (vectors, projections, time derivatives)	2
Lec4	Planetary gear trains	2
Lec5	Manipulators' properties. Planar serial and parallel systems	2
Lec6	Kinematics of planar manipulators, jacobian	2
Lec7	Matrix description of spatial systems	2
Lec8	Denavit-Hartenberg notation	2
Lec9	Introduction to mechanisms' dynamics	2
Lec10	Kinetostatic analysis	3
Lec11	Friction in joints, efficiency	3
Lec12	Dynamic motion analysis	2
Lec13	Fluctuation o machine motion, flyweels	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Introduction to modelling mechanisms in SAM (Simulation and Analysis of Mechanisms) – presentation of examplesi	2
Proj2	Mechanisms' topology: rules of drawing digrams, topology analysis - joint classification, mobility (test, project)	2
Proj3	Rules of creating models in SAM system, creating simple models, model motion simulation, presentation of analysis results	2

Proj4	Dimensional modelling of mechanisms, drivers' definition, massis, external loads	2
Proj5	Kinematic analysis - position analysis (project)	2
Proj6	Kinematic analysis - velocity and acceleration determination - vector methods (test, project)	2
Proj7	Kinematic analysis - velocity and acceleration determination using SAM (project)	2
Proj8	Kinematic analysis using analytical methods: loop equation, vectors, projections, time dirivative	2
Proj9	Planar manipulators - kinematic analysis using matrix notation	2
Proj10	Modelling manipulators in SAM: forward and inverse tasks (project)	2
Proj11	Anaysis of planetary transmissions, angular velocity ratio determination (test, project)	2
Proj12	Modelling of planetary transmissions and gear linkage mechanisms using SAM (project)	2
Proj13	Joint force and external equilibrium determination (test, project)	2
Proj14	Determination of joint forces including friction (test, project)	2
Proj15	Dynamic force analysis using SAM	2
		Total hours: 30

TEACHING TOOLS USED
N1. problem lecture N2. traditional lecture with the use of transparencies and slides N3. self study - preparation for project class N4. tutorials N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	written examination
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03	project defence, short test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Gronowicz A.: Fundamentals of kinematic systems analysis (in Polish). Oficyna Wydawnicza PWr., Wrocław 2003;
2. Morecki A., Knapczyk J., Kędzior K.: Theory of mechanisms and manipulators (in Polish). WNT 2002;
3. Miller S.: Theory of machines and mechanisms. Analysis of mechanical systems (in Polish). Oficyna Wydawnicza PWr. Wrocław 1996;
4. Gronowicz A. i inni: Theory of machines and mechanisms. Set of analysis and synthesis problems (in Polish). Oficyna Wydawnicza PWr. Wrocław 2002

SECONDARY LITERATURE
1. Olędzki A.: Fundamentals of machines and mechanisms theory (in Polish). WNT 1987;
2. Morecki A., Oderfeld J.: Theory of machines and mechanisms (in Polish). PWN 1987;
3. Waldron K., Kinzel G.: Kinematics, Dynamics and Design of Machinery. John Wiley &Sons, Inc. 1999

SUBJECT SUPERVISOR

dr inż. Artur Handke tel.: 71 320-27-10 email: artur.handke@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Geometric Metrology (Metrologia wielkości geometrycznych)**
Name of subject in English: **Geometric Metrology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3099**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of mathematics and physics at secondary school level
2. Student has the ability to read drawings and diagrams contained in the technical documentation.
3. Student has basic knowledge in the design of machine elements. It has a basic knowledge of manufacturing techniques of machine parts.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge about quantities and units of measurement associated with the geometry of the product description.
C2. Acquisition of knowledge about the types and characteristics of equipment for the measurement of geometrical quantities.
C3. Learning how to use the equipment for measurement of geometrical quantities.
C4. Gaining knowledge and skills in the selection of test equipment, analyze test results, evaluation of measurement errors and the expression of measurement uncertainty.
C5. Searching for relevant information and its critical analysis.
C6. The acquisition and consolidation of social skills including emotional intelligence, involving the cooperation among students with a view to effective problem solving. Responsibility, honesty and fairness in the academic society life.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - It can identify the quantity associated with of the geometrical description of the product, can name units of measure used to describe them, know diferences between universal and dedicated equipment for the measurement of geometrical quantities, know how to describe its metrological characteristics. He knows and is able to explain the terms used in metrology of geometrical quantities.
PEU_W02 - Able to define the elements of the measurement process and their impact on the result of the measurement.

II. Relating to skills:
PEU_U01 - Understands the dimensional requirements imposed to products included in the technical documentation. Can use standards for tolerances and fits linear and geometric tolerances. It can calculate the value of measurement errors, estimated measurement uncertainty for the different measurements.
PEU_U02 - He can make the selection of appropriate test equipment and set it up depending on the task measuring. Can use measuring equipment used in engineering to measure the geometrical quantities.

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Basic concepts of metrology. Quantities and units of measurement. Systems of SI units of measurement, standards of measurement units, measurement traceability.	2
Lec2	Classification of measuring equipment for measuring the geometry of products and its metrological characteristics.	3
Lec3	Measurement uncertainty, its sources in measurements of geometrical quantities. The role of uncertainty in adjudicating on the product's compliance or non-compliance with the specification.	2

Lec4	Types of product dimensional characteristics. Ways of their specification and tolerance in accordance with the provisions of the ISO GPS standards	2
Lec5	Types of geometric characteristics of the product. Ways of their specification and tolerance in accordance with the provisions of the ISO GPS standards	2
Lec6	Types of characteristics of the geometric structure of the surface of the product. Ways of their specification and tolerance in accordance with the provisions of the ISO GPS standards	2
Lec7	Basics of coordinate measuring technology of product geometry.	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Organizational matters. General principles of using measuring equipment	1
Lab2	Linear sizes measurements	2
Lab3	Measurements of angular sizes and cones	2
Lab4	Measurements of geometric deviations	2
Lab5	Measurements of the surface texture	2
Lab6	Identification and measurement of external threads	2
Lab7	Identification and measurements of spur gears	2
Lab8	Basics of coordinate measurements	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. laboratory experiment N3. report preparation N4. self study - preparation for laboratory class N5. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01; PEU_W02;	test
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01; PEU_U02;	lab report, test, oral answers
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SECONDARY LITERATURE

SUBJECT SUPERVISOR
dr inż. Marek Kuran tel.: 27-28 email: marek.kuran@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Chipless Processes -Plastic Forming**
Name of subject in English: **Chipless Processes -Plastic Forming**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3100**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Have knowledge of basic mechanical properties of metal materials.
2. Have a basic knowledge of mathematics, physics and mechanics.
3. Have skills in measurement methods, techniques for measuring and evaluating the results of the measurement.

SUBJECT OBJECTIVES

C1. Understanding the different manufacturing technologies by processing plastic products. Method used to investigate the effect of shaping the properties of the manufactured products.
C2. Understanding the phenomena limiting plastic forming processes.
C3. Knowledge of modern technologies for metal forming processes.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Knows the basic technologies and material plastic forming process parameters.
PEU_W02 - Able to properly define the problem in the field of plastic forming and properly be characterized.
PEU_W03 - Can choose the right technology plastic forming and defining the basic parameters of the process.

II. Relating to skills:
PEU_U01 - Can search for information on plastic forming and execute their critical analysis.
PEU_U02 - Can use the theoretical knowledge gained in forming the lecture and apply it in practice.
PEU_U03 - Able to perform selected laboratory tests and correct to assess their performance.

III. Relating to social competences:
PEU_K01 - Can think and act in a creative way.
PEU_K02 - Acquires the ability to work as a team.
PEU_K03 - Understands the impact of engineering.

PROGRAM CONTENT		
Form of classes – Lecture		Number of hours
Lec1	Introduction; Definitions, scope and history of metal forming	2
Lec2	Influence of deformation on the structure and properties of the material.	2
Lec3	Bulk metal forming. Analysis of the sheet and profile rolling process.	2
Lec4	The course and analysis of the extrusion process, types of extrusion process.	2
Lec5	The course and analysis of the forging process.	2
Lec6	Manufacturing of metal products in the drawing process.	2
Lec7	Sheet metal forming processes. Analysis of cutting, bending and stamping processes.	2
Lec8	Final test.	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction, health and safety rules. Cold deformation and annealing	2
Lab2	Rolling of sheets and sections.	2
Lab3	Metallurgical extrusion and machine parts.	2
Lab4	Manufacutring of metal products in the drawing process.	2
Lab5	Open die forging and closed die forging.	2
Lab6	Sheet metal forming, cutting, bending and deep drawing.	2
Lab7	Sheet metal stamping test.	2
Lab8	Credit	1

	Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - preparation for laboratory class N3. report preparation N4. laboratory experiment

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01÷ PEU_W03	test.
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01÷PEU_U03 PEU_K01÷PEU_K03	quizzes, lab report, participation in problem discussions
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Gronostajski J., Plastic working of metals, Wrocław 1974

SECONDARY LITERATURE
http://www.metalplast.pwr.wroc.pl/instrukcje.html

SUBJECT SUPERVISOR
dr hab. inż. Marek Hawryluk tel.: +48 71 32021-64 email: marek.hawryluk@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Chipless Processes -Welding Metallurgy**
Name of subject in English: **Chipless Processes -Welding Metallurgy**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3101**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge of the basic mechanical properties of engineering materials; has ordered knowledge of the types of metallic engineering materials - their structure, properties, applications and selection rules. Has sufficient knowledge in the field of steel and cast iron structures, the principles of their classification and marking; has basic knowledge of heat treatment and thermo-chemical treatment, has knowledge of alloy steels and non-ferrous metals and alloys.

SUBJECT OBJECTIVES

C1. Familiarizing students with welding processes and techniques used in mechanical engineering.
C2. Acquisition of knowledge in the field of welding techniques and the ability to select parameters for these processes.
C3. Acquiring and consolidating social competences including the ability to cooperate in a student group aimed at effective solving of engineering problems.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Knows the basic methods of welding and process parameters, and has knowledge of the applications of welding processes, resistance welding and soldering in the manufacture of products.

II. Relating to skills:
PEU_U01 - Is able to choose the appropriate method of joining the elements of the product and to determine the basic parameters of the process.

III. Relating to social competences:
PEU_K01 - Is aware of the responsibility for own work and readiness to comply with the rules of teamwork and take responsibility for jointly implemented tasks, correctly assesses the priorities of own and group tasks.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to welding. Health and safety of welding works.	2
Lec2	Arc welding with coated electrode. Submerged arc welding.	2
Lec3	Arc welding in protective gases (MAG, MIG, TIG).	2
Lec4	Laser welding.	2
Lec5	Resistance welding. Friction welding.	2
Lec6	Soldering and brazing.	2
Lec7	Adhesive bonding.	2
Lec8	Final test.	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Welding - introduction and occupational health and safety.	1
Lab2	Manual welding with coated electrodes.	2
Lab3	Gas-shielded welding TIG, MIG, MAG.	2
Lab4	Welding stresses and strains. Submerged arc welding.	2
Lab5	Electric resistance welding. Friction welding.	2
Lab6	Soldering and brazing.	2
Lab7	Gas welding of steel. Thermal cutting - oxygen and plasma.	2
Lab8	Robotic welding.	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. multimedia presentation N3. self study - preparation for laboratory class N4. laboratory experiment

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01	Final test
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_K01	short test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Ambroziak A. (red.): Techniki Wytwarzania. Spawalnictwo. Laboratorium PWr, skrypt, 2010
[2] Pilarczyk J. (red.): Poradnik inżyniera. Spawalnictwo. tom 1 i 2. PWN, 2003

SECONDARY LITERATURE
[1] Klimpel A.: Spawanie, Zgrzewanie i Cięcie Metali., WNT, 1999
[2] Ferenc J., Ferenc K.: Konstrukcje spawane: połączenia, PWN, 2018

SUBJECT SUPERVISOR
dr inż. Tomasz Szulc tel.: 21-25 email: tomasz.szulc@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Strength of Materials (Wytrzymałość materiałów)**
Name of subject in English: **Strength of Materials**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3102**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	2	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the fundamentals of solid mechanics: tensor analysis, static laws
2. Knowledge of the fundamentals of materials strength
3. Knowledge of higher mathematics in integral and differential calculation - solving differential equations

SUBJECT OBJECTIVES

C1. To solve technical problems based on the principles of the mechanics
C2. To perform strength analysis of machine components
C3. To obtain knowledge of energy methods in the mechanics of deformable bodies

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Students know how to determine stresses and displacements in rotating discs and in pipes and thick-walled cylindrical vessels, know the theory of thin-walled axisymmetric shells loaded with pressure
PEU_W02 - Knowledge of the theoretical basis and methods of determining stresses in a complex state of stress in any structural component
PEU_W03 - Student is able to define the elastic energy of a system and can formulate the Castigliano and Menabrea-Castigliano theorems

II. Relating to skills:
PEU_U01 - Student knows how to check the strength conditions and evaluate the state of the stress in rotating discs and pipes & thick-walled vessels, knows the theory of thin-walled axisymmetric shells loaded with pressure
PEU_U02 - Student knows how to apply Castigliano's theorem to determine displacements of the structure as well as the Menabrea-Castigliano method to calculate hyperstatic systems
PEU_U03 - Student is able to design mechanical systems and perform their strength analysis

III. Relating to social competences:
PEU_K01 - is able to and understands the need for continuing education and acquiring new information.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Multiaxial stress condition; analysis of selected engineering load cases and evaluation of stress condition based on selected stress hypotheses	2
Lec2	Energy methods for determining displacements in the bar systems. Statically indeterminate systems	2
Lec3	Determination of displacements by the Maxwell-Mohr method. Force method.	2
Lec4	Bending of strongly curved beams	2
Lec5	Eccentric compression of straight bars	2
Lec6	Thick-walled single and multi-layer cylinders	2
Lec7	Shields and rotating discs.	2
Lec8	Symmetrically loaded circular plates. Rectangular plates	2
Lec9	Axially symmetric shells	2
Lec10	Time and temperature dependent loads – creep, relaxation.	2
Lec11	Material fatigue - basics of calculations	2
Lec12	Basics of fracture mechanics. Determination of crack propagation rate	2
Lec13	Impact loads of rod elements	2
Lec14	Contact stress. Stresses under compression of balls and rollers	2
Lec15	Internal stresses - causes, prevention, tests	2
		Total hours: 30

Form of classes – Classes		Number of hours
Cl1	Calculation of structural elements under complex stress state.	3
Cl2	Calculation of displacements of structures in statically determinate systems using energy methods	2
Cl3	Statically indeterminate systems - solving tasks using the Menabrea-Castigliano theorem	2
Cl4	Thick-walled single and multilayer cylinders - calculations	2
Cl5	Shields and rotating discs - calculations	2
Cl6	Axisymmetric shells - calculations	2
Cl7	Colloquium	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. calculation exercises

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	exam
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03	colloquium
P = F1		

PRIMARY AND SECONDARY LITERATURE
<u>PRIMARY LITERATURE</u> [1] M. E. Niezgodziński, T. Niezgodziński: Wytrzymałość materiałów, PWN, 1998. [2] Z. Dyląg, A. Jakubowicz, Z. Orłoś: Wytrzymałość materiałów. Tom I. WNT, 1999. [3] M. Zakrzewski, J. Zawadzki: Wytrzymałość materiałów, PWN, 1983. [4] Z. Brzoska: Wytrzymałość materiałów. PWN, 1979. [5] R. Żuchowski: Wytrzymałość materiałów, Oficyna Wydawnicza PWr., 1996. [6] M.E. Nizgodziński, T. Niezgodziński: Obliczenia zmęczeniowe elementów maszyn, PWN, Warszawa 1973 [7] Jakowluk A.: Procesy pełzania i zmęczenia w materiałach, WN-T, 1998, [8] German J. Podstawy mechaniki pękania, Wyd. Politechniki Krakowska, 2011 <u>SECONDARY LITERATURE</u> [1] S. Katarzyński, S. Kocańda, M. Zakrzewski: Badania własności mechanicznych metali. WNT, 1967. [2] J. Walczak: Wytrzymałość materiałów oraz podstawy teorii sprężystości i plastyczności, PWN, 1973. [3] S. Kocańda: Zmęczeniowe niszczenie metali, WN-T, Warszawa 1978, [4] S. Kocańda, J. Szala., Podstawy obliczeń zmęczeniowych, PWN, Warszawa 1985, [5] Brózda J.: Wprowadzenie do mechaniki pękania, Politechnika Śląska, Instytut Spawalnictwa, Gliwice 2008

SUBJECT SUPERVISOR
dr hab. inż. Grzegorz Lesiuk tel.: 713204216 email: grzegorz.lesiuk@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Computer Aided Machine Design I (Modelowanie komputerowe w projektowaniu)**

Name of subject in English: **Computer Aided Machine Design I**

Main field of study (if applicable): **Mechanical Engineering and Machine Building**

Specialization (if applicable): **Mechanical engineering design**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **W10MBM-SI3103**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	
Number of hours of total student workload (CNPS)				30	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of strength of materials, Analytical methods in strength calculations. Knowledge of types of engineering materials.
2. Student can implement a construction project using computer methods in the field of design and numerical analyses.
3. Ability to perform strength analysis using numerical methods.

SUBJECT OBJECTIVES

C1. Acquisition of the ability to design the load-bearing structure considering the definied criteria.
C2. Ability to define input data (boundary and initial conditions) necessary for modeling loads acting on the load-bearing structure.
C3. Acquisition the ability to use CAD/CAE systems in designing.
C4. Acquisition and consolidating the ability to work in a group and the ability to search for information.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:
PEU_U01 - Student can design a mechanical assembly including the selected criteria, using the appropriate methods, techniques and tools, along with calculations of their components, using the computer-aided design software.
PEU_U02 - Student can correctly formulate the kinetic and kinematic conditions that a machine or machine assembly is subjected to.
PEU_U03 - Student can prepare the documentation concerning the implemented engineering tasks and prepare a presentation of the results of this task.

III. Relating to social competences:
PEU_K01 - Acquires the ability to take responsibility for the work done.
PEU_K02 - Able to work in a group, taking different roles.
PEU_K03 - Acquires the teamwork skills.

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Overview of the curriculum. Presentation of the goal and scope of the project. The proposals for the subjects of construction works (multi-body systems).	1
Proj2	Selecting the project subject. Overview of sources: parts catalogs, standards. Neutral design data exchange formats used in CAD.	2
Proj3	Analysis of existing design solutions (multimedia presentation).	2
Proj4	Identification of features and structure. Definition of design assumptions. Analysis of fulfillment of functional requirements and parameters.	2
Proj5	Development of the structural form (considering the kinematic chain) - construction and analysis of the model.	2
Proj6	Analysis of the possibility of using unified subassemblies, parts and drives.	2
Proj7	Development of a preliminary design using CAD systems.	4
		Total hours: 15

TEACHING TOOLS USED
N1. self study - preparation for project class N2. multimedia presentation N3. project presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02, PEU_K03	Evaluation of the completed project
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Rusiński E., Czmochowski J., Smolnicki T. Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000
[2] Rakowski G., Kacprzyk Z.: Metoda elementów skończonych w mechanice konstrukcji, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2016
[3] Zienkiewicz O.C.: Metoda elementów skończonych, Arkady 1972

SECONDARY LITERATURE
[1] Szmelter J., Dacko M., Dobrociński S., Wieczorek M.: Metoda elementów skończonych w statyce konstrukcji, Arkady 1979
[2] Gawroński W., Kruszewski J., Ostachowicz W., Tarnowski K., Wittbrodt E.: Metoda elementów skończonych w dynamice konstrukcji, Arkady, Warszawa 1984
[3] Waszczyszyn Z., Cichoń Cz., Radwańska M.: Metoda elementów skończonych w stateczności konstrukcji, Arkady, Warszawa 1990
[4] Kleiber M.: Wprowadzenie do metody elementów skończonych, PWN, Warszawa-Poznań 1989
[5] Cichoń Cz., Cecot W., Krok J., Pluciński P.: Metody Komputerowe w liniowej mechanice konstrukcji, Wydawnictwo Politechniki Krakowskiej, Kraków, 2010
[6] Olszowski B. Wybrane metody numeryczne, Wydawnictwo Politechniki Krakowskiej, Kraków, 2007

SUBJECT SUPERVISOR
dr hab. inż. Jacek Karliński tel.: 71 320-29-46 email: jacek.karlinski@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Vehicle Engineering (Budowa pojazdów samochodowych)**
Name of subject in English: **Vehicle Engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3104**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	90				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	3				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.8				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. knowledge of fundamentals of machine design
2. ability to associate and use the acquired knowledge

SUBJECT OBJECTIVES

C1. Getting to konow the design and functional structure of motor vehicle systems
C2. Getting to know the basic technical and operational characteristics of a motor vehicle
C3. Understanding the basic principles of selection of systems of motor vehicles

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - is able to distinguish and characterize elements and systems of a motor vehicle
PEU_W02 - can define and explain the motion of a motor vehicle and select the source of its propulsion
PEU_W03 - knows the current state and indicates development trends in the design of motor vehicles

II. Relating to skills:

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic information about components of the road transport system	2
Lec2	Motor vehicle classification. homologation. Identification of elements	2
Lec3	Fundamentals of vehicle motion mechanics. Movement resistances	2
Lec4	Characteristics of propulsion systems. Vehicle drive selection.	2
Lec5	Design of vehicle chassis. Systems: carrier and suspension	2
Lec6	Road wheels. Tires	2
Lec7	Design of steering system	2
Lec8	Design of braking system	2
Lec9	Automation of vehicle systems	2
Lec10	Car safety assessment criteria	2
Lec11	Vehicle Compatibility	2
Lec12	Exterior lighting of the vehicle	2
Lec13	CAN/BUS networks	2
Lec14	Features of vehicles with special purpose	2
Lec15	Final test	2
		Total hours: 30

TEACHING TOOLS USED

N1. problem lecture
N2. multimedia presentation
N3. case study
N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	activity during class
F2	PEU_W01, PEU_W02, PEU_W03	Final test
P = F1*0,2+F2*0,8		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.Reimpell J., Betzler J.: Podwozia samochodów. Podstawy konstrukcji. WKŁ Warszawa 2001. Wrzecioniarz P.A., Ambroszko W., Górniak A.: Energy Efficient design of powetrain and body, PWr, 2011.
2.Merkisz, J., Pielecha I., Układy mechaniczne pojazdów hybrydowych, Polit. Poznańska, 2015.
3.Zieliński A., Konstrukcja nadwozi samochodów osobowych i pochodnych. WKiŁ Warszawa 2018
4.Wicher., J. , Bezpieczeństwo samochodów i ruchu drogowego. Pojazdy samochodowe, WKŁ, 2004.
5.Kwaśniowski S. Systemy transportowe. Skr. MWSLiTr we Wrocławiu. W-w 2012

SECONDARY LITERATURE

1. Leon Prochowski, Mechanika ruchu, Pojazdy samochodowe, WKŁ, 2005.
2. Informatory techniczne „Bosch”.
3. Materiały konferencyjne prowadzącego dotyczące rozwiązań układów i zespołów pojazdów samochodowych.
4. Basiewicz T., Gołaszewski A., Rudziński L., Infrastruktura transportu. Of. Wyd. Pol.War. 1998.

SUBJECT SUPERVISOR
dr hab. inż. Zbigniew Sroka email: zbigniew.sroka@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Trybology (Podstawy tribologii)**
Name of subject in English: **Trybology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3105**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge: 1 He has ordered knowledge about the types of engineering materials - metal, ceramic, polymer and composite materials.2. It has a basic knowledge of the construction, operation and use of the main components and machine assemblies.3. It has a basic knowledge of physics, chemistry, statistics.
2. Skills: 1. It can analyze the macroscopic fractures, microstructure of materials, technological drawbacks of origin, is able to determine the characteristics of the microstructure of metallic materials.2. He can choose the material on a given machine element and can explore its basic properties.
3. Competencies: 1 Is aware of the importance and understanding of non-technical aspects and impacts of mechanical engineer.2. Is aware of the importance of behavior in a professional manner and have a sense of responsibility for their own work.

SUBJECT OBJECTIVES

C1. Familiar with the processes of friction, wear and lubrication of moving nodes and methods for machine control these processes in terms of minimizing their effects (special attention will be paid to the construction and technological methods of increasing the reliability and durability of sliding pairs, as well as the problem of lubrication and lubricant selection as an effective prevention of friction and wear).
C2. Understanding the impact of selected parameters of friction vector, ie, pressure, velocity slip material cooperating associations and grease on the tribological characteristics of sliding pairs. Get to know the influence of the structure of the material to abrasion and impact bushing stiffness for load distribution in the bearing friction.
C3. Show students that they can effectively counteract the negative effects of friction in the moving solid contact with real objects illustrate some of the issues discussed theoretically in the lecture.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Has knowledge of the processes of friction, wear and lubrication of moving nodes machine.
PEU_W02 - Know the basic types of lubricants and their applications.
PEU_W03 - He knows the design and technological methods of increasing the reliability and durability of sliding pairs.

II. Relating to skills:
PEU_U01 - It can choose materials for sliding nodes and understand relationships and dependencies between the material used and its durability.
PEU_U02 - It can perform basic tests of materials used in the nodes of friction, interpret them and implement in the final node machines.
PEU_U03 - He can use the theoretical knowledge acquired friction and lubrication of the lecture and apply it in practice.

III. Relating to social competences:
PEU_K01 - It can search for information and critically analyze them.
PEU_K02 - Properly define and resolve dilemmas, adheres to the principle of professional ethics.
PEU_K03 - Able to work independently and as a team, and properly assess their own tasks and priorities of the group.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Program and requirements. Brief history of tribology.	1
Lec2	Elastic contact of smooth bodies. The real contact of solids. The problem of the surface layer. Friction processes, their distribution and characteristics. Sliding and rolling friction. Theories of friction.	2
Lec3	Wear processes, their distribution and characteristics. Effect of pressure and sliding velocity on the friction and wear.	2
Lec4	Characteristics of materials (metal and others) on the sliding nodes and the rules for their selection. Simple and reversed pair of friction.	2

Lec5	Susceptibility, stiffness and configuration elements as factors that increase the wear resistance.	2
Lec6	Grease as a construction material. Objectives lubrication. The way of obtaining a fluid friction. Distribution of lubricants. Lubricating oils and their properties.	2
Lec7	Greases, their distribution and characteristics.Their characteristics.	2
Lec8	Final test.	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Determining of properties of slide bearing materials.	2
Lab2	Determining of coefficient of static friction.	2
Lab3	Research of lubricity of greases using a four ball tester.	2
Lab4	Determination of the behavior of friction materials for brakes and clutches.	2
Lab5	Analysis of the impact bushing stiffness for load distribution in the sliding bearing.	2
Lab6	Analysis of the impact on the structure of the material on abrasive wear (Tester T-07).	2
Lab7	Determination of tribological characteristics of engine oils.	2
Lab8	Study materials for the seizure.	1
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - preparation for laboratory class N3. laboratory experiment N4. tutorials N5. multimedia presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01 - PEU_W03	test, quiz
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01 - PEU_U03, PEU_K01 - PEU_K03	quiz - entrance ticket, the report of the laboratory exercises, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Lawrowski Z.; Tribologia: Tarcie, zużywanie i smarowanie, Wydawnictwo Politechniki Wrocławskiej, 2008.
[2] Czarny R.; Smary plastyczne. Warszawa, WNT, 2004.
[3] Ćwiczenia laboratoryjne z podstaw konstrukcji maszyn. Praca zbiorowa pod red. F. Szymankiewicza, skrypt PWr., Wrocław , 1990 (detailed exercise instructions available on the website).
[4] Current tribology journals: „Tribologia", „Wear", „Tribology letters".
[5] Bushan B., Modern tribology handbook, 2000, Taylor & Francis Stmnetbase.

SECONDARY LITERATURE

[1] Bartz W.; Schmierfette, Zusammensetzung, Eingeschaften, Prüfung und Anwen-dung. Renningen, Export Verlag 2000
[2] Lawrowski Z.; Technika smarowania. W-a, PWN
[3] Płaza S.; Fizykochemia procesów tribologicznych, Łódź, Wyd. Uniwersytetu Łódzkiego, 1997

SUBJECT SUPERVISOR
dr inż. Tadeusz Leśniewski tel.: 71 320-40-31 email: Tadeusz.Lesniewski@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Hydraulic, Hydrotronic and Pneumatic Systems (Hydrostatyczne układy napędowe)**

Name of subject in English: **Hydraulic, Hydrotronic and Pneumatic Systems**

Main field of study (if applicable): **Mechanical Engineering and Machine Building**

Specialization (if applicable): **Mechanical engineering design**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **W10MBM-SI3106**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student posses basic knowledge of fluid mechanics.
2. Student can solve diferential equations of mathematical models of hydraulis components and systems.
3. Student possess basic knowledge of classic mechanics.

SUBJECT OBJECTIVES

C1. Students acquaintance withbasic lows of hydrostatic and pneumatic drive systems.
C2. Students acquaintance with hydraulic and pneumatic components and their working principle.
C3. Students acquaintance with configuration of simple hydrostatic and pneumatic drive systems.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - In the result of lesson student should be able to define requirements for work medium used in fluid power sustems.
PEU_W02 - In the result of lesson student should be able to describe working pinciple of basic components of fluid power systems.
PEU_W03 - In the result of lesson student should be able to characterize of working of basic fluid power systems.

II. Relating to skills:
PEU_U01 - As a result of the course, the student should be able to analyze the operation of hydraulic and pneumatic components and systems.
PEU_U02 - As a result of the course, the student should be able to calculate the basic parameters of hydraulic and pneumatic systems.
PEU_U03 - As a result of the course, the student should be able to interpret basic characteristics of hydraulic and pneumatic systems.

III. Relating to social competences:
PEU_K01 - As a result of the course, the student should possess the ability to analyze information of different levels of complexity.
PEU_K02 - As a result of the course, the student should possess the ability to objectively evaluate arguments, rationally explain and justify his own point of view using knowledge of of hydrostatic drive systems.
PEU_K03 - As a result of the course, the student should possess the ability to observe the customs and rules of the academic environment.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, lecture scope presentation, requirements. Basic infomration on fluid power systems - pressure and flow.	2
Lec2	fluid power medium - parameters, cleanness, filtration.	2
Lec3	Pressure losses in fluid power systems - linear, local, elements.	2
Lec4	Efficiency: hydraulic, volumetric and overall.	2
Lec5	Positive displacement pumps - types, characteristics, efficiencies.	2
Lec6	Directional control valves in fluid power systems.	2
Lec7	Acting elements in fluid power systems - types, characteristics, efficiencies.	2
Lec8	Final exam.	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Safety rules in hydraulics laboratory, equipment presentation, definition of requirements and conditions of ratings.	2
Lab2	Hydraulic fluids - viscosity and bulk modulus.	2

Lab3	Linear resistance in hydraulic systems - pressure losses.	2
Lab4	Local resistance in hydraulic systems - pressure losses.	2
Lab5	Hydraulic pumps - fixed displacement pump flow characteristics.	2
Lab6	Directional control valve flow characteristics.	2
Lab7	Air preparation systems, pneumatic supply systems.	2
Lab8	Final test.	1
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. multimedia presentation N3. laboratory experiment N4. report preparation N5. self study - preparation for laboratory class

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03, PEU_K03	Colloquium
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02	Report
F2	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02	Colloquium
P = 0,2F1+0,8F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Akers A., Gassman M., Smith R., Hydraulic Power System Analysis (Fluid Power and Control), CRC Press, 2006

W.Durfee, Z.Sun, J. Van de Ven, Fluid Power System Dynamics

Department of Mechanical Engineering, University of Minnesota, A National Science Foundation Engineering Research Center, September 25, 2015

Rexroth Bosch Group, Project Manual Industrial Hydraulics, Trainer's manual

SECONDARY LITERATURE

Lambeck R.: Hydraulic pumps and motors. Marcel Dekker INC. New York 1983.

Pippenger J.: Hydraulic valves and control. Marcel Dekker INC. New York 1984

Ivantysyn J., Ivantysyn M.:Hydrostatic Pumps and Motors,

SUBJECT SUPERVISOR

Prof. dr hab. inż. Wiesław Fiebig tel.: 71 320-27-00 email: Wieslaw.Fiebig@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Finite Elements Method (Metoda elementów skończonych)**
Name of subject in English: **Finite Elements Method**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3107**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			30	
Number of hours of total student workload (CNPS)	30			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of strength materials. Analysis of beam, plate and shell structures. Fundamentals of engineering materials.
2. Matrix algebra.
3. Skills in basic CAD tolls. Skills for solving basic engineering elements with use of classical elastic theory.

SUBJECT OBJECTIVES

C1. Learn the basics of the finite element method theory.
C2. Learn how to prepare proper model for FEM calculations.
C3. Ability to carry out computer simulations in the FEM program.

SUBJECT LEARNING OUTCOMES
I. Relating to knowledge: PEU_W01 - Have knowledge in the fundamentals of finite element method PEU_W02 - Have the knowledge to prepare proper geometrical and discrete model to solve FEM task. PEU_W03 - Has a basic knowledge of the possibilities of applying the finite element method in engineering calculations **II. Relating to skills:** PEU_U01 - Has the ability to use computer systems to carry out numerical calculations with the use of FEM. PEU_U02 - Have the knowledge to prepare proper geometrical and discrete model to solve the task in the range of elastic deformation. PEU_U03 - He can perform FEM calculations in the field of statics, free vibrations and elastic stability. **III. Relating to social competences:** PEU_K01 - Acquires the ability to bear responsibility for the work done. PEU_K02 - Think and act creatively. PEU_K03 - Acquires teamwork skills.

PROGRAM CONTENT		
Form of classes – Lecture		Number of hours
Lec1	Development of the numerical methods	1
Lec2	The place of the finite element method in the process of modeling real systems	1
Lec3	The essence of FEM, interpolation functions, convergence conditions of the method	2
Lec4	Classification of finite elements	2
Lec5	Principles of finite element stiffness matrix construction	4
Lec6	Modeling boundary conditions in numerical models.	2
Lec7	Examples of practical application of modern computational methods in CAD design (FEM)	2
Lec8	Test	1
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Introduction. Presentation of the software	1
Proj2	Principles of building a physical model, idealization of the system, simplifications used in physical models.	2
Proj3	Discretization of solid models, analysis of factors (type of element finite element, density of discretization) affecting the accuracy of the calculations.	6

Proj4	Plane state of stress on the example of a rectangular plate with a hole. Accuracy analysis using different types of finite elements and the influence of partition density in comparison with the theoretical solution of the Kirsch problem.	4
Proj5	Bending analysis of a plate using different types and densities of shell and solid elements division. Influence of the number of layers in a solid model on the accuracy of calculations of displacements and stresses in comparison with the theoretical solution. The use of symmetry.	4
Proj6	Analysis of the state of stresses and forces in the elements of a truss, using both a bar model and a beam model. Analysis of the elastic stability of the truss elements calculated with the use of the beam model	6
Proj7	The problem of elastic stability of axially compressed cylindrical shell. Analysis of the impact of shell geometry on the value of the critical load. Local and global stability.	2
Proj8	The axial-symmetric problem on the example of a thick-walled pipe subjected to internal pressure. The contact problem on the example of two composite pipes with a clamp. Analysis of the distribution of radial displacements, radial and circumferential stresses.	2
Proj9	Performing a project - computer simulation of the stress state of the selected load-bearing structure.	3
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. problem exercises N3. self study - preparation for project class N4. project presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	Colloquium final
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03 PEU_K01, PEU_K02, PEU_K03	The rating for the execution of project
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Rusiński E., Czmochowski J., Smolnicki T. Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000
Rakowski G., Kacprzyk Z.: Metoda elementów skończonych w mechanice konstrukcji, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2016
Zienkiewicz O.C.: Metoda elementów skończonych, Arkady 1972

SECONDARY LITERATURE
Szmelter J., Dacko M., Dobrociński S., Wieczorek M.: Metoda elementów skończonych w statyce konstrukcji, Arkady 1979
Gawroński W., Kruszewski J., Ostachowicz W., Tarnowski K., Wittbrodt E.: Metoda elementów skończonych w dynamice konstrukcji, Arkady, Warszawa 1984
Waszczyszyn Z., Cichoń Cz., Radwańska M.: Metoda elementów skończonych w stateczności konstrukcji, Arkady, Warszawa 1990
Kleiber M.: Wprowadzenie do metody elementów skończonych, PWN, Warszawa-Poznań 1989
Cichoń Cz., Cecot W., Krok J., Pluciński P.: Metody Komputerowe w liniowej mechanice konstrukcji, Wydawnictwo Politechniki Krakowskiej, Kraków, 2010
Olszowski B. Wybrane metody numeryczne, Wydawnictwo Politechniki Krakowskiej, Kraków, 2007

SUBJECT SUPERVISOR
dr inż. Artur Górski tel.: 71 320-28-47 email: artur.gorski@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Fundamentals of Machine Design II (Podstawy konstrukcji maszyn II)**
Name of subject in English: **Fundamentals of Machine Design II**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3108**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			30	
Number of hours of total student workload (CNPS)	60			90	
Form of crediting	Examination			Crediting with grade	
Group of courses					
Number of ECTS points	2			3	
including number of ECTS points for practical (P) classes				3	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2			2.1	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge: 1 It has a basic knowledge of metallurgy, construction materials, mechanics, strength of materials and manufacturing techniques, engineering graphics. 2 It has a basic knowledge of Fundamentals od Machine Design I (process design and engineering, connections used in mechanical engineering) and perform the technical documentation using AutoCAD.
2. Skills: 1 It has self-learning ability, and is able to retrieve information from various sources, to make their interpretation, and to draw conclusions and formulate and justify opinions. 2 It can be used in the process of constructing knowledge gained on subjects: metallurgy, mechanics, strength of materials, Engineering Graphics, Fundamentals of Machine Design I.
3. Competencies: 1 He can think and act in an entrepreneurial manner. 2 Is aware of the seriousness and impact of activities in mechanical engineering, and understands the need for professional activities (both individually and collectively).

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge about the design of machine shafts (structural calculations, the selection of geometric features, resonance, mounting elements on the shaft) and the holder shafts - bearings (bearings characteristics, selection criteria, rules for bearing and fit).
C2. Gaining knowledge of the construction, operation, selection, design calculations and operation of the couplings and conveyor units and changing the rotation (mechanical transmission belts, chains and gears).
C3. Gain practical skills to make a simple construction task through a typical solution to the problem, the content of which is the optimal design of the drive unit driven machine (eg conveyor, ball mill, crusher, rotary kiln, etc.) The process of constructing a computer-aided both in the selection of design features (using the computer programs for the calculation of constructed elements) as well as at the stage of their graphical application (AutoCAD).

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - He knows the algorithm design calculations machine shafts and shafts supporting elements.
PEU_W02 - It has an extended knowledge in the construction of clutches, their applications and the selection and calculation.
PEU_W03 - It has a basic knowledge of construction, operation, principles of selection and design calculations of the conveyor units and changing the rotation (mechanical gears: belt, chain and gear).

II. Relating to skills:
PEU_U01 - Able to independently formulate and solve simple technical tasks.
PEU_U02 - He can choose and calculate the shafts, bearings, couplings, mechanical.
PEU_U03 - It can construct an optimal (in light of the criteria used) drive any machine work.

III. Relating to social competences:
PEU_K01 - Can search information and carry out their critical analysis.
PEU_K02 - Able to work independently and in a team.
PEU_K03 - Objectively evaluate the task, conceptual design, and they can justify the chosen solution and the method of its implementation.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Syllabus and requirements. Shafts and axes – characteristics. Theoretical bases selection of constructional features of shafts. Fundamentals of shafts and axes forming. Methods for the axial location of machine elements on a shaft.	2
Lec2	Design calculations of the shafts (preliminary, checkout). The phenomenon of resonance. Calculations of shafting for resonance in bending mode.	2
Lec3	Main features of rolling and sliding friction. Classification of bearings, main features of rolling contact and sliding bearings. Procedure and criteria for the selection of roller contact bearings.	2
Lec4	Bearing arrangement. Fits, lubrication and sealing in application for roller bearings.	2

Lec5	Classification of coupling and clutches. Main features of couplings. Selection and calculation rules.	2
Lec6	Main features of clutches. Engagement process, Work and friction losses, heat balance, service life. Equivalent friction radius.	2
Lec7	Belt transmissions, classification, general characteristic and selection criteria. Friction coupling of the belt with the wheel. Elastic slip, actual transmission ratio, load transfer coefficient.	2
Lec8	Force distribution, tensioning devices in belt. Required tension force and ways of regulation.	2
Lec9	Efficiency of belt transmission and belt durability. Characteristics material for belts. The design of pulleys (material, main dimensions). Design calculations of V-belt transmissions.	2
Lec10	Chain transmissions – characteristic and calculation.	2
Lec11	Gear transmissions. Classification and main features. Fundamental rule of engagement. Cycloid and involute profiles.	2
Lec12	Basic rack tooth profile. Standardization of involute wheels. Basic notions. Geometry of spur gears. Generation methods.	2
Lec13	Boundary tooth number, mesh correction, addendum modification.	2
Lec14	Tooth loading model for bending and contact pressure. Service factor. Distribution of forces in spur and helical gearing.	2
Lec15	ISO recommended methods for the calculation of gear transmission, a summary.	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Preparation of design specifications for the designed drive system (operation principles, location data, quantitative data, operation conditions).	2
Proj2	Possible solutions of the problem, a draft drawing (without details) of one selected solution (acceptance criteria included).	4
Proj3	Assumption of acceptance criteria for each of the sub-assemblies of the unit. Selection of the best solution using a dedicated software.	12
Proj4	Implementation stage of the design process: assembly and selected working drawings. Drafting technique - CAD.	12
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. calculation exercises N3. tutorials N4. self study - preparation for project class N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01 - PEU_W03	exam, quiz
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01 - PEU_U03, PEU_K01 - PEU_K03	defense of project, quizzes, evaluation of computational design review, review of project preparation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1) Robert Mott, Edward Vavrek, Jyhwen Wang, Machine elements in mechanical design, Pearson, 2017
2) Norton, Robert L., Machine Design: An Integrated Approach, Pearson, 2019
3) Shigley, Joseph Edward. Red., Standard Handbook Of Machine Design, McGraw-Hill Education Ltd, 2004

SECONDARY LITERATURE

1) Erik Oberg, Franklin D. Jones, Holbrook Horton, Machinery's Handbook: Large Print, INDUSTRIAL PR INC, 2020
2) Ajeet Singh, Fundamentals of Machine Design: Volume 1, Cambridge University Press, 2017
3) Jack A. Collins, Henry R. Busby, George H. Staab, Mechanical Design of Machine Elements and Machines: A Failure Prevention Perspective, John Wiley & Sons, 2009

SUBJECT SUPERVISOR

dr inż. Tadeusz Leśniewski tel.: 71 320-40-31 email: Tadeusz.Lesniewski@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Fundamentals of Automatic Control (Podstawy automatyki)**
Name of subject in English: **Fundamentals of Automatic Control**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3109**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge of mathematics, including: complex functions, differential equations, systems of equations, matrix algebra.
2. Has a knowledge of the basic laws and principles of physics.
3. Can describe and analyze the operation of basic mechanical and physical systems.

SUBJECT OBJECTIVES

C1. Familiarizing students with methods of describing the static and dynamic properties of linear automation components in the construction of machines and devices.
C2. Familiarizing students with the basic control systems and methods of testing their stability.
C3. Familiarization students with the procedure for dealing with control systems in mechanics and machine construction.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Has a knowledge of the basic methods of describing automation systems.
PEU_W02 - Has a knowledge of the basic methods of automation systems analysis
PEU_W03 - Has a knowledge of the basic methods of automation systems synthesis.

II. Relating to skills:
PEU_U01 - Can define the mathematical description of the automation system.
PEU_U02 - Can analyze the function of the automation system.
PEU_U03 - Can design an automation system.

III. Relating to social competences:
PEU_K01 - Can expand knowledge using additional aids.
PEU_K02 - Can think and act in a creative way.
PEU_K03 - Understands the need to respect the customs and rules of the academic environment and society.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	An introduction to the lecture, basic concepts, structure of automation systems and their classification.	2
Lec2	Basic automation signals. Description of linear automation systems: mathematical models, operator transfer function, time characteristics.	2
Lec3	Dynamic non-linear systems. Methods of description and analysis. Operating point of a dynamic system, linearization. Static characteristics.	2
Lec4	Basic dynamic terms and their mathematical models. Examples of physical systems.	2
Lec5	Description of linear automation systems: spectral transmittance, frequency characteristics.	2
Lec6	Systems with a complex structure. Block diagrams of automation systems and methods of their transformations.	2
Lec7	Regulators used in automation, classification. Two-position and three-position regulation.	2
Lec8	Control: P, PI, PD, PID. Methods of P, I, D setting selection.	2
Lec9	Stability of control systems. Stability theorem, properties of stable and unstable systems. The stability criteria.	2
Lec10	Elements of logic. Boolean Algebra. Analysis and synthesis of logic circuits. Logic gates.	2
Lec11	Relay - contactor control systems. Designing of schematic diagrams.	2
Lec12	Application of PLC controllers in industrial automation. Designing and writing control algorithms.	2
Lec13	Combination logic circuits in control systems.	2

Lec14	Sequential logic circuits in industrial automation.	2
Lec15	Summary. Test of knowledge in the form of a colloquium.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Organizational activities. Health and safety regulations in the automation laboratory. Introduction, basic concepts. Classification of control systems.	2
Lab2	Static characteristics of automation elements.	2
Lab3	Dynamic time characteristics of automation elements.	2
Lab4	Frequency characteristics of automation elements.	2
Lab5	Simulation tests of automation elements in the Matlab-Simulink environment.	2
Lab6	Two-position regulation method.	2
Lab7	Three-position regulation method.	2
Lab8	Studying the properties of control systems with P, PI, PID controllers in the Matlab-Simulink environment.	2
Lab9	Application of the PID control method in industrial automation.	2
Lab10	Control in industrial pneumatic systems.	2
Lab11	Relay - contactor control elements and systems.	2
Lab12	Synthesis of combinational control systems.	2
Lab13	Synthesis of sequential control systems.	2
Lab14	Modeling and programming of sequential processes.	2
Lab15	Modeling and programming of concurrent and complex processes.	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - preparation for laboratory class N3. report preparation N4. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement

F1	PEU_W01-PEU_W03, PEU_K03	exam
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01,PEU_K02, PEU_K03	report, quiz
P = average F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Greblicki W., Podstawy automatyki. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2006.
[2] Awrejcewicz J., Wodzicki W. Podstawy automatyki, Teoria i przykłady, Łódź 2001
[3] Laboratorium podstaw automatyki i automatyzacji, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2005

SECONDARY LITERATURE

[1] Wawrzycki J. Podstawy automatyki. Wykład dla kierunku transport, Wydawnictwo AHE, Łódź 2012

SUBJECT SUPERVISOR

dr inż. Mateusz Stachowicz tel.: 713204235 email: mateusz.stachowicz@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Manufacturing Processes - Machining**
Name of subject in English: **Manufacturing Processes - Machining**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3110**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	45		30		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student should be familiar with technical drawing, the basics of metrology, shape and position deviations and surface roughness.
2. The student should be familiar with basic knowledge of mathematics, physics and materials science.
3. The student should have the ability to general plan an experiment and solve simple technical problems.

SUBJECT OBJECTIVES

C1. To provide basic knowledge about the methods and possibilities of manufacturing by machining, abrasive and erosion machining.
C2. Presentation of tools, materials and machining parameters used in a variety of manufacturing techniques.
C3. Introduce the technological possibilities and applications of various manufacturing methods and familiarize students with the methodology of solving issues related to materials processing.

SUBJECT LEARNING OUTCOMES
I. Relating to knowledge: PEU_W01 - The student should understand the physical and chemical fundamentals of machining. He or she should define and characterize the tooling materials and coatings applied. PEU_W02 - Students should define and characterize the most important machining methods. They should be capable of describing the kinematics and application of machining. Students should be able to describe and classify machines, tools for machining and know the possible technological effects of cutting. PEU_W03 - Students should define and characterize the most important abrasive and erosive machining methods. They should be able to describe the kinematics and applications of abrasive and erosive methods. Students should classify and describe machines, machining tools and know the possible technological effects of abrasive and erosive machining. **II. Relating to skills:** PEU_U01 - The student should be able to plan a laboratory experiment in the field of machining, as well as perform measurements (e.g., strength, surface roughness, wear) and analyze the results. PEU_U02 - The student should be able to select tools, machine tools, machining parameters and conditions, both in machining and in abrasive or erosive machining, according to the expected technological results. PEU_U03 - Students should be able to analyze problems in machining, as well as solve simple technological problems. **III. Relating to social competences:** PEU_K01 - The student should be aware of professional work behavior and know the safety rules when working with machinery. PEU_K02 - Students should be conscious of their responsibility for the results of their own and other team members' work. PEU_K03 - The student should understand the need for continuous improvement, acquiring knowledge and skills in accordance with changing technical and social requirements.

PROGRAM CONTENT		
Form of classes – Lecture		Number of hours
Lec1	Fundamentals of cutting, tool materials and coatings.	1
Lec2	Cutting tools geometry on the example of turning.	2
Lec3	Milling, broaching and drilling with other hole making technics.	2
Lec4	Gear forming or generating and threads manufacturing.	2
Lec5	Fundamentals of abrasive processes, grinding and other methods.	2
Lec6	Fundamentals of electrical discharge machining	2
Lec7	Finishing methods of machining, roller burnishing, lapping, honing and polishing.	2
Lec8	Construction and application of the selected machine tools	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Turning - tools, kinematics, process parameters and application.	2

Lab2	Drilling and other hole making technics.	2
Lab3	Milling - tools, kinematics, process parameters and application.	2
Lab4	Abrasive machining - grinding.	2
Lab5	Abrasive machining - sandblasting, lapping and vibromachining	2
Lab6	Methods of gear machining and cutting the threads.	2
Lab7	Electrical discharge machining.	2
Lab8	WEDM and hard to machine materials shaping.	2
Lab9	Super finishing of shafts and roller burnishing applications.	2
Lab10	The application of diamond tools in materials machining.	2
Lab11	Mechanics of cutting.	2
Lab12	The impact of the stiffness of the OUPN set and uneven distribution of allowance on turning inaccuracy.	2
Lab13	Structure and application of the modern modular tools.	2
Lab14	Funadamentals of manual CNC programming.	2
Lab15	Completion processes.	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. laboratory experiment N3. self study - preparation for laboratory class N4. self study - self studies and preparation for examination N5. report preparation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01; PEU_WO2; PEU_W03	exam
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01; PEU_UO2; PEU_U03PEU_K01; PEU_K02; PEU_K03	quiz
F2	PEU_U01; PEU_UO2; PEU_U03PEU_K01; PEU_K02; PEU_K03	participate in discussion
F3	PEU_U01; PEU_UO2; PEU_U03PEU_K01; PEU_K02; PEU_K03	laboratory report
P = 0,3F1+0,3F2+0,4F3		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SECONDARY LITERATURE

SUBJECT SUPERVISOR
dr inż. Dariusz Poroś tel.: 27-91 email: dariusz.poros@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Computer Aided Machine Design II (Computer Aided Machine Design II)**
Name of subject in English: **Computer Aided Machine Design II**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3111**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				90	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				3	
including number of ECTS points for practical (P) classes				3	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				2.1	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of strength of materials, Analytical methods in strength calculations. Knowledge of types of engineering materials.
2. Student can implement a construction project using computer methods in the field of design and numerical analyses.
3. Ability to perform strength analysis using numerical methods.

SUBJECT OBJECTIVES

C1. Acquisition of the ability to design the load-bearing structure considering the defined criteria.
C2. Ability to define input data (boundary and initial conditions) necessary for modeling loads acting on the load-bearing structure.
C3. Acquisition of the ability to use CAD/CAE systems in designing.
C4. Acquisition and consolidating the ability to work in a group and the ability to search for information.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:
PEU_U01 - Student can design a mechanical assembly including the defined criteria, using the appropriate methods, techniques and tools, along with calculations of the components, using the computer-aided design software.
PEU_U02 - Student can correctly formulate the kinetic and kinematic conditions to which machine or machine assembly is subjected.
PEU_U03 - Student can prepare the documentation concerning the implemented engineering tasks and prepare a presentation of the results of this task

III. Relating to social competences:
PEU_K01 - Acquires the ability to take responsibility for the work done.
PEU_K02 - Able to work in a group, taking different roles.
PEU_K03 - Acquires the teamwork skills.

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Overview of the curriculum. Introduction to the environment of adapted tools for computer-aided design.	2
Proj2	Determination of loads acting on the assembly and its individual members in various configurations using CAD.	4
Proj3	Analysis of the selection of materials for individual elements of the designed assembly (devices, machines). Determination of properties and geometric features of members and connecting elements.	2
Proj4	Development of a geometric model for numerical analysis using a computer-aided design (CAD) system.	4
Proj5	Development of a computational model with initial-boundary conditions (numerical model) in CAE systems.	6
Proj6	Numerical studies (depending on the type of project and the type of initial-boundary conditions).	4
Proj7	Development of a project in a computer-aided design (CAD) system.	4

Proj8	Development of technical documentation for the project (assembly drawing and detailed drawings of selected parts).	4
		Total hours: 30

TEACHING TOOLS USED
N1. self study - preparation for project class N2. multimedia presentation N3. project presentation N4. report preparation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02, PEU_K03	Evaluation of the completed project
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Rusiński E., Czmochowski J., Smolnicki T. Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000
[2] Rakowski G., Kacprzyk Z.: Metoda elementów skończonych w mechanice konstrukcji, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2016
[3] Zienkiewicz O.C.: Metoda elementów skończonych, Arkady 1972

SECONDARY LITERATURE
[1] Szmelter J., Dacko M., Dobrociński S., Wieczorek M.: Metoda elementów skończonych w statyce konstrukcji, Arkady 1979
[2] Gawroński W., Kruszewski J., Ostachowicz W., Tarnowski K., Wittbrodt E.: Metoda elementów skończonych w dynamice konstrukcji, Arkady, Warszawa 1984
[3] Waszczyszyn Z., Cichoń Cz., Radwańska M.: Metoda elementów skończonych w stateczności konstrukcji, Arkady, Warszawa 1990
[4] Kleiber M.: Wprowadzenie do metody elementów skończonych, PWN, Warszawa-Poznań 1989
[5] Cichoń Cz., Cecot W., Krok J., Pluciński P.: Metody Komputerowe w liniowej mechanice konstrukcji, Wydawnictwo Politechniki Krakowskiej, Kraków, 2010
[6] Olszowski B. Wybrane metody numeryczne, Wydawnictwo Politechniki Krakowskiej, Kraków, 2007

SUBJECT SUPERVISOR
dr hab. inż. Jacek Karliński tel.: 71 320-29-46 email: jacek.karlinski@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Offroad Vehicles Engineering (Inżynieria pojazdów przemysłowych)**
Name of subject in English: **Offroad Vehicles Engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3112**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30	15	
Number of hours of total student workload (CNPS)	60		60	30	
Form of crediting	Crediting with grade		Crediting with grade	Crediting with grade	
Group of courses					
Number of ECTS points	2		2	1	
including number of ECTS points for practical (P) classes			2	1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		1.4	0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge of the construction of vehicle drive systems;
2. Can cooperate with a group and individually solve complex tasks;
3. Has knowledge of mechanics, mathematical analysis and the fundamentals of machine design of vehicle drive. systems

SUBJECT OBJECTIVES

C1. The aim of the course is to improve knowledge of the construction and working methods of engineering vehicles in particularly wheeled and tracked vehicles. The scope also includes calculations of resistance to motion, steering of various chassis systems;
C2. The aim of the course is to acquire practical knowledge in the calculation of typical undercarriage components of the wheeled and tracked chassis. The class also extends the knowledge of the use of various systems of vehicle chassis systems;
C3. The aim of the course is to gain knowledge of how the tool interacts with the soil, to determine the suitability of tools for
a variety of jobs;
C4. The aim of the class is to gain skills in group work, in developing results.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Can calculate the individual components of suspension systems for wheeled and tracked vehicles as well as the transmission of drive systems.
PEU_W02 - Can identify the correct tool for the task to be carried out. Can estimate traction force. Knows the principle of braking systems of heavy-duty vehicles and calculates the braking distance.
PEU_W03 - He knows the basics of how the tool interacts with the ground and is familiar with the methods to achieve full loading.

II. Relating to skills:
PEU_U01 - can also use foreign language literature, and analyze and interpret the results obtained.
PEU_U02 - is able to analyze and process the results to obtain the characteristics or measured parameters in vehicle and drive systems with different control system settings parameters in vehicle and drive systems with different control system settings.
PEU_U03 - is able to propose its own chassis concepts.

III. Relating to social competences:
PEU_K01 - is able to and understands the need for continuing education and acquiring new information.
PEU_K02 - is responsible for the decisions he takes, both in terms of the environment and in terms of his activities as a mechanical engineer.
PEU_K03 - is able to work in a group and solve tasks assigned to him/her, also in different positions, and takes responsibility for the group achieving the intended purpose.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to off-road locomotion. Locomotion in nature. Overview of methods of movement of animals and vehicles with different chassis systems with examples. The efficiency of movement. Interaction of off-road vehicles with the ground.	2

Lec2	Division of working machinery into earth-moving machinery and transport machinery. Their types of workplaces, and their use distinguish the problems of locomotion of these groups of objects (bucket loaders, bulldozers, excavators, compactors...).	3
Lec3	Tire wheel theory of motion traveling over different terrains. Characteristics and examples of motion resistance calculations. Characteristics and examples of offroad movement resistance calculations. Wheel efficiency, adhesion coefficient, large size wheel, tread types. Tyre wheel test methods.	3
Lec4	Mechanics of movement of a non-automotive vehicle. Resistance to the movement of the trailer, and interaction with the towing vehicle. Distribution of weights acting on the axles during motion. Energy requirements during unsteady motion. Fuel consumption.	2
Lec5	Braking of multi-frame vehicles. Requirements for pneumatic, hydraulic, and combined braking systems. Components of industrial vehicle braking systems. Amount of dissipated energy expended. Sensors to optimize system operation (axle weight, speed...). Trailer-tractor interaction. Redundancy of the braking systems.	3
Lec6	Directional stability of wheeled vehicles. Directional stability during braking of an articulated vehicle. Steering kinematics. Vehicle suspensions and the adaptation of vehicle wheel positions to significant curvatures of the terrain. Use of spring and damping elements in suspension systems.	2
Lec7	Automation in earth-working machinery. Principles of operation of basic position and force, pressure, flow sensors to identify their advantages and disadvantages in process control. Autonomous systems for guiding a vehicle or tool along a set trajectory.	2
Lec8	Advanced control systems: weighing systems and positioning of the working tool. Inspection robots moving e.g. inside tunnels. Industrial vehicle operation in reduced visibility conditions.	2
Lec9	Theory of movement of a tracked vehicle. Examples of steel and elastomeric tracks in use. Comparison and their application. Calculations of track belt tension under internal and external forces. Turning kinematics of tracked vehicles. Resistance to the movement of these vehicles.	3
Lec10	Interaction of tracks with the ground. Influence of tread height, tractive force, number of load-bearing rollers, and determination of track slip on different soils. An unevenness of track pressure versus tractive force. Determination of traction forces.	2
Lec11	Steering and suspension systems of earth-working vehicles. Examples of applications. Selection of air springs. Role of individual suspension components.	2
Lec12	Vehicles for special applications. Theory of hover vehicles. Hover cushion generation methods, application, advantages and disadvantages of thisgroup of vehicles. Construction of screw and walking vehicles. Alternative energy sources.	2
Lec13	Mileage tests for special vehicles. Definition of requirements and verification methods. Arrangement of acquired knowledge. Summary of the course.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Study of basic paragmeters used in terra mechanics to describe soils.	2

Lab2	Investigations into the process of loading the crushed medium with a loader. bucket	2
Lab3	Soil shear resistance tests with the driving element.	2
Lab4	Investigations of the cutting process of compact rocks with various shaped cutters.	2
Lab5	Norm tests on work tool loads and tipping loads of an industrial vehicle	2
Lab6	Road vehicle resistance tests	2
Lab7	Testing of dynamic loads on the lifting mechanism of a overhead crane.	2
Lab8	Investigations into the process of digging the crushed medium with an excavator bucket.	2
Lab9	Tracked vehicle resistance tests.	2
Lab10	Testing of steering resistance and torsional stiffness of tire wheels.	2
Lab11	Investigations into the phenomenon of frictional coupling between an elastomer track and a cable.	2
Lab12	Traction tests on a cable vehicle.	2
Lab13	Testing of the multi-purpose wheeled vehicle.	2
Lab14	Turning resistance tests on a wheeled articulated vehicle.	2
Lab15	Driving characteristics of unconventional vehicles.	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	The aim of the project is to develop a drive system for a wheeled or tracked vehicle. The scope of the project includes the calculation of tractive forces, resistance to motion, driving moments, and the preparation of detailed drawings of the selected component. The design may also involve the selection of the boom geometry to maintain the straightness of the tool's movement and a classic or hybrid transmission system. In this case, the resistance to movement during excavation is determined and the individual components are selected. The selection of components should take into account the final efficiency achieved in the operation of the mechanism. 1. Discussion of the task to be carried out and definition of the prerequisites; 2. analysis of the Student's literature; 3. proposal by the Student to solve the problem; 4. calculation and selection of components/construction of technical documentation; 5. revising and completing the design; 6. submission of finished project; 7-8 Group presentation of the project.	15
		Total hours: 15

TEACHING TOOLS USED
N1. multimedia presentation N2. laboratory experiment N3. self study - preparation for project class N4. self study - preparation for laboratory class N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01-PEU_W03 PEU_U01-PEU_U03 PEU_K01-PEU_K03	Written exam
P = pozytywna ocena z egzaminu		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03 PEU_K01-PEU_K03	mid-term paper, oral answers, laboratory exercise report
P = pozytywna ocena ze wszystkich ocenionych ćwiczeń laboratoryjnych		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03 PEU_K01-PEU_K03	defending the project, evaluating the calculation part of the project,
P = pozytywnie ocenione wszystkie części składowe projektu		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Inżynieria maszyn roboczych, K. Pieczonka, OW PWr, 2007
2. Theory of ground vehicles; J. Y. Wong, John Wiley & Sons, New York
3. Tyre and Vehicle Dynamics, H. B. Pacejka, Delft University of Technology
4. Vehicle Dynamisc, Theory and Applicaton, R. N. Jazar, Springer, 2008
5. Automotive Engineering Powertrain, Chassis System and Vehicle Body, A. Crolla, Elsevier, 2009
6. Fundamentals of Vehicle Dynamisc, T. D. Gillespie, Society of Automotive Engeeners,
7. Ciągniki, H. Dajniak, Wydawnictwa Komunikacji i Łączności, 2008
8. Kierowalność i stateczność samochodu, A. Litwinow, WKŁ, 1975
9. Teoria ruchu pojazdu gąsienicowego, Z. Burdziński, WKŁ, 1972

SECONDARY LITERATURE

SUBJECT SUPERVISOR

dr inż. Aleksander Skurjat tel.: 71 320-23-46 email: Aleksander.Skurjat@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Hydraulic Drive Systems (Napęd hydrauliczny)**
Name of subject in English: **Hydraulic Drive Systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3113**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30	15	
Number of hours of total student workload (CNPS)	60	60	30		
Form of crediting	Examination	Crediting with grade		Crediting with grade	
Group of courses					
Number of ECTS points	2	2	1		
including number of ECTS points for practical (P) classes		2	1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		1.4	0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Students have basic knowledge of fluid mechanics.
2. Students have basic knowledge of the construction of hydrostatic drive systems components.
3. Students have basic knowledge of machine power transmission systems.

SUBJECT OBJECTIVES

C1. Introduce students with the functions of hydraulic elements in hydrostatic systems.
C2. Introduce students with hydraulic drive systems.
C3. Introduce students with the methods of controlling and regulating specific parameters of hydraulic drives.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - As a result of the course, the student has the knowledge to describe basic systems hydraulic systems.
PEU_W02 - As a result of the course, the student has the knowledge and ability to explain the principles of designing of hydraulic drive systems.
PEU_W03 - As a result of the course, the student has the knowledge to characterize the elements of of hydraulic systems that control the relevant parameters or regulate them.

II. Relating to skills:
PEU_U01 - As a result of the conducted classes, the student is able to design a hydraulic system with appropriate control system, conduct technical calculations and based on them, select the proper hydraulic components.
PEU_U02 - As a result of the classes, the student is able to make measurements on hydraulic system components, discuss the results and draw appropriate conclusions.
PEU_U03 - In the results of the course, the student is able to assemble, launch make adjustments to the hydraulic system,
analyze the correctness of operation of hydraulic and electro-hydraulic drive systems.

III. Relating to social competences:
PEU_K01 - Able to interact and work in a group during assembly of hydraulic and electrohydraulic systems, preparation of report.
PEU_K02 - Can properly plan measurements during the laboratory exercise and plan execution of the project.
PEU_K03 - Correctly identifies and solves problems encountered during the assembly of hydraulic and electro-hydraulic systems and the project. Draws appropriate conclusions from the exercise.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, presentation of the content of the course, forms of evaluation and requirements, literature on the subject. Features of hydraulic systems.	2
Lec2	Hydrostatic transmission - principle of operation, basic parameters and dependencies.	2
Lec3	Methods of regulating the parameters of the hydraulic energy source and the parameters of the hydrostatic actuators.	4
Lec4	Key operating parameters of positive displacement pumps.	2
Lec5	Multi-pump vs single pump systems with priority power allocation.	2
Lec6	Synchronization of hydraulic actuators.	2
Lec7	Hydraulic accumulators in hydrostatic systems.	2
Lec8	Simultaneous control of hydraulic actuators - sequential, logical and electro-hydraulic systems	2
Lec9	Hydrostatic transmission in drive systems.	2
Lec10	Hydrostatic drive systems of machine work tool systems.	2

Lec11	Hydrostatic braking systems.	2
Lec12	Hydrostatic vehicle steering systems.	2
Lec13	Energy balance and heat energy emission of hydrostatic systems.	2
Lec14	Efficiency of hydrostatic systems, systems with energy recuperation, and architecture of hydrostatic systems in the energy aspect.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Introduction to laboratory, safety regulations, organizational matters.	2
Lab2	Direction control methods in hydraulic systems.	2
Lab3	Pressure valves in hydraulic systems.	2
Lab4	Hydraulic power source unloading methods.	2
Lab5	Pilot operated check valve - safety in hydraulic systems.	2
Lab6	In series throttle – open loop hydraulic acting elements speed control.	2
Lab7	Parallel throttle – open loop hydraulic acting elements speed control.	2
Lab8	Closed loop hydraulic acting elements speed control methods.	2
Lab9	Load sensing hydraulic systems - Fixed displacement pump.	2
Lab10	Variable displacement pump - hydraulic characteristics.	2
Lab11	Load sensing hydraulic systems - Variable displacement pump.	2
Lab12	Hydraulic flow rectifier.	2
Lab13	Hydraulic accumulators.	2
Lab14	Dynamics of hydraulic systems.	2
Lab15	Final exam.	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Introduction to the project. Assignment of project topics.	3
Proj2	Determination of assumed parameters. Design of the hydraulic system structure.	2
Proj3	Preliminary calculations.	2
Proj4	Selection of system components.	2
Proj5	Description of designed hydraulic system, design verification in terms of function, parameters and selected hydraulic components.	2
Proj6	Determination of the final parameters of the designed system, comparison vs preliminary assumptions.	2
Proj7	Project assessment.	2
		Total hours: 15

TEACHING TOOLS USED
N1. informative lecture N2. self study - preparation for laboratory class N3. laboratory experiment N4. self study - preparation for project class N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	Exam
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U02, PEU_U03, PEU_K01, PEU_K02	Activity during class
F2	PEU_U02, PEU_K01, PEU_K02	Report
P = 0,2F1+0,8F2		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_K02, PEU_K03	Project assessment
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE Akers A., Gassman M., Smith R., Hydraulic Power System Analysis (Fluid Power and Control), CRC Press, 2006 W.Durfee, Z.Sun, J. Van de Ven, Fluid Power System Dynamics Department of Mechanical Engineering, University of Minnesota, A National Science Foundation Engineering Research Center, September 25, 2015 Rexroth Bosch Group, Project Manual Industrial Hydraulics, Trainer’s manual SECONDARY LITERATURE Lambeck R.: Hydraulic pumps and motors. Marcel Dekker INC. New York 1983. Pippenger J.: Hydraulic valves and control. Marcel Dekker INC. New York 1984

SUBJECT SUPERVISOR
Prof. dr hab. inż. Wiesław Fiebig tel.: 71 320-27-00 email: Wieslaw.Fiebig@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Internal Combustion Engines (Silniki spalinowe)**
Name of subject in English: **Internal Combustion Engines**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3114**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the conservation principle: mass, energy and momentum, and the equation of state of the factor
2. Ability to perform laboratory exercises based on elementary manual skills
3. Awareness of individual and group work and the ability to carry it out

SUBJECT OBJECTIVES

C1. obtaining knowledge on the conversion of energy from chemical to mechanical form in an internal combustion engine
C2. awareness of the design requirements for engines in order to achieve the efficiency of the combustion process
C3. understanding of construction requirements obtained thanks to adequate manufacturing technology

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - has knowledge of chemistry, fluid mechanics and thermodynamics enabling the selection of fuel
PEU_W02 - acquires skills enabling estimation of the charge exchange and the amount of fuel necessary for the combustion process
PEU_W03 - knows the parameters for evaluating the efficiency of a real internal combustion engine

II. Relating to skills:
PEU_U01 - has the ability to perform a dynamometer test of an internal combustion engine
PEU_U02 - has the ability to analyze test results and evaluate thermodynamic parameters
PEU_U03 - has the ability to draw conclusions based on the assessment of specyfik fuel consumption and mechanical efficiency

III. Relating to social competences:
PEU_K01 - understands the need for additional training in the field of drives (powertrains)
PEU_K02 - is aware of the size of the efficiency of energy conversion and the impact on the natural environment
PEU_K03 - is aware of environmental emissions from currently used propulsion systems

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	A history of the industrial age with a detailed description of the development of internal combustion engines	2
Lec2	Classification of internal combustion engines with a description of applications in industries	2
Lec3	Engine fuels	2
Lec4	Thermodynamic cycles, efficiencies and additional performance parameters	2
Lec5	The combustion process in a spark ignition engine	2
Lec6	The combustion process in a self-ignition engine (Diesel)	2
Lec7	Charge exchange loop (breathing)	2
Lec8	Engine characteristics	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Construction of the piston-crank system	2
Lab2	engine timing gear	2
Lab3	Historical injection apparatus	2
Lab4	Common rail fuel systems	2
Lab5	Test bench ISO8178 - descryption and formulas	2
Lab6	Test bench - mesurement	2

Lab7	Specyfic fuel consumption and emission calculation	2
Lab8	Fuel cell drive	1
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. multimedia presentation N3. laboratory experiment N4. calculation exercises N5. problem discussion

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01	test
F2	PEU_W02	test
F3	PEU_W03	test
P = (F1+F2+F3)/3		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_K01	report
F2	PEU_U02, PEU_K02	report
F3	PEU_U03, PEU_K03	report
P = (F1+F2+F3)/3		

PRIMARY AND SECONDARY LITERATURE
<u>PRIMARY LITERATURE</u> Heywood, J.B. (1988) Internal Combustion Engine Fundamentals, McGraw-Hill, New York. Stone, R. (2005) Introduction to Internal Combustion Engines, SAE International, Warrendale. <u>SECONDARY LITERATURE</u> ISO8178

SUBJECT SUPERVISOR
dr inż. Marcin Tkaczyk tel.: 71 347-79-18 email: Marcin.Tkaczyk@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Carrying Structures**
Name of subject in English: **Carrying Structures**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3115**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			30	
Number of hours of total student workload (CNPS)	30			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Strength of materials fundamentals; trusses , beams, plates and shells analysis. Fundamentals of materials science.
2. Fundamentals of Finite Element Method
3. Ability to perform numerical strength analysis of basic elements in the elastic range behavior.

SUBJECT OBJECTIVES

C1. Recommendations for trusses, thin and thick plates elements design
C2. Presentation of problem related to proper design of connections and structural nodes under static and alternating loads
C3. Ability to design basic load carryings structures with use of the CAD/CAE software

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Knowledge in the field of design of load carrying structure under alternating loads, prone to fatigue (trusses, frames, thin shell, solid elements)
PEU_W02 - Knowledge in the field of designing of structural nodes and connections of load carrying structures
PEU_W03 - Knowledge in the field of designing on the basis of standards (cranes, steel structures) with respect to the stiffness and durability criterion

II. Relating to skills:
PEU_U01 - Ability to develop numerical model of basic structural elements for strength, buckling and vibrations analysis
PEU_U02 - Ability to define proper kinetic, kinematic boundaries to the structure
PEU_U03 - Ability to proper results intepretation

III. Relating to social competences:
PEU_K01 - Acquire skills in the responsibility of performed tasks
PEU_K02 - Acquire skills of creative engineering
PEU_K03 - Acquire skills of team work

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Survey of the machines load carrying structures	1
Lec2	Failures and disasters analysis of load carrying structures	2
Lec3	Load carrying structures modeling	2
Lec4	Recommendations for connecting structure elements under alternating loads	2
Lec5	Recommendations for design of thin shell elements. Local and global stability approach.	2
Lec6	Recommendations for structural nodes design	2
Lec7	Calculation methods in load carrying structures design – permissible stresses method, limiting stresses method	2
Lec8	Fatigue phenomenon of load carrying structures	2
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Description and scope of the project classes. Introduction to the software	2
Proj2	Designing, modeling of volume/solid elements structures	2
Proj3	Boundary conditions: support definition; symmetry, kinetic and kinematic load, strength analysis	2
Proj4	Optimization of the solid elements structures (mass minimization)	2
Proj5	Designing and modeling of thin shell elements (I profiles, box profiles)	2

Proj6	Designing and modeling of thin shell elements (mass minimization)	4
Proj7	Designing and modeling of truss elements (3D truss)	2
Proj8	Designing and modeling of structural nodes (rigid, elastic and revolute joints)	4
Proj9	Designing and modeling of 3D beam structures of machines and vehicles	4
Proj10	Design optimization of the 3D beam structure	2
Proj11	Definition and combination of fundamental loads for cranes	2
Proj12	Natural frequencies and linear buckling analysis of load carrying structures	2
		Total hours: 30

TEACHING TOOLS USED
N1. self study - preparation for project class N2. report preparation N3. multimedia presentation N4. project presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	Colloquium and possible orally improvement
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03 PEU_K01, PEU_K02, PEU_K03	Assessment of project preparation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Rusinski E., Czmochowski J., Smolnicki T.: The advanced finite element method in the construction of load-bearing (in polish), Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000
Rusiński E.: Finite Element Method. COSMOS/M (in Polish) System, WKiŁ, Warszawa 1994
Rusiński E.: Computer analysis of frames and bodies of vehicles and work machines (in Polish), WKiŁ, Warszawa 1990
Rusiński E.: Principles of design of bearing structures of vehicles (in Polish). Oficyna Wyd. PWr Wrocław 2002

SECONDARY LITERATURE

Augustyn J., Śledziewski E.: Technology of steel welded constructions (in Polish), Arkady, Warszawa 1981
Augustyn J.: Welded and spot-welded joints (in Polish), Arkady, Warszawa 1987
Dudczak A.: Excavators. Theory and design (in Polish), PWN, Warszawa 2000
Ferenc K., Ferenc J.: Welded constructions. Designing connections. (in Polish) WNT, Warszawa 2000
Pieczonka K.: Engineering of work machines. Part I. The basics of mining, driving, lifting and turning (in Polish), Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2007
Żmuda J.: Basic design of metal structures (in Polish), Arkady, Warszawa 1997
EN 1993-1 Eurokod 3 Design of steel structures

SUBJECT SUPERVISOR

dr hab. inż. Jerzy Czmochowski tel.: 71 320 42 84 email: jerzy.czmochowski@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Safety of machines and technological processes (Podstawy eksploatacji i remontów maszyn)**
Name of subject in English: **Safety of machines and technological processes**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3116**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				15
Number of hours of total student workload (CNPS)	60				30
Form of crediting	Examination				Crediting with grade
Group of courses					
Number of ECTS points	2				1
including number of ECTS points for practical (P) classes					1
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2				0.7

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. A student has knowledge on the foundations of machines designing, manufacturing and operation.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge on methods for evaluating and shaping the machines safety during various phases of operation of a technical object.
C2. Acquisition of knowledge on legal regulations in the area of responsibility for desined, manufactured and used machines.
C3. Familiarizing the student with the methods of identifying threats using individual and team analysis of cases.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Student knows the methods for safety and risk evaluation and shaping during various phases of the technical object lifetime.

II. Relating to skills:
PEU_U01 - Student can apply methods for the safety evaluation of machines and processes as well as can identify preventive and mitigation measures for the recognized hazards.

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Discussion on the lecture content and exam requirements. Basic concepts and definitions. Models of an incident and protection.	1
Lec2	Formulation of safety requirements for a technical object. HAZOP as the method for the identification of process hazards.	2
Lec3	FMEA / FMECA – the methods supporting the designing and evaluation of technical object and process safety.	2
Lec4	FTA, ETA methods.	2
Lec5	The reliability structure of an unrecoverable system. Basic and mixed structures. The methods for the reliability increase of a system.	2
Lec6	Legal regulations on machines and processes safety.	2
Lec7	Case studies of safety hazards of machines and technological processes. Assessment of the possibility of earlier threats identification.	4
		Total hours: 15

Form of classes – Seminar		Number of hours
Sem1	Introduction. Discussion on the seminar content and exam requirements.	1
Sem2	Formulation of the safety requirements and identification of the causes of incidents - a case study.	2
Sem3	Application of HAZOP method for the identification of hazard in a technological process.	4
Sem4	Failure Modes and Effects Analysis (FMEA).	4
Sem5	Fault Tree Analysis and Event Tree Analysis for a chosen machine / machine’s subsystem. Identification of protection and mitigation means.	4
		Total hours: 15

TEACHING TOOLS USED
N1. multimedia presentation N2. problem discussion N3. case study N4. informative lecture

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01	written exam
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Seminar)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01	participation in problem discussions
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Ważyńska_Fiok K., Jaźwiński J.: Niezawodność systemów technicznych. PWN, Warszawa 1990.
[2] Podstawy racjonalnej eksploatacji maszyn. Red. M. Woropay. Biblioteka Problemów Eksploatacji. ITE, Radom 1996.
[3] Dwiliński L., Wstęp do teorii eksploatacji obiektu technicznego, Wyd. Politechniki Warszawskiej, Warszawa 1991.
[4] Poradnik niezawodności, tom I. Red. J. Migdalski. WEMA, Warszawa 1982.
[5] Poradnik Niezawodności, tom II. Red. J. Migdalski. WEMA, Warszawa 1992.
[6] Lorenc A.K., Szkoda M., Rezerwowanie jako metoda zwiększenia gotowości i niezawodności floty pojazdów. Instytut Logistyki i Magazynowania 2014.
[7] Kozłowski M. (red.), Budowa i eksploatacja pojazdów. Cz. 2, Obsługa, diagnostyka i naprawa zespołów i podzespołów, Wrocław: Vogel Business Media 2005.
[8] Kozłowski M. (red.), Budowa i eksploatacja pojazdów. Cz. 1, Działanie zespołów i podzespołów, Wrocław: Vogel Business Media 2005.

SECONDARY LITERATURE
[1] Szopa T., Niezawodność i bezpieczeństwo, Wyd. Politechniki Warszawskiej, Warszawa 2009.
[2] Młynarski S., Problemy prognozowania niezawodności pojazdów eksploatowanych w transporcie drogowym. Monografie Politechniki Krakowskiej. Seria Mechanika. Kraków: Wydawnictwo PK 2018.
[3] OprzędkiewiczJ., Technologia budowy samochodów: skrypt dla studentów wyższych szkół technicznych do przedmiotów: technologia pojazdów samochodowych i technologia silników spalinowych. Cz. 11, Podstawy niezawodności maszyn i urządzeń. Kraków: Wydawnictwa Politechniki Krakowskiej 1982.

SUBJECT SUPERVISOR

dr inż. Tomasz Siwulski tel.: 71 320-28-92 email: tomasz.siwulski@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Manufacturing Systems CNC (Maszyny technologiczne CNC i roboty)**
Name of subject in English: **Manufacturing Systems CNC**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3117**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15	15	
Number of hours of total student workload (CNPS)	30		30	30	
Form of crediting	Crediting with grade		Crediting with grade	Crediting with grade	
Group of courses					
Number of ECTS points	1		1	1	
including number of ECTS points for practical (P) classes			1	1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6		0.7	0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge of the design and construction process, the construction and operation of machine components and assemblies, and the principles of their selection and construction.
2. Has a well-established knowledge of basic manufacturing techniques and the role of process machinery.
3. Able to design a technological process in the field of non-cut and cavity machining.

SUBJECT OBJECTIVES

C1. To familiarize with the construction of basic CNC technological machines and robots, in particular their systems: control, drive and measurement.
C2. To learn the principles of programming CNC machines and the principles of construction and implementation of control programs, and to learn methods to support the programmer's work.
C3. To learn the principles and possibilities of using automated single- and multi-machine systems to perform specific machining tasks.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - As a result of the course, the student should be able to explain the construction and principles of operation of modern CNC technological machines, especially the principles of control of their work.
PEU_W02 - As a result of the course, the student should be able to describe the principles of selection of CNC technological machines for specific machining tasks.
PEU_W03 - As a result of the course, the student should be able to describe the basics of CNC machine programming.

II. Relating to skills:
PEU_U01 - As a result of the class, the student should be able to evaluate CNC technological machines for their suitability to perform specific machining tasks.
PEU_U02 - As a result of the course, the student should be able to develop a program structure for basic CNC machines, and be able to use subroutines and standard cycles.
PEU_U03 - As a result of the activities, the student should be able to analyse how a process machine functions.

III. Relating to social competences:
PEU_K01 - Able to search and use the literature recommended for the course and acquire independently knowledge.
PEU_K02 - Able to use modern IT tools.
PEU_K03 - Understands the need to work systematically and independently to master the course material.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	General characteristics of technological machines and their classification. Elements, mechanisms and components of CNC machines	1
Lec2	Main and feed drive systems of process machines, construction and characteristics. Measuring, diagnostic and supervisory systems.	2
Lec3	Structure and basics of automatic control of technological machines. Classification of control systems (NC, CNC, DNC, AC and PLC systems).	2
Lec4	Introduction to programming of numerically controlled machine tools - geometric basics of CNC control, coordinate systems, structure of the control program, interpolation. Ways to support programming - machining simulators.	4

Lec5	Machine tools for machining housings, rotary and flat surfaces - drilling machines, milling machines, boring machines. Technical and operational features and purpose of machines.	2
Lec6	Cutting machines for machining rotary and flat surfaces - grinders. Elements of construction and technological purpose of machines.	1
Lec7	Machine tools for erosion and laser machining - technical and application characteristics and purpose of the machines.	1
Lec8	Industrial robots and manipulators (construction, classification and areas of application).	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction, familiarization with technological machines	1
Lab2	Computer tomography application in geometry measurements and defectoscopy	2
Lab3	Rapid Prototyping technology based on Additive manufacturing - metal	2
Lab4	Rapid Prototyping technology based on Additive manufacturing - plastics	2
Lab5	The structure, operation and programming of the industrial robot	2
Lab6	Using CNC machines in machining processes	2
Lab7	Using a manipulator in processes of cold gas spraying	2
Lab8	The use of robots in sheet and spot welding processes	2
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Choice of machine tool, preparation of process card, definition of preparation, selection of tools and tooling, determination of machining parameters.	1
Proj2	Preparing the machine tool and programming environment, configuring the simulator. Determining the positioning of the workpiece in the workspace of the machine tool. Creating the control program.	2
Proj3	Programming of basic technological procedures using rectilinear movements.	2
Proj4	Programming arc and circle movements. Coordinate system transformations.	2
Proj5	Programming motion along a contour using tool path correction. Combining motion segments by rounding and chamfering.	2
Proj6	Subroutine technique, incremental programming, use of loop functions in program flow.	2
Proj7	Use of machining cycles in programming.	2
Proj8	Advanced programming techniques.	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - preparation for laboratory class N3. self study - preparation for project class N4. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03,	Colloqium
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03,	Short test / lab report
P = średnia arytmetyczna F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03,	Assessment of the prepared project
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SECONDARY LITERATURE

SUBJECT SUPERVISOR
dr inż. Marcin Madeja tel.: 3204185 email: marcin.madeja@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Legal aspects of engineering activities (Uwarunkowania prawne działalności inżyniera)**

Name of subject in English: **Legal aspects of engineering activities**

Main field of study (if applicable): **Mechanical Engineering and Machine Building**

Specialization (if applicable): **Mechanical engineering design**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **W10MBM-SI3120**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has firm knowledge of fundamentals of machine design, materials science, strength of materials, mechanics and production techniques.
2. Can independently seek information in source texts, catalogues and the Internet.
3. Can read and create mechanical technical documentation.

SUBJECT OBJECTIVES

C1. To gain basic knowledge about legal context of machine manufacturers' work.
C2. To gain basic knowledge about safety of machine operation.
C3. To gain practical ability to analyze and reduce risk posed by machines.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Has knowledge about basic legal requirements for machine designers.
PEU_W02 - Has basic knowledge about the process of risk reduction.

II. Relating to skills:
PEU_U01 - Can identify risk posed by a machine and propose means of its reduction.
PEU_U02 - Can determine proper norms for given problem.

III. Relating to social competences:
PEU_K01 - Is aware of the threats posed by different types of machines.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to the legal aspects of machine manufacturer’s work. Machinery Directive. The role of the designer in the process of risk reduction.	2
Lec2	Harmonized norms of type A, B and C.	2
Lec3	Threats posed by machines – types and identification.	2
Lec4	Risk assessment methods.	2
Lec5	Safety measures used by the designer – design safe in itself.	2
Lec6	Safety measures used by the designer – use of safeguards.	2
Lec7	Safety measures used by the designer – residual risk.	2
Lec8	User instructions – legal requirements.	1
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Presentation of the machine to be analyzed. Definition of requirements for the analyzed machine.	1
Proj2	Development of preliminary concept of machine according to the reuirements. An approach to design machine safe on its own.	4
Proj3	Machine risk assesment.	4
Proj4	Proposal of technical safeguards reducing risk.	4
Proj5	Residual risk assesment.	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. tutorials N3. project presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01	written test
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01- PEU_U02 PEU_K01	project defense
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE 2006/42/EC Machine directive SECONDARY LITERATURE

SUBJECT SUPERVISOR
dr inż. Damian Stefanow tel.: 320-27-18 email: damian.stefanow@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Production System Organisation (Podstawy organizacji produkcji)**
Name of subject in English: **Production System Organisation**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3121**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows and understands the nature of the management process and the basic functions of management.
2. Understands the basic concepts and basic economic rights and economic phenomena and their effects.
3. Posesses a basic knowledge of manufacturing processes.

SUBJECT OBJECTIVES

C1. Knowing the specifics of management of the production and manufacturing processes
C2. Getting familiar with methods and techniques for managing different types of manufacturing processes
C3. The acquisition of skills in planning, organizing and controlling of production processes

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Distinguishes and characterizes by different types of production systems.
PEU_W02 - Can define the concepts of production and technological processes.
PEU_W03 - Has knowledge of the methods and techniques of production systems management.

II. Relating to skills:

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Characteristics of manufacturing organizations	2
Lec2	Characteristics of production systems	2
Lec3	Manufacturing system, its organization and components	2
Lec4	Classifications of production processes	2
Lec5	Methods of production control - pull systems. Just In Time concept. Lean manufacturing concept.	4
Lec6	Methods of production control - push systems. MRP, MRP II, ERP concepts.	4
Lec7	Methods of production control - squeeze systems. OPT concept.	4
Lec8	Methods of organization of production systems	2
Lec9	Production inventory management methods	2
Lec10	Principles of planning and scheduling of production processes	4
Lec11	Methods of production data acquisition	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01-PEU_W03	Written test
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE
SECONDARY LITERATURE

SUBJECT SUPERVISOR
dr inż. Jarosław Chrobot tel.: 20-66 email: jaroslaw.chrobot@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Polymers in Engineering (Tworzywa sztuczne konstrukcyjne)**
Name of subject in English: **Polymers in Engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3122**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	90				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	3				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.8				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge about properties of polymeric materials
2. Basic knowledge about technology of manufacturing plastic elements
3. Basic knowledge about design of machine elements

SUBJECT OBJECTIVES

C1. Acquisitions of skills in applications of plastics for machine elements, taking into account assumptions about working conditions, manufacturing technology, production costs, etc.
C2. Knowledge of issues related to design principles of machine elements made from plastics
C3. Knowledge of issues related to design of plastics element joints

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

PEU_W01 - The student knows the characteristic properties of plastics and is able to propose a polymeric material for a specific technical application.

PEU_W02 - The student knows the design principles and calculation methods of plastic machine elements.

PEU_W03 - The student knows the methods of joining plastic machine elements

II. Relating to skills:

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Properties of polymeric materials used in machines. Characteristics of mechanical and operational properties of polymeric materials - effect of temperature and time.	2
Lec2	Overview of engineering polymers - properties and technical applications. Polymeric composite materials.	4
Lec3	Modeling of mechanical properties of polymeric materials. Application of models in calculations that take into account viscoelasticity of polymers.	2
Lec4	Design principles for plastic housings and bodies - technology, determining the geometric shape of the product, methods of calculation.	2
Lec5	Methods of joining plastic parts - separable and non-separable joints. Joint design, strength calculation methods.	4
Lec6	Friction and wear of plastic machine parts. Plastic plain bearings - calculations and design solutions.	2
Lec7	Plastics gears - design, calculations.	2
Lec8	Use of numerical methods in strength calculations for plastic components	2
Lec9	Polymeric materials in bioengineering applications.	2
Lec10	Plastic parts manufactured by 3D printing technology. Design issues.	2
Lec11	Plastics parts of hydraulic equipment - materials selection, design.	2
Lec12	Final test	2
Lec13	Recycling of plastics products. Course summary. Pass grade.	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of multimedia techniques N2. problem discussion

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03	post-lecture tests (quizzes)
F2	PEU_W01, PEU_W02, PEU_W03	final test
P = 0.1*F1+0.9*F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Erhard G.: Designing with Plastics. Hanser Gardner Publications, 2006
[2] Harper Ch. A. Modern Plastics Handbook. McGraw-Hill Comp.2000
[3] Supporting materials for the lecture - ePortal WUST

SECONDARY LITERATURE

[1] Tutorials and brochures of plastics manufacturers on the websites (links are given at the first lecture)

SUBJECT SUPERVISOR
Prof. dr hab. inż. Wojciech Wieleba tel.: +4871 320-27-74 email: wojciech.wieleba@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Vehicles Loading Modelling (Modelowanie obciążeń pojazdów samochodowych)**
Name of subject in English: **Vehicles Loading Modelling**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3123**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. knowledge of the principles of conservation: mass, energy and momentum
2. the ability to work independently with a computer
3. awareness of the need for independent work and the ability to implement it

SUBJECT OBJECTIVES

C1. The concept of the possibility of calculating fields: speed, pressure and temperature based on the laws of conservation rules (energy and momentum) applied with the use of the Finite Volume Method for engineering problems.
C2. Understanding the loads affecting the car vehicle resulting from the vehicle moving in the fluid medium (air) and thermal loads resulting from the presence of heat sources and their impact on the vehicle components.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - He has knowledge of the Finite Volume Method to the extent that allows explaining the application of the integral form of the equations of behavior (mass, energy and momentum) to the selected flow.
PEU_W02 - He can define guidelines on the shaping of car bodies and selected vehicle components depending on the loads they are subjected to

II. Relating to skills:
PEU_U01 - Is able to simulate a selected flow for a motor vehicle or its components.
PEU_U02 - Analyzes simulation results to determine places with maximum load.
PEU_U03 - Based on its own analysis, it is able to design selected components of motor vehicles.

III. Relating to social competences:
PEU_K01 - understands the need and has the possibility of continuous training especially in the field of computer software
PEU_K02 - appreciates the need to raise professional, personal and social competences

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to CFD type calculation systems - definition of terms	2
Lec2	Generalized transport equation - presenting the principles of behavior: mass, energy and momentum (integral form).	2
Lec3	Finite volume method - Turbulence models used.	2
Lec4	Finite Volume Method - presentation of calculation diagrams (explicit, implicit, Cranka-Nicolson).	2
Lec5	Finite Volume Method - applied matrix calculus solutions.	2
Lec6	Types of boundary conditions - mathematical and physical foundations	2
Lec7	Post-processing - Analysis of the speed and pressure field	2
Lec8	Post-processing - Temperature field analysis	1
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Measurement of input values	2
Proj2	Construction of geometry	1
Proj3	Discretization of computing space	2
Proj4	Defining a numerical model	2
Proj5	Definition of boundary conditions and initial conditions	1
Proj6	Carrying out calculations	1

Proj7	Visualization of results	1
Proj8	Analysis of results	2
Proj9	Modernization of the modeled object - change of geometry	1
Proj10	Performing calculations, visualization of results	1
Proj11	Analysis of results and editing of the project report	1
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - preparation for project class N3. ANSYS Fluent calculation system N4. report preparation N5. project presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01,PEU_W02	test
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03	peport
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SECONDARY LITERATURE

SUBJECT SUPERVISOR
dr inż. Marcin Tkaczyk tel.: 71 347-79-18 email: Marcin.Tkaczyk@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Fundamentals of Exploitation and Repair (Podstawy eksploatacji i remontów maszyn)**
Name of subject in English: **Fundamentals of Exploitation and Repair**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3124**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. 1. Has basic knowledge of chemistry, physics, engineering graphics, materials science, construction of machine elements. He knows the basic elements of machines, he can select them from the catalogue, he knows what is the need to use lubricants and preventive principles in the operation of machines. He knows the basic technological processes of typical machine parts. He is able to protect the natural environment, rationally use its resources and reduce the generation of waste. He is aware of the consequences of polluting the environment with post-production waste.
2. 2. He can recognize the risks associated with the industrial operation of machinery, knows international conventions
and Polish legal acts in the field of environmental protection. He knows the ecological principles of construction, use and modernization of machines. Is aware of the importance and understanding of non-technical aspects and effects of the engineer's and production manager's activities, including its impact on the environment, and the related responsibility for decisions made.

SUBJECT OBJECTIVES

C1. The student is to acquire basic knowledge about machine operation processes; to understand the systemic approach to operation and to the description and assessment of the operation process; to learn to describe the technical condition and reliability of an object
C2. The student is to learrn models of the reliability of simple repairable und unrepairable and complex objects.
C3. The student is to acquire skills of planning stocks of spare parts and consumable materials; to learn the principles of implementing repair management, the methods of regenerating worn out machine parts, modernizing machines, waste acquisition and recycling; to learn the principles of preventing and diagnosing in the operation of machines and the environmental principles of their operation.
C4. The student is to learn how to process rating indices and operational test simulation results; to acquire basic knowledge relating to diagnosing and assessing the condition of machines through the measurement and analysis of such machine operating parameters as energy consumption, machine component heating, vibration and noise levels and machine unit positioning accuracy; to learn to determine the technical condition of a machine, the degree of its wear and the range of repairs
C5. The student is to acquire the skill of selecting a machine repair system and organizing repairs.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - The student understands the systemic approach to the operation process, knows how to describe this process and the technical condition of an object and knows the principles of assessing its reliability.
PEU_W02 - The student has knowledge relating to the assessment of the technical condition of an object, the costeffectiveness of a machine repair, the way of preparing and carrying out the repair; understands the impact of the
machine and the processes being conducted on the human being and the environment; knows the principles of ecofriendly machine operation.
PEU_W03 - The student knows the methods of assessing machine condition;can assess the need for, viability and range of a machine repair

II. Relating to skills:
PEU_U01 - The student can assess the condition of simple and complex technical objects and their reliability
PEU_U02 - The student can assess the need for repair and its essential extent, select a method of regenerating oarts, manage the stock of consumable materials and spare parts
PEU_U03 - The student can minimize the adverse effects of a machine and the process being run on the oersonnel and the environment

III. Relating to social competences:
PEU_K01 - The student knows how to search for information on machine repairs and to critically evaluate this information.
PEU_K02 - The student can objectively evaluate diagnostic parameters and collaborate in a team to select the optimum method of bringing a machine back to its original operating condition.
PEU_K03 - The student can objectively evaluate arguments, substantiate her/his ideas, using machine operation knowledge.

PROGRAM CONTENT		
Form of classes – Lecture		Number of hours
Lec1	Basic machine operation terms.	1
Lec2	The praxeological and systemic approach to operation	2
Lec3	The description and assessment of the operation process.	2
Lec4	The description of the technical condition of an object	2
Lec5	The notion of reliability.	2
Lec6	The reliability of simple reapairable and unrepairable objects.	2
Lec7	The reliability of complex objects.	2
Lec8	The planning of spare parts and consumable materials inventories.	2
Lec9	The technically justified methods of regenerating machine parts.	2
Lec10	Repair management, repair systems, machine modernization.	3
Lec11	Prevention and diagnostics in machine use	3
Lec12	Waste acqisition, recycling and neutralization.	1
Lec13	Environmental aspects of constructing, operating and repairing machines	2
Lec14	The rational lubrication of machines, lubrication tecgniques, minimal lubrication.	2
Lec15	The treatment and neutralization of lubricants, cooling agents and techological fluids.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	The basic operational states of a technical object, operating process rating indices.	1
Lab2	The analisysis of the condition of a technical object (a car, an engineering machine) on the basis of its fuel and energy consumption.	2
Lab3	The analysis of the undamageability of a selected technical object. Basic reliability indices.	2
Lab4	The analysis of the repairability of a selected technical object. The determination of repair time and weak links.	2
Lab5	The power losses and efficiency of complex drive system, the assessment of the condition of a drive.	2
Lab6	The assessment of the enery consumption and condition of bearings.	2
Lab7	The acoustic diagnosis of the technical condition of machine assembiles, the testing ofthe dynamic properties of machines.	2
Lab8	The operating properties of and the determination of the charakteristic of a drive system with a ball screw.	2

	Total hours: 15

TEACHING TOOLS USED
N1. laboratory experiment N2. self study - preparation for laboratory class N3. traditional lecture with the use of transparencies and slides N4. report preparation N5. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01 ÷ PEU_W03	written exam
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01 ÷ PEU_U03, PEU_K01 ÷ PEU_K03	short test
F2	PEU_U01 ÷ PEU_U03, PEU_K01 ÷ PEU_K03	assessment from the report
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE Ecological and Health Effects of Lubricant Oils Emitted into the Environment, Nowak, Kucharska, Kamiński, Int J Environ Res Public Health 2019. SECONDARY LITERATURE Maintenance and Engineering

SUBJECT SUPERVISOR
dr inż. Paweł Turek email: pawel.turek@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Management in production (Zarządzanie w produkcji)**
Name of subject in English: **Management in production**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3125**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows and understands the nature of the management process and the basic functions of management.
2. Understands the basic concepts and basic economic rights and economic phenomena and their effects.
3. Posesses a basic knowledge of manufacturing processes.

SUBJECT OBJECTIVES

C1. Knowing the specifics of management of the production and manufacturing processes
C2. Knowledge of methods and techniques for managing different types of manufacturing processes
C3. The acquisition of skills in planning, organizing and controlling of production processes

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

PEU_W01 - Distinguishes and characterizes by different types of production systems.
PEU_W02 - Can define the concepts of production and technological processes.
PEU_W03 - Has knowledge of the methods and techniques of production systems management.

II. Relating to skills:

III. Relating to social competences:

PROGRAM CONTENT		
Form of classes – Lecture		Number of hours
Lec1	Characteristics of manufacturing organizations	1
Lec2	Characteristics of production systems	1
Lec3	Manufacturing system, its organization and components	1
Lec4	Classifications of production processes	1
Lec5	Types and forms of production	1
Lec6	Production control methods (pull, push and squeeze systems)	2
Lec7	Methods of organization of production systems	2
Lec8	Characteristics of bottlenecks in manufacturing processes	2
Lec9	Production inventory management methods	2
Lec10	Principles of planning and scheduling of production processes	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SECONDARY LITERATURE

SUBJECT SUPERVISOR
dr inż. Jarosław Chrobot tel.: 20-66 email: jaroslaw.chrobot@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Thesis, Seminar (Seminarium dyplomowe)**
Name of subject in English: **Thesis, Seminar**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SI3126**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					15
Number of hours of total student workload (CNPS)					30
Form of crediting					Crediting with grade
Group of courses					
Number of ECTS points					1
including number of ECTS points for practical (P) classes					1
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)					0.7

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the issues covered by the study program
2. Deficit of ECTS credits not greater than that resulting from the resolution of the Faculty Council

SUBJECT OBJECTIVES

C1. Transfer of knowledge about the requirements for writing an engineering diploma thesis
C2. Acquiring the ability to present one's own work and defend the theses included
C3. Acquisition of the ability to conduct discussions on engineering topics and formulate one's own position

SUBJECT LEARNING OUTCOMES
I. Relating to knowledge: **II. Relating to skills:** PEU_U01 - Able to prepare a presentation, discuss the purpose and scope of the engineering work and its progress PEU_U02 - Able to conduct discussions on engineering topics, including presentation of own position PEU_U03 - Able to formulate the purpose of engineering work and select methods to achieve it **III. Relating to social competences:** PEU_K01 - Understands the need for continuous acquisition of knowledge and professional competence PEU_K02 - Understands the need for discussions on how to solve engineering problems PEU_K03 - Has aware of the impact of his decisions on the way companies operate

PROGRAM CONTENT		
Form of classes – Seminar		Number of hours
Sem1	Discuss the plan and conduct of the seminar and the schedule of speeches	1
Sem2	Sharing the knowledge on the principles of preparing a presentation and how to conduct it	1
Sem3	Sharing the knowledge about writing an engineering diploma thesis and the course of the diploma exam. Presentation of own topics of engineering work.	13
		Total hours: 15

TEACHING TOOLS USED
N1. multimedia presentation N2. tutorials N3. problem discussion

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Seminar)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U03	Evaluation of preparing and presenting the presentation
F2	PEU_K01, PEU_K02, PEU_U02, PEU_K03	Participation in the discussion

P = 0,8*F1+0,2*F2

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Kowalkowska, A. (2022). Esej naukowy jako trening przed pisaniem pracy dyplomowej. Tutoring Gedanensis, 7 (3)
2. Majchrzak J.:Metodyka pisania prac magisterskich i dyplomowych, Wydawnictwo Uniwersytetu Ekonomicznego, Poznań 2009 2. Brycz B.: Przewodnik dla piszących prace magisterskie w zakresie zarządzania, Polskie Wydawnictwo Ekonomiczne, Warszawa 2011

SECONDARY LITERATURE
1. Wiszniewski A.: Sztuka pisania. Videograf II, Katowice 2003
2. Wiszniewski A.: Sztuka mówienia. Videograf II, Katowice 2003

SUBJECT SUPERVISOR

dr hab. inż. Mirosław Bocian tel.: 320-27-54 email: miroslaw.bocian@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Military technology in armed conflicts (Technika wojskowa w konfliktach zbrojnych)**
Name of subject in English: **Military technology in armed conflicts**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W10MBM-SI3128**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. General knowledge in the field of state security.
2. Basic knowledge of military technology.
3. General knowledge of the law of armed conflicts.

SUBJECT OBJECTIVES

C1. Getting to know the basic information about individual categories of individual and collective armament and their combat functions against the historical background to the present day.
C2. Acquisition of elementary knowledge in the field of the law of war, weapons science, the combat capabilities of the discussed weapon systems and the ways of using it against the background of the development of the art of war from the earliest times to the present day.
C3. Ability to interpret basic legal acts, especially the law on weapons and ammunition and the defense capabilities of the state.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - He has knowledge about the defense potential of the state in the structure of internal security and alliance systems.
PEU_W02 - He can explain the specifics of the armament of the Polish army against the background of the armies of other countries in history and the present day.
PEU_W03 - He has knowledge of military terminology in the field of armaments, both modern and historical.

II. Relating to skills:

III. Relating to social competences:
PEU_K01 - He understands the need to shape the awareness of engineering activities in terms of the development of military thought and technology.
PEU_K02 - Skilful selection of tactical and technical capabilities of the armament elements of the world's leading armies.
PEU_K03 - He understands the need to shape knowledge in the field of the main directions of development of military technology on the example of armed conflicts.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic concepts related to armed conflicts and military equipment - definitions of weapons and armaments, the role of weapons in the culture and history of mankind.	2
Lec2	Cutting and stabbing weapons. Old war machines, rolling stock equipment, horse tack and riding equipment.	2
Lec3	Weapon transformations in modern times.	2
Lec4	Small arms development.	2
Lec5	Genesis and development of ammunition for small arms and small hands.	2
Lec6	Protective armament from historical times to the present day.	2
Lec7	Artillery in modern and contemporary times. Its importance on the modern battlefield and in future armed conflicts.	2

Lec8	Combat vehicles and their importance in the perspective of robotization of the future battlefield.	2
Lec9	Heavy combat vehicles - tanks. The genesis and tactics of their use against the background of the past and present century.	2
Lec10	Means of air attack against the historical background to the present day.	2
Lec11	Missile and hypersonic weapons.	2
Lec12	Naval armament in historical and contemporary outline and directions of development.	2
Lec13	Other types of conventional weapons (explosives, mines, etc.).	2
Lec14	Customization of military technology and armament resulting from the defense needs of the changing situation of armed conflicts	2
Lec15	Knowledge check. Test	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03.	Test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Encyklopedia wojskowa. Dowódcy i ich armie. Historia wojen i bitew. Technika wojskowa. T. 1 (A-M), Wyd. PWN, Bellona, Warszawa 2007.
2. Gwóźdź Z., Zarzycki P., Polskie konstrukcje broni strzeleckiej. SIGMA-NOT, Warszawa 1993.
3. Hogg I., Encyklopedia uzbrojenia. Rozwój uzbrojenia od prehistorii do XXI wieku. Warszawa 2009.
4. Kochański S., Małokalibrowa broń samoczynna. Wydawnictwo Politechniki Warszawskiej, Warszawa 1989.
5. Kwaśniewicz W., Encyklopedia dawnej broni i uzbrojenia ochronnego. Bellona, Warszawa 2022.
6. Weir W., 50 broni, które zmieniły sposób prowadzenia wojen. Warszawa 2005.
7. Wiśniewski A., Pancerze, budowa, projektowanie i badania. WNT, Warszawa 2001.
8. Włodarczyk E., Podstawy fizyki wybuchu. WNT, Warszawa 2012.
9. Zasieczny A., Broń Wojska Polskiego 1939-1945. Warszawa 2010.
10. Żygulski Z., Gradowski M., Słownik uzbrojenia historycznego. Warszawa 1998.

SECONDARY LITERATURE

1. Ciepliński A., Woźniak R., Ilustrowana encyklopedia współczesnej broni palnej. Wydawnictwo Lampart, Warszawa 1997.
2. Hart R., Współczesne czołgi i pojazdy opancerzone od 1991 do dzisiaj. Wyd. 2, Alma-Press, Warszawa 2023.
3. Hazell P.J., Armour: Materials, Theory, and Design. CRC Press, Taylor & Francis Group, New York 2016.
4. Ius ad bellum versus ius in bello (Międzynarodowe Prawo Humanitarne. Tom IX). Praca zbiorowa, Wydawnictwo Marynarki Wojennej, Gdynia 2018.
5. Jamroziak K., Kędzia K., Śliwa Z., Standaryzacja amunicji strzeleckiej: budowa, znakowanie i przechowywanie. Skrypt. Wydawnictwo Wyższej Szkoły Oficerskiej Wojsk Lądowych. Wrocław 2003.
6. Puchała F., Budowa potencjału bojowego Wojska Polskiego 1945-1990. Bellona, Warszawa 2013.
7. Ustawa z dnia 21 maja 1999 r. o broni i amunicji (Dz.U. z 2022 r. poz. 2516).

SUBJECT SUPERVISOR

dr hab. inż. Krzysztof Jamroziak tel.: 320 27 60 email: krzysztof.jamroziak@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Intellectual Property Law (Ochrona własności intelektualnej)**
Name of subject in English: **Intellectual Property Law**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W10MBM-SI3129**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. General knowledge in the area of innovation.
2. Basic knowledge of accounting and finance.
3. General knowledge of commercial law and marketing.

SUBJECT OBJECTIVES

C1. Getting to know the basic information about the functioning legal protection system intellectual property and various forms of goods: copyright, industrial property law, patents, utility designs and industrial, etc.
C2. Acquiring elementary skills to prepare application descriptions for inventions, utility and industrial designs, etc.
C3. Skills to use patent information.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - He has knowledge of patent information.
PEU_W02 - Can explain patentability.
PEU_W03 - He has knowledge of plagiarism.

II. Relating to skills:

III. Relating to social competences:
PEU_K01 - Understands the need to shape awareness of engineering activities in terms of intellectual property protection.
PEU_K02 - Skillful verification of legal aspects in the field of copyright and related rights as well as industrial property law.
PEU_K03 - Ability to work in a group.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic concepts of intellectual property protection. Research, science, knowledge, discovery, invention and innovation, patent claim, utility designs, industrial designs, integrated circuit topography.	2
Lec2	Examination procedure for patent applications and utility designs.	2
Lec3	Patentability assessment. Application description of the invention.	2
Lec4	Patent information: sources and collections of patent documentation and literature, access to information and databases of the Patent Office of the Republic of Poland.	2
Lec5	Trademarks and their legal protection. Copyright and related rights of literary and artistic works.	2
Lec6	Protection of intellectual property of software. Organizations dealing with collective management of copyrights.	2
Lec7	Protection of intellectual property of databases and domains.	2
Lec8	Plagiarism and engineering work.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03.	Test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Michniewicz G. Protection of intellectual property. Academic textbooks,. 5th Edition.C.H.Beck. Warsaw 2022.
2. Czub K. Intellectual property law. Wolters Kluwer. Warsaw 2021.
3. Kostański P. Żelechowski Ł., Industrial property Law. Academic Handbook. Warsaw 2014.
4. Barta J., Markiewicz R. Copyright and related rights. 5th edition. Warsaw 2011.
5. Adamczak A., Gedłek M. Trademarks in the activities of small and medium enterprises. National Chamber of Commerce. Warsaw 2009.
6. Adamczak A., Dobosz E., Gedłek M. Industrial designs in the activities of small and medium enterprises. National Chamber of Commerce. Warsaw 2009.
7. Kondrat M., Dreszer-Lichańska H. Industrial property in the UE. Gdansk 2007.

SECONDARY LITERATURE

1. Pawlik K., Zenderowski R. Internet Diploma. How to use the Internet when writing diploma theses?CeDeWu. Warsaw 2013.
2. Jeziorow J. Wroclaw code of good practice in the use of the results of intellectual work. Marshal's Office of the Lower Silesian Voivodeship. Wroclaw 2010.
3. Act of June 30, 2000. Industrial property law (tj. Dz.U. 2003 nr 119, poz. 1117 z późn. zm.).
4. Act of February 4, 1994 on copyright and related rights (tj. Dz.U. 2006 nr 90, poz. 631 z późn. zm.).
5. Convention on the Grant of European Patents (European Patent Convention), done at Munich on 5 October 1973. (Dz. U. z 2004 r. Nr 79, poz. 737), Act of 29 November 2000 revising the Convention on the Grant of European Patents, done at Munich on 5 October 1973. (Dz. U. z 2007 r. Nr 236, poz. 1736).
6. Paris Convention for the Protection of Industrial Property of March 20, 1883, as amended by Brussels on December 14, 1900, Washington on June 2, 1911, The Hague on November 6, 1925, London on June 2, 1934, in Lisbon on 31 October 1958 and in Stockholm on 14 July 1967 - Stockholm Act of 14 July 1967 (Dz. U. z 1975 r. Nr 9, poz. 51).
7. Basic - applicable legal acts in the field of industrial property protection on the website of the Patent Office of the Republic of Poland: https://uprp.gov.pl/pl.

SUBJECT SUPERVISOR

dr hab. inż. Krzysztof Jamroziak tel.: 320 27 60 email: krzysztof.jamroziak@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Solid and surface modeling in CATIA (Modelowanie bryłowe i powierzchniowe w systemie CATIA)**
Name of subject in English: **Solid and surface modeling in CATIA**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W10MBM-SI3134**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	
Number of hours of total student workload (CNPS)				30	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge in terms of descriptive geometry.
2. Fundamentals of machines design.
3. Ability to use CAD/CAE programs.

SUBJECT OBJECTIVES

C1. Getting acquainted with the methods of creating surface and solid models.
C2. Mastering methods for creating assemblies and defining mechanism animations.
C3. Acquaintance with methods of shaping the strength of thin-walled and solid structures.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:
PEU_U01 - Can develop solid or surface model in CATIA.
PEU_U02 - He can execute the assembly model and perform a motion animation in CATIA.
PEU_U03 - Can perform strength analysis of solid or thin-walled structure in CATIA.

III. Relating to social competences:
PEU_K01 - Acquires the ability to take responsibility for the work done.
PEU_K02 - Think and act in a creative way.
PEU_K03 - Acquires the skill of teamwork.

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction, getting to know the CATIA environment, working with a sketchbook.	1
Proj2	Fundamentals of solid modeling in CATIA.	2
Proj3	Fundamentals of surface modeling in CATIA.	2
Proj4	Creating assemblies and motion animation.	2
Proj5	Performing stress analysis for solid structures.	2
Proj6	Performing stress analysis for thin-walled structures.	2
Proj7	Preparation of design documentation.	2
Proj8	Development of the project report.	2
		Total hours: 15

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. multimedia presentation
N3. project presentation
N4. report preparation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01 PEU_U02 PEU_U03 PEU_K01 PEU_K02	Evaluation of the completed project
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Rusinski E., Czmochowski J., Smolnicki T. Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000

Rakowski G., Kacprzak Z.: Metoda elementów skończonych w mechanice konstrukcji, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2016

Wyleżoł M. CATIA. Podstawy modelowania powierzchniowego i hybrydowego, Helion, Gliwice 2003

Wełyczko A. CATIA V5. Sztuka modelowania powierzchniowego, Helion 2008

Sokół K. CATIA. Wykorzystanie metody elementów skończonych w obliczeniach inżynierskich, Helion 2014

SECONDARY LITERATURE

Wyleżoł M. CATIA v5 Modelowanie i analiza układów kinematycznych, Helion 2007

Skarka W., Mazurek A. CATIA. Podstawy modelowania i zapisu konstrukcji, Helion 2005

Pieczonka K.: Inżynieria maszyn roboczych. Część I. Podstawy urabiania, jazdy, podnoszenia i obrotu, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2007

Dudczak A.: Koparki. Teoria i projektowanie, PWN, Warszawa 2000

Augustyn J., Śledziewski, Technologiczność stalowych konstrukcji spawanych, Arkady, Warszawa 1981

Ferenc K., Ferenc J.: Konstrukcje spawane. Projektowanie połączeń. WNT, Warszawa 2000

SUBJECT SUPERVISOR

dr hab. inż. Jacek Karliński tel.: 71 320-29-46 email: jacek.karlinski@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Biomedical Engineering (Biomechanika inżynierska)**
Name of subject in English: **Biomedical Engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W10MBM-SI3149**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. He has knowledge of the basics of mechanics and strength of materials.
2. He has knowledge of the basics of materials science.

SUBJECT OBJECTIVES

C1. Mastering the knowledge of modern techniques used to support selected human life functions.
C2. Acquire knowledge of biomaterials used in existing design solutions for implants and artificial organs.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Has knowledge of the mechanical and physical properties of the essential human anatomical elements in terms of the possibility of application of artificial replacements.
PEU_W02 - Has a well-ordered knowledge of the current designs of joint endoprostheses and stabilizers and the principles of their design, taking into account the specific material and strength requirements.

II. Relating to skills:

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Current state and directions of development of medical engineering. The role and function of the engineer in medicine.	2
Lec2	The human body as a complex mechanical system. Biomechanics of the human musculoskeletal system. Load models of the human musculoskeletal system.	2
Lec3	Fundamentals of the strength of tissue materials - biomechanical aspects of overloading of tissue structures.	2
Lec4	Biomaterials, requirements, their mechanical and biophysical properties, modification of implant surfaces. Phenomena at the implant-tissue interface.	2
Lec5	Joint endoprostheses of the lower limbs (hip, knee, ankle) and upper limbs (wrist, elbow, shoulder). Biotribology.	2
Lec6	Implants and systems for stabilizing spinal injuries. Intervertebral disc prosthesis.	2
Lec7	External and internal stabilizers of long bones. Scaffolds as bone tissue support scaffolds.	2
Lec8	Colloquium/credit	1
		Total hours: 15

TEACHING TOOLS USED

N1. informative lecture
N2. multimedia presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02	Colloquium/credit
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SECONDARY LITERATURE

SUBJECT SUPERVISOR
Prof. dr hab. inż. Celina Pezowicz tel.: 71 320-27-13 email: Celina.Pezowicz@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Technique in Medicine (Technika w medycynie)**
Name of subject in English: **Technique in Medicine**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **W10MBM-SI3150**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of mechanics and strength of materials.
2. Knowledge of the basics of mechanical design.
3. Knowledge of powertrain.

SUBJECT OBJECTIVES

C1. Discussion of the construction and operation principles of devices and systems supporting surgical procedures and operations.
C2. Discussion of the construction and operation principles of selected artificial organs and controlling their work.
C3. Presentation of technical means supporting human locomotion.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - It formulates and explains the requirements for devices supporting human functioning and robots and manipulators intended for medical applications.
PEU_W02 - Know the principles of selecting technical solutions supporting the functioning of human organs and systems.

II. Relating to skills:

III. Relating to social competences:
PEU_K01 - Is aware of the importance and understands the non-technical aspects and effects of the engineer's activity and understands the related responsibility for the decisions made.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Assisting the locomotion of the disabled: wheelchairs, wheelchairs with verticalization function, exoskeletons. Standards for the design of means of transport for the disabled, drive systems and control methods, directions for the development of structures supporting the mobility of the disabled.	2
Lec2	Upper and lower limb prostheses; functions, classification, discussion of prosthesis construction solutions, drive systems in prostheses, bionic prostheses.	2
Lec3	Technical means used in the rehabilitation of the osteoarticular and muscular systems, devices for active and passive rehabilitation of limbs, standers and parapodia, exoskeletons and rehabilitation systems using biofeedback.	2
Lec4	Manipulators and medical robots, design solutions used in medical manipulators, tools for laparoscopic operations, directions of telemedicine development.	2
Lec5	Navigation systems in the operating room, purpose, classification, principle of operation of optical and magnetic navigation, examples of design solutions for mechanical elements of navigation systems, examples of application in clinical practice.	2
Lec6	Imaging in medicine, construction and operation principle of computer tomographs, types of construction, scope of application, magnetic resonance imaging, intravascular ultrasonography, algorithms forreconstruction of threedimensional images of internal organs.	2
Lec7	Technical support of the circulatory system: artificial heart, construction idea, applied solutions, materials, control, cardiac pacemakers, extracorporeal circulation systems, technique of minimally invasive vascular angioplasty; vascular stents, stent grafts, structure, principle of operation, applied design solutions.	2
Lec8	Final test	1
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_K01	test
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE 1) Inżynieria Biomedyczna - podstawy i zastosowania (tomy: I - X); red. Władysław Torbicz, Akademicka Oficyna Wydawnicza EXIT, Warszawa 2013 SECONDARY LITERATURE e-resources of the WUST Library

SUBJECT SUPERVISOR
dr hab. inż. Jarosław Filipiak tel.: 71 320-21-50 email: jaroslaw.filipiak@pwr.edu.pl

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Fizyka 1A**
Name of subject in English: **Physics 1A**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W11MBM-SI0002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	90	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	3	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.5	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge and skills in physics and mathematics from high school

SUBJECT OBJECTIVES

C1. Acquisition of knowledge, taking into account its application aspects, in kinematics and dynamics, including issues of work and mechanical energy, mechanical waves and principles of conservation of energy and momentum

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - has general knowledge of the basic concepts and principles of: the kinematics of a material point; the dynamics of a material point; the motion of a system of material points and a rigid body; the principle of conservation of momentum, angular momentum, mechanical energy; work; mechanical waves

II. Relating to skills:
PEU_U01 - is able to carry out a quantitative analysis related to a physical problem and formulate qualitative conclusions

III. Relating to social competences:
PEU_K01 - understands the need for learning (both independently and in a group)

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational issues. Physics methodology. Vectors. Operations on vectors	2
Lec2	Kinematics of a material point	2
Lec3	The dynamics of a material point	4
Lec4	Work, mechanical energy	2
Lec5	Rigid body - kinematics, dynamics	4
Lec6	Vibrations	2
Lec7	Mechanical waves	2
Lec8	Lectures extending the current knowledge of physics11	12
		Total hours: 30

Form of classes – Classes		Number of hours
Cl1	Organizational issues	1
Cl2	Solving calculation tasks related to the issues discussed in the lecture	12
Cl3	Final test	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - self studies and preparation for examination N3. tutorials N4. calculation exercises

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_K01	Exam
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_K01	Test
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SECONDARY LITERATURE

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Laboratorium podstaw fizyki**
Name of subject in English: **Basic physics laboratory**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W11MBM-SI0003**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			15		
Number of hours of total student workload (CNPS)			60		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)			1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge and skills in Physics 1A or Physics 1B and mathematics

SUBJECT OBJECTIVES

C1. Obtaining the ability to use various measuring devices
C2. Obtaining the ability to carry out a simple experiment according to the instructions
C3. Obtaining the ability to develop the results of the experiment and present them in the form of a report
C4. Obtaining the ability to estimate the uncertainty of the obtained results and to determine measurement uncertainties

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:
PEU_U01 - knows how to use simple measuring instruments, is able to perform measurements of basic physical quantities using the instructions of the experimental setup
PEU_U02 - is able to develop measurement results and analyze measurement uncertainties using engineering tools
PEU_U03 - can prepare a report summarizing the performed exercise based on the results obtained

III. Relating to social competences:
PEU_K01 - reinforces teamwork skills
PEU_K02 - is aware of their own limitations and knows how important further self-education is
PEU_K03 - consolidates the skills of reliable and responsible performance of tasks

PROGRAM CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Organizational matters, short OHS training	1
Lab2	Exemplary measurements of various physical quantities - familiarization with the methods of: determination of measurement uncertainties; numerical and graphic processing of the obtained results; development of the report. Discussion of the first reports	4
Lab3	Carrying out of four experiments in different fields of physics according to the schedule	8
Lab4	Discussion on the development of results and report execution. Verification of knowledge of the principles of determining measurement uncertainties - colloquium	2
		Total hours: 15

TEACHING TOOLS USED

N1. self study - preparation for laboratory class
N2. laboratory experiment
N3. report preparation
N4. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03, PEU_K01-PEU_K03	Evaluation of reports from each performed experiment
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE [1] Descriptions of exercises, instructions, teaching aids, LPF home page http://lpf.wppt.pwr.edu.pl SECONDARY LITERATURE [1] D. Halliday, R. Resnick, J. Walker: Physics, vols. 1-2, 4

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Physics 1A (Fizyka 1A)**
Name of subject in English: **Physics 1A**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W11MBM-SI3002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	90	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	3	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.5	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge and skills in physics and mathematics from high school

SUBJECT OBJECTIVES

C1. Acquisition of knowledge, taking into account its application aspects, in kinematics and dynamics, including issues of work and mechanical energy, mechanical waves and principles of conservation of energy and momentum

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - has general knowledge of the basic concepts and principles of: the kinematics of a material point; the dynamics of a material point; the motion of a system of material points and a rigid body; the principle of conservation of momentum, angular momentum, mechanical energy; work; mechanical waves

II. Relating to skills:
PEU_U01 - is able to carry out a quantitative analysis related to a physical problem and formulate qualitative conclusions

III. Relating to social competences:
PEU_K01 - understands the need for learning (both independently and in a group)

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational issues. Physics methodology. Vectors. Operations on vectors	2
Lec2	Kinematics of a material point	2
Lec3	The dynamics of a material point	4
Lec4	Work, mechanical energy	2
Lec5	Rigid body - kinematics, dynamics	4
Lec6	Vibrations	2
Lec7	Mechanical waves	2
Lec8	Lectures extending the current knowledge of physics11	12
		Total hours: 30

Form of classes – Classes		Number of hours
Cl1	Organizational issues	1
Cl2	Solving calculation tasks related to the issues discussed in the lecture	12
Cl3	Final test	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - self studies and preparation for examination N3. tutorials N4. calculation exercises

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_K01	Exam
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_K01	Test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] D. Halliday, R. Resnick, J. Walker, Podstawy fizyki, tomy 12., Wydawnictwo Naukowe PWN.
[2] J. Orear, Fizyka t.1 i 2, WNT, 1993, Warszawa 2003

SECONDARY LITERATURE
[1] J. Massalski, M. Massalska, Fizyka dla inżynierów, cz. 1. i 2., WNT, Warszawa 2008.
[2] Fizyka dla szkół wyższych, https://openstax.org/books/

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Basic physics laboratory (Laboratorium podstaw fizyki)**
Name of subject in English: **Basic physics laboratory**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W11MBM-SI3003**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			15		
Number of hours of total student workload (CNPS)			60		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge and skills in Physics 1A or Physics 1B and mathematics

SUBJECT OBJECTIVES

C1. Obtaining the ability to use various measuring devices
C2. Obtaining the ability to carry out a simple experiment according to the instructions
C3. Obtaining the ability to develop the results of the experiment and present them in the form of a report
C4. Obtaining the ability to estimate the uncertainty of the obtained results and to determine measurement uncertainties

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:
PEU_U01 - knows how to use simple measuring instruments, is able to perform measurements of basic physical quantities using the instructions of the experimental setup
PEU_U02 - is able to develop measurement results and analyze measurement uncertainties using engineering tools
PEU_U03 - can prepare a report summarizing the performed exercise based on the results obtained

III. Relating to social competences:
PEU_K01 - reinforces teamwork skills
PEU_K02 - is aware of their own limitations and knows how important further self-education is
PEU_K03 - consolidates the skills of reliable and responsible performance of tasks

PROGRAM CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Organizational matters, short OHS training	1
Lab2	Exemplary measurements of various physical quantities - familiarization with the methods of: determination of measurement uncertainties; numerical and graphic processing of the obtained results; development of the report. Discussion of the first reports	4
Lab3	Carrying out of four experiments in different fields of physics according to the schedule	8
Lab4	Discussion on the development of results and report execution. Verification of knowledge of the principles of determining measurement uncertainties - colloquium	2
		Total hours: 15

TEACHING TOOLS USED

N1. self study - preparation for laboratory class
N2. laboratory experiment
N3. report preparation
N4. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03, PEU_K01-PEU_K03	Evaluation of reports from each performed experiment
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE [1] Descriptions of exercises, instructions, teaching aids, LPF home page http://lpf.wppt.pwr.edu.pl SECONDARY LITERATURE [1] D. Halliday, R. Resnick, J. Walker: Physics, vols. 1-2, 4

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Elektronika**
Name of subject in English: **Electronics**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W12MBM-SI0002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of physics, electrical engineering and chemistry at the high school level.

SUBJECT OBJECTIVES

C1. Understanding the construction's principles and applications of selected semiconductor devices and integrated circuits (analog and digital).
C2. Learning the principle of operation and application of various sensors of physical quantities (temperature, force, displacement, light, vibration)

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - The student understands the physical basis of functioning and knows the application of semiconductor elements
PEU_W02 - The student knows the principle of operation and the use of various sensors of physical quantities

II. Relating to skills:

III. Relating to social competences:
PEU_K01 - The student understands the implementation of new techniques and technologies in engineering activities and is able to define goals and deliver effects in real experimental activities.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Development trends in electronics. Analogue and digital technique.	2
Lec2	Signals in electronics: analog, digital (description of the nature of these signals)	2
Lec3	Description of the properties of RLC electronic components, Ohm's law.	2
Lec4	Outline of semiconductor device technology. p-n junction: mechanism of junction formation, I-U constant current characteristic.	2
Lec5	Semiconductor diode: types, applications	2
Lec6	Transistors: bipolar, unipolar, field effect, junction - PNFET, unipolar, field effect, with insulated gate - MOSFET - design, principle of operation	2
Lec7	Semiconductor devices (thyristor, triac, varistor, Hall sensor)	2
Lec8	Transistor circuits	2
Lec9	Power amplifier classes	2
Lec10	Design and integration of electronic circuits	2
Lec11	Operational amplifiers: history, applications, basic circuits	2
Lec12	Sensors of physical quantities: temperature, light, force, stress, pressure	2
Lec13	Displacement, rotation and vibration sensors	2
Lec14	MEMS sensors.	2
Lec15	Final test	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01-PEU_W03	Test
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE P. Hempowicz, R. Kiełsznia, A. Piłatowicz, J.Szymczyk i inni, Elektrotechnika i elektronika dla nieelektryków, WNT, 2004 A. Świt, J. Pułtorak, Przyrządy półprzewodnikowe, WNT, 1984 W. Marciniak, Przyrządy półprzewodnikowe i układy scalone, WNT, 1984 M. Polowczyk, A. Jurewicz, Elektronika dla mechaników, Wyd. Politechniki Gdańskiej, 2002 SECONDARY LITERATURE M. Rusek, J. Pasierbiński, Elementy i układy elektroniczne w pytaniach i odpowiedziach, WNT, 1991 G. Rizzoni, Fundamentals of Electrical Engineering, McGraw-Hill, 2010 Ch. A. Schuler, Electronics. Principles & Applications, 2008

SUBJECT SUPERVISOR
dr inż. Piotr Pruchnicki email: piotr.pruchnicki@pwr.edu.pl

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Electronics (Elektronika)**
Name of subject in English: **Electronics**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Mechanical engineering design**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W12MBM-SI3002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of physics, electrical engineering and chemistry at the high school level.

SUBJECT OBJECTIVES

C1. Understanding the construction's principles and applications of selected semiconductor devices and integrated circuits (analog and digital).
C2. Learning the principle of operation and application of various sensors of physical quantities (temperature, force, displacement, light, vibration)

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - The student understands the physical basis of functioning and knows the application of semiconductor elements
PEU_W02 - The student knows the principle of operation and the use of various sensors of physical quantities

II. Relating to skills:

III. Relating to social competences:
PEU_K01 - The student understands the implementation of new techniques and technologies in engineering activities and is able to define goals and deliver effects in real experimental activities.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Development trends in electronics.Analogue and digital technique.	2
Lec2	Signals applied in electronics: analog and digital (description of the fundamentals of the signals).	2
Lec3	Description of the properties of RLC electronic components, Ohm's law.	2
Lec4	Outline of semiconductor device technology. p-n junction: mechanism of junction formation, I-U constant current characteristic.	2
Lec5	Semiconductor diode: types, applications	2
Lec6	Transistors: bipolar, unipolar, field effect, junction - PNFET, unipolar, field effect, with insulated gate - MOSFET - design, principle of operation	2
Lec7	Semiconductor devices (thyristor, triac, varistor, Hall sensor)	2
Lec8	Transistor circuits	2
Lec9	Power amplifier classes	2
Lec10	Design and integration of electronic circuits	2
Lec11	Operational amplifiers: history, applications, basic circuits	2
Lec12	Sensors of physical quantities: temperature, light, force, stress, pressure	2
Lec13	Displacement, rotation and vibration sensors	2
Lec14	MEMS sensors.	2
Lec15	Final test	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01-PEU_W03	Test
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE P. Hempowicz, R. Kiełsznia, A. Piłatowicz, J.Szymczyk i inni, Elektrotechnika i elektronika dla nieelektryków, WNT, 2004 A. Świt, J. Pułtorak, Przyrządy półprzewodnikowe, WNT, 1984 W. Marciniak, Przyrządy półprzewodnikowe i układy scalone, WNT, 1984 M. Polowczyk, A. Jurewicz, Elektronika dla mechaników, Wyd. Politechniki Gdańskiej, 2002 SECONDARY LITERATURE M. Rusek, J. Pasierbiński, Elementy i układy elektroniczne w pytaniach i odpowiedziach, WNT, 1991 G. Rizzoni, Fundamentals of Electrical Engineering, McGraw-Hill, 2010 Ch. A. Schuler, Electronics. Principles & Applications, 2008

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Algebra liniowa z geometrią analityczną B**
Name of subject in English: **LINEAR ALGEBRA WITH ANALITIC GEOMETRY B**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W13MBM-SI0004**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	2	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.5	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has the knowledge required for the Matura exam in Mathematics at least at basic level

SUBJECT OBJECTIVES

C1. Exposition of the basic concepts of linear algebra and analytic geometry.
C2. Exposition of the methods for solving basic problems related to complex numbers, matrices, systems of equations and analytic geometry in Euclidean space R3.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Student knows the basic properties of complex numbers, Student knows the basic concepts and theorems about the matrix.
PEU_W02 - Student knows the basic concepts and theorems on polynomial algebra. Student knows the basic methods of solving linear equations.
PEU_W03 - Student knows how to describe lines, planes and conic curves.

II. Relating to skills:
PEU_U01 - Student can carry out calculations with complex number. Student can use matrix notation and transformations appropriate for the algebra of matrices and determinants.
PEU_U02 - Student can factor a polynomial and factor rational functions for real simple fractions. Student can effectively solve systems of equations linear.
PEU_U03 - Student can solve problems concerning mutual position of points, lines and vectors in Euclidean space.

III. Relating to social competences:
PEU_K01 - Student knows the rules of behavior in the environment academic.
PEU_K02 - student improves communication skills
PEU_K03 - student can use reliable scientific information sources.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Matrix. Operations on matrices. The transpose of a matrix. Types of matrices (triangular, symmetric, diagonal, etc.).	2
Lec2	The determinant of a matrix. Laplace expansion. The algebraic complement of a matrix element. minor. Properties of determinants. Calculation of determinants. Cauchy's theorem on the multiplication of determinants. Nonsingular matrix.	3
Lec3	Inverse matrix. The method of algebraic complements and elementary transformations. Properties of inverse matrices. Matrix equations.	2
Lec4	System of linear equations. Cramer formulas. Gauss elimination method. Solving arbitrary systems of linear equations.	3
Lec5	A complex number. Algebraic form. Operations on complex numbers. Coupling. Module. Argument.	2
Lec6	Geometric interpretation of a complex number. Trigonometric form and exponential form. De Moivre's formula. The nth root of a complex number.	2
Lec7	Polynomial. Bezout's theorem. Fundamental theorem of algebra. Roots of real polynomials.	2
Lec8	Linear and square divisors of real polynomials. Factoring a polynomial. A rational function. Real simple fraction. Decomposition of a rational function into real simple fractions.	2

Lec9	Analytic geometry in R3 space. Operations on vectors. Vector length. Products: scalar, vector, mixed. Application for calculating areas and volumes.	2
Lec10	Plane. Normal vector. General, parametric, determinant equation. Relative position of the planes.	2
Lec11	Simple. Parametric, directional and edge equations. The distance of the point from the line and from the plane. Reciprocal position of straight lines. Relative position of a straight line and a plane. Projection of a point onto a straight line and a plane.	2
Lec12	Conic curves. Circle. Ellipse. Hyperbole. Parabola	2
Lec13	Applications of the Linear Algebra.	4
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Transformations of algebraic expressions	1
Cl2	Solving tasks related to the topics presented in the lecture.	14
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. calculation exercises N3. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01-PEU_W03	exam
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement

F1	PEU_U01-PEU_U03	Tests, oral presentations, quizzes
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna. Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław 2020.
[2] T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna. Definicje, twierdzenia, wzory. Oficyna Wydawnicza GiS, Wrocław 2022.
[3] P. Kajetanowicz, J. Wierzejewski, Algebra z geometrią analityczną, PWN 2008.
[4] M. Zakrzewski, Markowe wykłady z matematyki, Algebra z geometrią, Oficyna Wyd. GiS, Wrocław 2015.

SECONDARY LITERATURE

[1] G. Banaszak, W. Gajda, Elementy algebry liniowej, cz.I, WNT, 2002.
[2] A. Mostowski, M. Stark, Elementy algebry wyższej, PWN, Warszawa 1963.
[3] W. Stankiewicz, Zadania z matematyki dla wyższych uczelni technicznych, Cz. A, PWN, Warszawa 2003.
[4] F. Leja, Geometria analityczna, PWN, Warszawa 1972.
[5] E. Kącki, D. Sadowska, L. Siewierski, Geometria analityczna w zadaniach, PWN, Warszawa 1993

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Analiza matematyczna 1A**
Name of subject in English: **Mathematical analysis 1A**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W13MBM-SI0005**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	30			
Number of hours of total student workload (CNPS)	150	90			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	5	3			
including number of ECTS points for practical (P) classes		3			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.5	1.5			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. High school graduation at basic level.

SUBJECT OBJECTIVES

C1. Exposition of basic elementary functions and their properties.
C2. Exposition of basic notions and theorems of differential calculus of functions of a single variable.
C3. Introduction of the concept of the definite integral, its basic properties and methods of calculation.
C4. Presentation of practical applications of methods of differential and integral calculus of functions of a single variable.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - knows the graphs and properties of basic elementary functions,
PEU_W02 - knows basic notions and theorems of differential calculus of functions of a single variable,
PEU_W03 - knows the concept of the definite integral, its properties and the basic applications.

II. Relating to skills:
PEU_U01 - can solve typical equations and inequalities with elementary functions,
PEU_U02 - can examine a function and draw its graph, can apply differential calculus to solve practical problems,
PEU_U03 - can evaluate typical indefinite integrals and calculate definite integrals and can apply integral calculus to solve practical problems.

III. Relating to social competences:
PEU_K01 - understands the need for systematic and independent work on mastery of course material.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Repetition and completion of information about functions. Elements of mathematical logic. Definition of a function. Composition of functions. Transformations of graphs of functions. Monotonic, one-to-one function. Linear, quadratic, polynomials, rational functions.The inverse function and its graph. Power and exponential functions and their inverses. Unit (trigonometric) circle. Trigonometric and inverse trigonometric functions.	8
Lec2	Sequences of real numbers. Bounded, monotonic sequences. Finite and infinite limit of a sequence. Theorems on limits of sequences. Indeterminate expressions. The number e.	3
Lec3	Limits of a function, asymptotes, continuous functions. The limit of a function at a point and the limit at infinity. Limit theorems. Examples of the limits of certain indeterminate expressions. Asymptotes. Continuity of a function at a point and on an interval. Basic properties of continuous functions. Approximate solutions of equations.	4
Lec4	Differential calculus. Definition of the derivative of a function. Geometrical and physical interpretations of the derivative. Derivatives of basic elementary functions. Differentiation rules. Differential of a function. Lagrange’s theorem. Intervals of monotonicity of a function. De l’Hospital’s rule. Local and global extrema. Examples of optimization problems.	7
Lec5	Indefinite integral. Definition and basic properties of indefinite integral. Basic rules/formulas. The substitution rule and integration by parts. Integration of rational and trigonometric functions.	4

Lec6	Definite integral. Definition and basic properties of definite integral. Fundamental theorem of calculus (Newton-Leibniz theorem). Applications of integral calculus (e.g. average value of a function, area of a flat region, arc length, volumes and lateral surface area of solids of revolution).	4
		Total hours: 30

Form of classes – Classes		Number of hours
Cl1	Repetition and completion of information about functions. Elements of mathematical logic (logical connectives, quantifiers). Determination of the domain of a function. Checking whether a function is even or odd. Composition of functions. Transformations of graphs of functions. Typical equations and inequalities with exponential and logarithmic functions. The inverse function. Trigonometric and inverse trigonometric functions. Typical trigonometric equations and inequalities.	8
Cl2	Sequences of real numbers. Examination of monotonicity and boundedness of sequences. Computing limits of sequences.	2
Cl3	Limits of functions, asymptotes, continuous functions. Computing limits of a function at a point and at infinity. Determination of asymptotes. Continuity testing. Approximate solutions of equations.	4
Cl4	Differential calculus. Definicja pochodnej. Rules of differentiation Tangent line. Differential of a function. De l'Hospital's rule. Intervals of monotonicity of a function. Determining local and global extrema of a function.	7
Cl5	Indefinite integral. Evaluation of indefinite integrals. Integration by parts and by substitution. Integration of rational and trigonometric functions.	3
Cl6	Definite integral. Calculation of definite integrals. Usage definite integrals for calculating areas of flat regions, arc lengths, volumes and surface areas of solids of revolution.	4
Cl7	Test	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. calculation exercises N3. self study - self studies and preparation for examination N4. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement

F1	PEU_W01-PEU_W03	exam
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03	Tests, oral presentations, quizzes
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] G. Decewicz, W. Żakowski, Matematyka, Cz.1, WNT, Warszawa 2007.
[2] M. Gewert, Z. Skoczylas, Analiza matematyczna 1. Definicje, twierdzenia, wzory, Oficyna Wydawnicza GiS, Wrocław 2021.
[3] M. Gewert, Z. Skoczylas, Analiza matematyczna 1. Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław 2021.
[4] W. Krysicki, L. Włodarski, Analiza matematyczna w zadaniach, Cz. I, PWN, Warszawa 2006

SECONDARY LITERATURE
[5] F. Leja, Rachunek różniczkowy i całkowy, PWN, 2012.
[6] R. Leitner, Zarys matematyki wyższej dla studiów technicznych, cz.1-2, WNT, Warszawa 2006.
[7] M. Zakrzewski, Markowe wykłady z matematyki. Analiza, Oficyna Wydawnicza GiS, Wrocław 2013.

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Elementy analizy matematycznej 2**
Name of subject in English: **Elements of mathematical analysis 2**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W13MBM-SI0006**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	15			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	2	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.7	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student must have basic knowledge in one-variable differential and integral calculus, confirmed by completing the Mathematical Analysis 1A, 1B course with a positive grade or other course covering single variable differentia and integral calculus

SUBJECT OBJECTIVES

C1. Exposition of the basic concepts and theorems of multivariate calculus.
C2. Exposition of the concept of a double integral, methods of its calculation and applications.
C3. Exposition of the basic convergence tests for series and properties of power series.

SUBJECT LEARNING OUTCOMES
I. Relating to knowledge: PEU_W01 - knowledge of basic concepts and theorems of differential calculus of functions of two variables, PEU_W02 - knowledge of methods for calculating double integrals, PEU_W03 - knowledge of the basic criteria for the convergence of numerical series and properties of power series, **II. Relating to skills:** PEU_U01 - the ability to calculate partial and directional derivatives and the gradient of functions of many variables and the ability to interpret the obtained quantities, ability to solve optimization problems for functions two variables, PEU_U02 - ability to calculate double integrals and use them to calculate areas, volume and selected physical quantities, PEU_U03 - ability to verify of convergence of infinite series and to expand a function into a power series using expansions of elementary functions, **III. Relating to social competences:** PEU_K01 - understanding the need for systematic and independent work on mastery of course material.

PROGRAM CONTENT		
Form of classes – Lecture		Number of hours
Lec1	Differential calculus of functions of two (many) variables. Functions of two (many) variables. Graphs of typical functions of two variables. Definition and geometric interpretation of a first order partial derivative. The tangent plane to the graph of two-variable function. The differential. Directional derivatives. Gradient of a function. Higher order partial derivatives. Schwarz’s Theorem. Local extrema of two-variable function. Necessary and sufficient conditions for the existence of minimum /maximum.	6
Lec2	Double integrals. Definition of a double integral. Geometric interpretation. Methods of calculation of double integrals over normal regions. Double integrals in polar coordinates. Applications of double integrals.	4
Lec3	Infinite and power series. Definition of the improper integral of type I. Definition of the series. The basic criteria for convergence of series. Absolute and conditional convergence. The alternating series test (Leibniz’s theorem). Definition of the power series. The radius and interval of convergence. Cauchy-Hadamard theorem. Taylor and Maclaurin series.	5
		Total hours: 15
Form of classes – Classes		Number of hours

Cl1	Differential calculus of functions of two (many) variables. Finding the domain. Sketching level curves and the graphs of cylindrical surfaces and surfaces of revolution. Calculation of partial derivatives. Finding the tangent plane equation. Using the differential to estimate the accuracy of calculations. Determination and interpretation of the gradient of a function and the directional derivative. Determination of local and conditional extremes of functions of two variables..	6
Cl2	Double integrals. Reduction of a double integral to an iterated integral. Calculation of double integrals over normal regions. Double integrals in polar coordinates. Examples of applications of double integrals.	4
Cl3	Infinite and power series. Verification of convergence of infinite series. Computation of the radius and interval of convergence of a power series. Finding power series of functions using expansions of basic functions.	4
Cl4	Test	1
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. calculation exercises N3. self study - self studies and preparation for examination N4. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01-PEU_W03	exam
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03, PEU_K01	Tests, oral presentations, quizzes
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] M. Gewert, Z. Skoczylas, Analiza Matematyczna 2. Definicje, twierdzenia, wzory. Oficyna Wydawnicza GiS, Wrocław 2016.
[2] M. Gewert, Z. Skoczylas, Analiza Matematyczna 2. Przykłady i Zadania, Oficyna Wydawnicza GiS, Wrocław 2016.
[3] R. Leitner, Zarys Matematyki Wyższej dla Studiów Technicznych, Cz. 1 - 2 WNT, Warszawa, 2006.

SECONDARY LITERATURE

[1] W. Krysicki, L. Włodarski, Analiza Matematyczna w Zadaniach, Cz. II, PWN, Warszawa 2006.
[2] F. Leja, Rachunek Różniczkowy i Całkowy, Wydawnictwo Naukowe PWN, 2012.
[3] M.Zakrzewski, Markowe wykłady z matematyki. Analiza, geometria i świat fizyczny, Oficyna Wydawnicza GiS, Wrocław 2017.

Faculty of Mechanical Engineering   Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Linear algebra with analitic geometry B (Algebra liniowa z geometrią analityczną B)**

Name of subject in English: **Linear algebra with analitic geometry B**

Main field of study (if applicable): **Mechanical Engineering and Machine Building**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **W13MBM-SI3004**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	2	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.5	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has the knowledge required for the Matura exam in Mathematics at least at basic level

SUBJECT OBJECTIVES

C1. Exposition of the basic concepts of linear algebra and analytic geometry.
C2. Exposition of the methods for solving basic problems related to complex numbers, matrices, systems of equations and analytic geometry in Euclidean space R3.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Student knows the basic properties of complex numbers, Student knows the basic concepts and theorems about the matrix.
PEU_W02 - Student knows the basic concepts and theorems on polynomial algebra. Student knows the basic methods of solving linear equations.
PEU_W03 - Student knows how to describe lines, planes and conic curves.

II. Relating to skills:
PEU_U01 - Student can carry out calculations with complex number. Student can use matrix notation and transformations appropriate for the algebra of matrices and determinants.
PEU_U02 - Student can factor a polynomial and factor rational functions for real simple fractions. Student can effectively solve systems of equations linear.
PEU_U03 - Student can solve problems concerning mutual position of points, lines and vectors in Euclidean space.

III. Relating to social competences:
PEU_K01 - Student knows the rules of behavior in the environment academic.
PEU_K02 - student improves communication skills
PEU_K03 - student can use reliable scientific information sources.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Matrix. Operations on matrices. The transpose of a matrix. Types of matrices (triangular, symmetric, diagonal, etc.).	2
Lec2	The determinant of a matrix. Laplace expansion. The algebraic complement of a matrix element. minor. Properties of determinants. Calculation of determinants. Cauchy's theorem on the multiplication of determinants. Nonsingular matrix.	3
Lec3	Inverse matrix. The method of algebraic complements and elementary transformations. Properties of inverse matrices. Matrix equations.	2
Lec4	System of linear equations. Cramer formulas. Gauss elimination method. Solving arbitrary systems of linear equations.	3
Lec5	A complex number. Algebraic form. Operations on complex numbers. Coupling. Module. Argument.	2
Lec6	Geometric interpretation of a complex number. Trigonometric form and exponential form. De Moivre's formula. The nth root of a complex number.	2
Lec7	Polynomial. Bezout's theorem. Fundamental theorem of algebra. Roots of real polynomials.	2
Lec8	Linear and square divisors of real polynomials. Factoring a polynomial. A rational function. Real simple fraction. Decomposition of a rational function into real simple fractions.	2

Lec9	Analytic geometry in R3 space. Operations on vectors. Vector length. Products: scalar, vector, mixed. Application for calculating areas and volumes.	2
Lec10	Plane. Normal vector. General, parametric, determinant equation. Relative position of the planes.	2
Lec11	Simple. Parametric, directional and edge equations. The distance of the point from the line and from the plane. Reciprocal position of straight lines. Relative position of a straight line and a plane. Projection of a point onto a straight line and a plane.	2
Lec12	Conic curves. Circle. Ellipse. Hyperbole. Parabola	2
Lec13	Applications of the Linear Algebra.	4
		Total hours: 30

Form of classes – Classes		Number of hours
Cl1	Transformations of algebraic expressions	1
Cl2	Solving tasks related to the topics presented in the lecture.	14
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. calculation exercises N3. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01-PEU_W03	exam
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement

F1	PEU_U01-PEU_U03	Tests, oral presentations, quizzes
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE [1] T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna. Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław 2020. [2] T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna. Definicje, twierdzenia, wzory. Oficyna Wydawnicza GiS, Wrocław 2022. [3] P. Kajetanowicz, J. Wierzejewski, Algebra z geometrią analityczną, PWN 2008. [4] M. Zakrzewski, Markowe wykłady z matematyki, Algebra z geometrią, Oficyna Wyd. GiS, Wrocław 2015. SECONDARY LITERATURE [1] G. Banaszak, W. Gajda, Elementy algebry liniowej, cz.I, WNT, 2002. [2] A. Mostowski, M. Stark, Elementy algebry wyższej, PWN, Warszawa 1963. [3] W. Stankiewicz, Zadania z matematyki dla wyższych uczelni technicznych, Cz. A, PWN, Warszawa 2003. [4] F. Leja, Geometria analityczna, PWN, Warszawa 1972. [5] E. Kącki, D. Sadowska, L. Siewierski, Geometria analityczna w zadaniach, PWN, Warszawa 1993

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Mathematical analysis 1A (Analiza matematyczna 1A)**
Name of subject in English: **Mathematical analysis 1A**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W13MBM-SI3005**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	30			
Number of hours of total student workload (CNPS)	150	90			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	5	3			
including number of ECTS points for practical (P) classes		3			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.5	1.5			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. High school graduation at basic level.

SUBJECT OBJECTIVES

C1. Exposition of basic elementary functions and their properties.
C2. Exposition of basic notions and theorems of differential calculus of functions of a single variable.
C3. Introduction of the concept of the definite integral, its basic properties and methods of calculation.
C4. Presentation of practical applications of methods of differential and integral calculus of functions of a single variable.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - knows the graphs and properties of basic elementary functions,
PEU_W02 - knows basic notions and theorems of differential calculus of functions of a single variable,
PEU_W03 - knows the concept of the definite integral, its properties and the basic applications.

II. Relating to skills:
PEU_U01 - can solve typical equations and inequalities with elementary functions,
PEU_U02 - can examine a function and draw its graph, can apply differential calculus to solve practical problems,
PEU_U03 - can evaluate typical indefinite integrals and calculate definite integrals and can apply integral calculus to solve practical problems.

III. Relating to social competences:
PEU_K01 - understands the need for systematic and independent work on mastery of course material.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Repetition and completion of information about functions. Elements of mathematical logic. Definition of a function. Composition of functions. Transformations of graphs of functions. Monotonic, one-to-one function. Linear, quadratic, polynomials, rational functions.The inverse function and its graph. Power and exponential functions and their inverses. Unit (trigonometric) circle. Trigonometric and inverse trigonometric functions.	8
Lec2	Sequences of real numbers. Bounded, monotonic sequences. Finite and infinite limit of a sequence. Theorems on limits of sequences. Indeterminate expressions. The number e.	3
Lec3	Limits of a function, asymptotes, continuous functions. The limit of a function at a point and the limit at infinity. Limit theorems. Examples of the limits of certain indeterminate expressions. Asymptotes. Continuity of a function at a point and on an interval. Basic properties of continuous functions. Approximate solutions of equations.	4
Lec4	Differential calculus. Definition of the derivative of a function. Geometrical and physical interpretations of the derivative. Derivatives of basic elementary functions. Differentiation rules. Differential of a function. Lagrange’s theorem. Intervals of monotonicity of a function. De l’Hospital’s rule. Local and global extrema. Examples of optimization problems.	7
Lec5	Indefinite integral. Definition and basic properties of indefinite integral. Basic rules/formulas. The substitution rule and integration by parts. Integration of rational and trigonometric functions.	4

Lec6	Definite integral. Definition and basic properties of definite integral. Fundamental theorem of calculus (Newton-Leibniz theorem). Applications of integral calculus (e.g. average value of a function, area of a flat region, arc length, volumes and lateral surface area of solids of revolution).	4
		Total hours: 30

Form of classes – Classes		Number of hours
Cl1	Repetition and completion of information about functions. Elements of mathematical logic (logical connectives, quantifiers). Determination of the domain of a function. Checking whether a function is even or odd. Composition of functions. Transformations of graphs of functions. Typical equations and inequalities with exponential and logarithmic functions. The inverse function. Trigonometric and inverse trigonometric functions. Typical trigonometric equations and inequalities.	8
Cl2	Sequences of real numbers. Examination of monotonicity and boundedness of sequences. Computing limits of sequences.	2
Cl3	Limits of functions, asymptotes, continuous functions. Computing limits of a function at a point and at infinity. Determination of asymptotes. Continuity testing. Approximate solutions of equations.	4
Cl4	Differential calculus. Definicja pochodnej. Rules of differentiation Tangent line. Differential of a function. De l'Hospital's rule. Intervals of monotonicity of a function. Determining local and global extrema of a function.	7
Cl5	Indefinite integral. Evaluation of indefinite integrals. Integration by parts and by substitution. Integration of rational and trigonometric functions.	3
Cl6	Definite integral. Calculation of definite integrals. Usage definite integrals for calculating areas of flat regions, arc lengths, volumes and surface areas of solids of revolution.	4
Cl7	Test	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. calculation exercises N3. self study - self studies and preparation for examination N4. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement

F1	PEU_W01-PEU_W03	egzam
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03	Tests, oral presentations, quizzes
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] G. Decewicz, W. Żakowski, Matematyka, Cz.1, WNT, Warszawa 2007.
[2] M. Gewert, Z. Skoczylas, Analiza matematyczna 1. Definicje, twierdzenia, wzory, Oficyna Wydawnicza GiS, Wrocław 2021.
[3] M. Gewert, Z. Skoczylas, Analiza matematyczna 1. Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław 2021.
[4] W. Krysicki, L. Włodarski, Analiza matematyczna w zadaniach, Cz. I, PWN, Warszawa 2006

SECONDARY LITERATURE
[5] F. Leja, Rachunek różniczkowy i całkowy, PWN, 2012.
[6] R. Leitner, Zarys matematyki wyższej dla studiów technicznych, cz.1-2, WNT, Warszawa 2006.
[7] M. Zakrzewski, Markowe wykłady z matematyki. Analiza, Oficyna Wydawnicza GiS, Wrocław 2013.

Faculty of Mechanical Engineering Zał. nr 5 ZW16/2020

SUBJECT CARD

Name of subject in Polish: **Elements of mathematical analysis 2 (Elementy analizy matematycznej 2)**
Name of subject in English: **Elements of mathematical analysis 2**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **W13MBM-SI3006**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	15			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	2	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.7	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student must have basic knowledge in one-variable differential and integral calculus, confirmed by completing the Mathematical Analysis 1A, 1B course with a positive grade or other course covering single variable differentia and integral calculus

SUBJECT OBJECTIVES

C1. Exposition of the basic concepts and theorems of multivariate calculus.
C2. Exposition of the concept of a double integral, methods of its calculation and applications.
C3. Exposition of the basic convergence tests for series and properties of power series.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - knowledge of basic concepts and theorems of differential calculus of functions of two variables,
PEU_W02 - knowledge of methods for calculating double integrals,
PEU_W03 - knowledge of the basic criteria for the convergence of numerical series and properties of power series,

II. Relating to skills:
PEU_U01 - the ability to calculate partial and directional derivatives and the gradient of functions of many variables and the ability to interpret the obtained quantities, ability to solve optimization problems for functions two variables,
PEU_U02 - ability to calculate double integrals and use them to calculate areas, volume and selected physical quantities,
PEU_U03 - ability to verify of convergence of infinite series and to expand a function into a power series using expansions of elementary functions,

III. Relating to social competences:
PEU_K01 - understanding the need for systematic and independent work on mastery of course material.

PROGRAM CONTENT		
Form of classes – Lecture		Number of hours
Lec1	Differential calculus of functions of two (many) variables. Functions of two (many) variables. Graphs of typical functions of two variables. Definition and geometric interpretation of a first order partial derivative. The tangent plane to the graph of two-variable function. The differential. Directional derivatives. Gradient of a function. Higher order partial derivatives. Schwarz's Theorem. Local extrema of two-variable function. Necessary and sufficient conditions for the existence of minimum /maximum.	6
Lec2	Double integrals. Definition of a double integral. Geometric interpretation. Methods of calculation of double integrals over normal regions. Double integrals in polar coordinates. Applications of double integrals.	4
Lec3	Infinite and power series. Definition of the improper integral of type I. Definition of the series. The basic criteria for convergence of series. Absolute and conditional convergence. The alternating series test (Leibniz's theorem). Definition of the power series. The radius and interval of convergence. Cauchy-Hadamard theorem. Taylor and Maclaurin series.	5
		Total hours: 15
Form of classes – Classes		Number of hours

Cl1	Differential calculus of functions of two (many) variables. Finding the domain. Sketching level curves and the graphs of cylindrical surfaces and surfaces of revolution. Calculation of partial derivatives. Finding the tangent plane equation. Using the differential to estimate the accuracy of calculations. Determination and interpretation of the gradient of a function and the directional derivative. Determination of local and conditional extremes of functions of two variables..	6
Cl2	Double integrals. Reduction of a double integral to an iterated integral. Calculation of double integrals over normal regions. Double integrals in polar coordinates. Examples of applications of double integrals.	4
Cl3	Infinite and power series. Verification of convergence of infinite series. Computation of the radius and interval of convergence of a power series. Finding power series of functions using expansions of basic functions.	4
Cl4	Test	1
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. calculation exercises N3. self study - self studies and preparation for examination N4. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01-PEU_W03	exam
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03, PEU_K01	Tests, oral presentations, quizzes
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] M. Gewert, Z. Skoczylas, Analiza Matematyczna 2. Definicje, twierdzenia, wzory. Oficyna Wydawnicza GiS, Wrocław 2016.
[2] M. Gewert, Z. Skoczylas, Analiza Matematyczna 2. Przykłady i Zadania, Oficyna Wydawnicza GiS, Wrocław 2016.
[3] R. Leitner, Zarys Matematyki Wyższej dla Studiów Technicznych, Cz. 1 - 2 WNT, Warszawa, 2006.

SECONDARY LITERATURE
[1] W. Krysicki, L. Włodarski, Analiza Matematyczna w Zadaniach, Cz. II, PWN, Warszawa 2006.
[2] F. Leja, Rachunek Różniczkowy i Całkowy, Wydawnictwo Naukowe PWN, 2012.
[3] M.Zakrzewski, Markowe wykłady z matematyki. Analiza, geometria i świat fizyczny, Oficyna Wydawnicza GiS, Wrocław 2017.

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Elektrotechnika**
Nazwa przedmiotu w języku angielskim: **Electrical engineering**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W05MBM-SI0003**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	2				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Zna i rozumie podstawowe prawa fizyki, a szczególnie elektrostatyki i elektromagnetyzmu
2. Potrafi posłużyć się rachunkiem różniczkowym i całkowym
3. Potrafi pozyskiwać informacje z literatury.

CELE PRZEDMIOTU

C1. Zdobycie wiedzy o podstawowych zasadach działania obwodów elektrycznych i zjawiskach elektromagnetycznych.
C2. Zdobycie wiedzy o budowie i pracy obwodów, urządzeń i maszyn elektrycznych

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Rozumie podstawowe prawa teorii obwodów elektrycznych i elektromagnetyzmu oraz ich zastosowanie w maszynach i urządzeniach elektrycznych.
PEU_W02 - Rozumie zasadę działania, budowę i przeznaczenie transformatorów.
PEU_W03 - Zna budowę, zasadę działania i charakterystyki podstawowych rodzajów maszyn elektrycznych.

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie do przedmiotu. Wymagania i literatura. Podstawowe prawa elektrotechniki.	2
Wy2	Prawa teorii obwodów. Obwody prądu stałego. Praca i moc.	2
Wy3	Elektromagnetyzm – wielkości podstawowe, właściwości magnetyczne ośrodka, obwody magnetyczne.	2
Wy4	Obwody prądu przemiennego. Zjawisko indukcji elektromagnetycznej, indukcyjność własna i wzajemna.	2
Wy5	Elementy R, L, C w obwodach prądu zmiennego sinusoidalnego.	2
Wy6	Obwody rezonansowe, moc czynna, moc bierna, poprawa współczynnika mocy - kompensacja mocy biernej.	2
Wy7	Obwody prądu trójfazowego. Wytwarzanie napięcia trójfazowego. Układy połączeń w gwiazdę i trójkąt. Pomiary mocy w układach trójfazowych.	2
Wy8	Dławiki i transformatory – budowa, zasada działania i analiza pracy.	2
Wy9	Rodzaje transformatorów i ich zastosowania, autotransformatory, przekładniki prądowe i napięciowe.	2
Wy10	Silniki indukcyjne – rodzaje budowy, zasada działania.	2
Wy11	Rodzaje pracy silników indukcyjnych, charakterystyki robocze. Rozruch, hamowanie, regulacja prędkości obrotowej. Zastosowania silników indukcyjnych.	2
Wy12	Maszyny synchroniczne – budowa, zasada działania, moment elektromagnetyczny, charakterystyki, zastosowania.	2
Wy13	Komutatorowe maszyny prądu stałego – budowa, zasada działania, rodzaje, charakterystyki, rozruch, regulacja prędkości obrotowej, zastosowania.	2
Wy14	Bezszczotkowe silniki prądu stałego (Silniki BLDC): budowa, zasada działania, istota powstawania momentu elektromagnetycznego, regulacja prędkości obrotowej, charakterystyki ruchowe, zastosowania.	2
Wy15	Kolokwium.	2

	Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. prezentacja multimedialna N3. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01-PEU_W03	kolokwium
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA P. Hempowicz, R. Kiełsznia, Elektrotechnika i elektronika dla nieelektryków.WNT. Elektrotechnika dla nieelektryków. Ćwiczenia laboratoryjne, Zbiór zadań, skrypt P.Wr. pod redakcją P. Zielińskiego (2000). LITERATURA UZUPEŁNIAJĄCA Elektrotechnika, skrypt P.Wr. pod redakcją P. Zielińskiego (1990).

OPIEKUN PRZEDMIOTU
dr hab. inż. Marek Ciurys email: marek.ciurys@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Elektrotechnika**
Nazwa przedmiotu w języku angielskim: **Electrical engineering**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W05MBM-SI0004**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)			15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)			30		
Forma zaliczenia			Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS			1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)			0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Zna i rozumie podstawowe prawa fizyki, a szczególnie elektrostatyki i elektromagnetyzmu.
2. Potrafi posłużyć się rachunkiem różniczkowym i całkowym.
3. Potrafi pozyskiwać informacje z literatury.

CELE PRZEDMIOTU

C1. Nabycie umiejętności grupowego wykonywania pomiarowych badań maszyn i urządzeń elektrycznych.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Potrafi połączyć układ pomiarowy i wykonać podstawowe pomiary wielkości elektrycznych.
PEU_U02 - Posiada umiejętność przeprowadzenia prostych badań laboratoryjnych maszyn elektrycznych.
PEU_U03 - Potrafi wyznaczyć charakterystyki robocze silników elektrycznych i tranformatorów.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Ma świadomość odpowiedzialności za pracę własną oraz gotowość podporządkowania się zasadom pracy w zespole i ponoszenia odpowiedzialności za wspólnie realizowane zadania.

TREŚCI PROGRAMOWE

Forma zajęć – Laboratorium		Liczba godzin
Lab1	Wprowadzenie, omówienie przepisów BHP i regulaminu wewnętrznego laboratorium. Przedstawienie zasad zaliczenia przedmiotu. Zapoznanie się ze stanowiskami laboratoryjnymi.	1
Lab2	Realizacja sześciu spośród następujących ćwiczeń laboratoryjnych: 1. Pomiary mocy w trójfazowych układach prądu przemiennego. 2. Badanie obwodów prądu przemiennego zawierających elementy R, L, C. 3. Badanie transformatora. 4. Badanie silnika indukcyjnego. 5. Badanie silnika indukcyjnego zasilanego z przemiennika częstotliwości. 6. Poprawa współczynnika mocy - kompensacja mocy biernej. 7. Badanie silnika bocznikowego prądu stałego. 8. Badanie silnika szeregowego prądu stałego. 9. Badanie silnika synchronicznego.	12
Lab3	Zaliczenie zajęć laboratoryjnych.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. eksperyment laboratoryjny
N2. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się

F1	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Sprawozdania z ćwiczeń laboratoryjnych.
F2	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Sprawdzenie przygotowania do zajęć laboratoryjnych.
F3	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Aktywność na zajęciach.
P = 0,4*F1+0,3*F2+0,3*F3		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

P. Hempowicz, R. Kiełsznia, Elektrotechnika i elektronika dla nieelektryków.WNT.

Elektrotechnika dla nieelektryków. Ćwiczenia laboratoryjne, Zbiór zadań, skrypt P.Wr. pod redakcją P. Zielińskiego (2000).

LITERATURA UZUPEŁNIAJĄCA

Elektrotechnika, skrypt P.Wr. pod redakcją P. Zielińskiego (1990).

E. Koziej, B. Sochoń: Elektrotechnika i elektronika. PWN 1986

OPIEKUN PRZEDMIOTU

dr hab. inż. Marek Ciurys email: marek.ciurys@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Electrical Engineering (Elektrotechnika)**
Nazwa przedmiotu w języku angielskim: **Electrical Engineering**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W05MBM-SI3003**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	2				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Zna i rozumie podstawowe prawa fizyki, a szczególnie elektrostatyki i elektromagnetyzmu.
2. Potrafi posłużyć się rachunkiem różniczkowym i całkowym.
3. Potrafi pozyskiwać informacje z literatury.

CELE PRZEDMIOTU

C1. Zdobycie wiedzy o podstawowych zasadach działania obwodów elektrycznych i o zjawiskach elektromagnetycznych.
C2. Zdobycie wiedzy o budowie i pracy obwodów, urządzeń i maszyn elektrycznych.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Rozumie podstawowe prawa teorii obwodów elektrycznych i elektromagnetyzmu oraz ich zastosowanie w maszynach i urządzeniach elektrycznych.
PEU_W02 - Rozumie zasadę działania, budowę i przeznaczenie transformatorów.
PEU_W03 - Zna budowę, zasadę działania i charakterystyki podstawowych rodzajów maszyn elektrycznych.

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie do przedmiotu. Wymagania i literatura. Podstawowe prawa elektrotechniki.	2
Wy2	Prawa teorii obwodów. Obwody prądu stałego. Praca i moc.	2
Wy3	Elektromagnetyzm – wielkości podstawowe, właściwości magnetyczne ośrodka, obwody magnetyczne.	2
Wy4	Obwody prądu przemiennego. Zjawisko indukcji elektromagnetycznej, indukcyjność własna i wzajemna.	2
Wy5	Elementy R, L, C w obwodach prądu zmiennego sinusoidalnego.	2
Wy6	Obwody rezonansowe, moc czynna, moc bierna, poprawa współczynnika mocy - kompensacja mocy biernej.	2
Wy7	Obwody prądu trójfazowego. Wytwarzanie napięcia trójfazowego. Układy połączeń w gwiazdę i trójkąt. Pomiary mocy w układach trójfazowych.	2
Wy8	Dławiki i transformatory – budowa, zasada działania i analiza pracy.	2
Wy9	Rodzaje transformatorów i ich zastosowania, autotransformatory, przekładniki prądowe i napięciowe.	2
Wy10	Silniki indukcyjne – rodzaje budowy, zasada działania.	2
Wy11	Rodzaje pracy silników indukcyjnych, charakterystyki robocze. Rozruch, hamowanie, regulacja prędkości obrotowej. Zastosowania silników indukcyjnych.	2
Wy12	Maszyny synchroniczne – budowa, zasada działania, moment elektromagnetyczny, charakterystyki, zastosowania.	2
Wy13	Komutatorowe maszyny prądu stałego – budowa, zasada działania, rodzaje, charakterystyki, rozruch, regulacja prędkości obrotowej, zastosowania.	2
Wy14	Bezszczotkowe silniki prądu stałego (Silniki BLDC): budowa, zasada działania, istota powstawania momentu elektromagnetycznego, regulacja prędkości obrotowej, charakterystyki ruchowe, zastosowania.	2

Wy15	Kolokwium.	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. prezentacja multimedialna

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01-PEU_W03	kolokwium
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA P. Hempowicz, R. Kiełsznia, Elektrotechnika i elektronika dla nieelektryków.WNT. Elektrotechnika dla nieelektryków. Ćwiczenia laboratoryjne, Zbiór zadań, skrypt P.Wr. pod redakcją P. Zielińskiego (2000). LITERATURA UZUPEŁNIAJĄCA Elektrotechnika, skrypt P.Wr. pod redakcją P. Zielińskiego (1990). E. Koziej, B. Sochoń: Elektrotechnika i elektronika. PWN 1986

OPIEKUN PRZEDMIOTU
dr hab. inż. Marek Ciurys email: marek.ciurys@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Electrical Engineering (Elektrotechnika)**
Nazwa przedmiotu w języku angielskim: **Electrical Engineering**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W05MBM-SI3004**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)			15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)			30		
Forma zaliczenia			Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS			1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)			0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Zna i rozumie podstawowe prawa fizyki, a szczególnie elektrostatyki i elektromagnetyzmu.
2. Potrafi posłużyć się rachunkiem różniczkowym i całkowym
3. Potrafi pozyskiwać informacje z literatury.

CELE PRZEDMIOTU

C1. Nabycie umiejętności grupowego wykonywania pomiarowych badań maszyn i urządzeń elektrycznych.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Potrafi połączyć układ pomiarowy i wykonać podstawowe pomiary wielkości elektrycznych.
PEU_U02 - Posiada umiejętność przeprowadzenia prostych badań laboratoryjnych maszyn elektrycznych.
PEU_U03 - Potrafi wyznaczyć charakterystyki robocze silników elektrycznych i tranformatorów.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Ma świadomość odpowiedzialności za pracę własną oraz gotowość podporządkowania się zasadom pracy w zespole i ponoszenia odpowiedzialności za wspólnie realizowane zadania

TREŚCI PROGRAMOWE

Forma zajęć – Laboratorium		Liczba godzin
Lab1	Wprowadzenie, omówienie przepisów BHP i regulaminu wewnętrznego laboratorium. Przedstawienie zasad zaliczenia przedmiotu. Zapoznanie się ze stanowiskami laboratoryjnymi.	1
Lab2	Realizacja sześciu spośród następujących ćwiczeń laboratoryjnych: 1. Pomiary mocy w trójfazowych układach prądu przemiennego. 2. Badanie obwodów prądu przemiennego zawierających elementy R, L, C. 3. Badanie transformatora. 4. Badanie silnika indukcyjnego. 5. Badanie silnika indukcyjnego zasilanego z przemiennika częstotliwości. 6. Poprawa współczynnika mocy - kompensacja mocy biernej. 7. Badanie silnika bocznikowego prądu stałego. 8. Badanie silnika szeregowego prądu stałego. 9. Badanie silnika synchronicznego.	12
Lab3	Zaliczenie zajęć laboratoryjnych.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. eksperyment laboratoryjny
N2. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się

F1	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Sprawozdania z ćwiczeń laboratoryjnych.
F2	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Sprawdzenie przygotowania do zajęć laboratoryjnych.
F3	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Aktywność na zajęciach.
P = 0,4*F1+0,3*F2+0,3*F3		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

P. Hempowicz, R. Kiełsznia, Elektrotechnika i elektronika dla nieelektryków.WNT.

Elektrotechnika dla nieelektryków. Ćwiczenia laboratoryjne, Zbiór zadań, skrypt P.Wr. pod redakcją P. Zielińskiego (2000).

LITERATURA UZUPEŁNIAJĄCA

Elektrotechnika, skrypt P.Wr. pod redakcją P. Zielińskiego (1990).

E. Koziej, B. Sochoń: Elektrotechnika i elektronika. PWN 1986.

OPIEKUN PRZEDMIOTU

dr hab. inż. Marek Ciurys email: marek.ciurys@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Wstęp do filozofii**
Nazwa przedmiotu w języku angielskim: **Introduction to philosophy**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **wybieralny**
Kod przedmiotu: **W08MBM-SI0002**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	2				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. 1.Brak wymagań wstępnych.

CELE PRZEDMIOTU

C1. Zapoznanie słuchaczy ze specyfiką myśli filozoficznej.
C2. Przyswojenie wiedzy na temat podstawowych metod uprawnionego wnioskowania regulującego i porządkującego nasze myślenie.
C3. Przedstawienie filozoficznych uwarunkowań działalności inżynierskiej.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - ma podstawową wiedzę niezbędną do zrozumienia prawnych, etyczno- społecznych, filozoficznych uwarunkowań działalności inżynierskiej

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:
PEU_K01 - ma świadomość ważności i zrozumienie humanistycznych aspektów i skutków działalności inżynierskiej; poznaje skutki wpływu działalności technicznej na środowisko, i związaną z tym odpowiedzialnością społeczną nauki i techniki;
PEU_K02 - prawidłowo identyfikuje i rozstrzyga dylematy związane z wykonywaniem zawodu; ma świadomość roli społecznej absolwenta uczelni technicznej; rozumie potrzebę formułowania i przekazywania społeczeństwu informacji i opinii dotyczących osiągnięć techniki i innych aspektów działalności inżyniera; potrafi przekazać taką informację i opinie w sposób zrozumiały, z uzasadnieniem różnych punktów widzenia;

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie (plan, cel i warunki zaliczenia)	2
Wy2	Co to jest filozofia?	2
Wy3	Filozofia a inne dziedziny wiedzy (1)	2
Wy4	Filozofia a inne dziedziny wiedzy (2)	2
Wy5	Wybrane zagadnienia z filozofii nauki i techniki (1)	2
Wy6	Wybrane zagadnienia z filozofii nauki i techniki (2)	2
Wy7	Poznanie jako klasyczny problem filozofii	2
Wy8	Wybrane zagadnienia z etyki	2
Wy9	Wybrane zagadnienia z filozofii społecznej (1)	2
Wy10	Wybrane zagadnienia z filozofii społecznej (2)	2
Wy11	Wybrane zagadnienia z filozofii polityki	2
Wy12	Elementy teorii argumentacji	2
Wy13	Pytanie o człowieka	2
Wy14	Kolokwium	2
Wy15	Podsumowanie i zaliczenie kursu	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. prezentacja multimedialna N3. dyskusja problemowa

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01	Kolokwium, wystąpienie końcowe lub praca pisemna
F2	PEU_K01, PEU_K02	Aktywność na zajęciach
P = (2*F!+F2)/3		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
[1] Blackburn S., Oksfordzki słownik filozoficzny, Warszawa 2004;
[2] Chalmers A., Czym jest to, co zwiemy nauką, Wrocław 1997;
[3] Grobler A., Metodologia nauk, Kraków 2004;
[4] Fry H., Hello World. Jak być człowiekiem w dobie maszyn?, Warszawa 2019.
[5] Martens E., Schnädelbach H., Filozofia. Podstawowe pytania, Warszawa 1995;
[6] Zuboff S., Wiek kapitalizmu inwigilacji, Warszawa 2020.

LITERATURA UZUPEŁNIAJĄCA
[1] Anzenbacher A., Wprowadzenie do filozofii, Kraków 2000;
[2] Buksiński T., Współczesne filozofie polityki, Poznań 2006;
[3] Stanford Encyclopedia of Philosophy, https://plato.stanford.edu/
[4] Tegmark, M., Życie 3.0. Człowiek w erze sztucznej inteligencji, Warszawa 2019.

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Prawo wynalazcze i autorskie**
Nazwa przedmiotu w języku angielskim: **Inventive Law and Copyright**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **wybieralny**
Kod przedmiotu: **W08MBM-SI0003**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	1				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Brak wymagań

CELE PRZEDMIOTU

C1. Zaznajomienie studentów z podstawowymi wiadomościami z zakresu prawa z uwzględnieniem systemu prawnomiędzynarodowego
C2. Przegląd podstawowych instytucji prawa
C3. Analiza przepisów prawnych

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Ma podstawową wiedzę niezbędną do zrozumienia prawnych uwarunkowań działalności inżynierskiej z zakresu własności przemysłowej i prawa autorskiego

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:
PEU_K01 - Rozumie prawne aspekty i skutki działalności inżynierskiej.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie i ogólna charakterystyka przedmiotu	1
Wy2	Przedmiot i podmiot prawa	2
Wy3	Główne problemy własności przemysłowej	2
Wy4	Główne problemy prawa autorskiego	2
Wy5	Autorskie prawa osobiste i ich ochrona	2
Wy6	Autorskie prawa majątkowe i ich ochrona	2
Wy7	Wybrane zagadnienia z zakresy prawa wynalazczego	2
Wy8	Podsumowanie i zaliczenie	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów
N2. prezentacja multimedialna
N3. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_K01	Aktywność w dyskusji, prezentacja, kazus
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA [1] R. Golat, Prawo autorskie i prawa pokrewne, C.H.Beck, 2010 [2] M. Barczewski, Traktatowa ochrona praw autorskich i praw pokrewnych, Wolters Kluwer Polska,2007 [3] M. Byrska, Wytyczne EWG w sprawie ochrony programów komputerowych a polski projekt prawa autorskiego, ZNUJ PWiOWI 1993 [4] Rejdak Monika, Nowe postępowanie w sprawach własności intelektualnej, lex 2020 komentarz praktyczny LITERATURA UZUPEŁNIAJĄCA [1] J. Barta, R. Markiewicz (red.) Prawo autorskie i prawa pokrewne. Komentarz, Warszawa 2011 [2] P. Slezak, Prawo autorskie. Wzory umów z komentarzem, Wolters Kluwer Polska - LEX, 2012

OPIEKUN PRZEDMIOTU
dr hab. inż. Mirosław Bocian tel.: 320-27-54 email: miroslaw.bocian@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Introduction to philosophy (Wstęp do filozofii)**
Nazwa przedmiotu w języku angielskim: **Introduction to philosophy**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **wybieralny**
Kod przedmiotu: **W08MBM-SI3002**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	2				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Brak wymagań wstępnych.

CELE PRZEDMIOTU

C1. Zapoznanie słuchaczy ze specyfiką myśli filozoficznej.
C2. Przyswojenie wiedzy na temat podstawowych metod uprawnionego wnioskowania regulującego i porządkującego nasze myślenie.
C3. Przedstawienie filozoficznych uwarunkowań działalności inżynierskiej.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - ma podstawową wiedzę niezbędną do zrozumienia prawnych, etyczno- społecznych, filozoficznych uwarunkowań działalności inżynierskiej

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:
PEU_K01 - ma świadomość ważności i zrozumienie humanistycznych aspektów i skutków działalności inżynierskiej; poznaje skutki wpływu działalności technicznej na środowisko, i związaną z tym odpowiedzialnością społeczną nauki i techniki;
PEU_K02 - prawidłowo identyfikuje i rozstrzyga dylematy związane z wykonywaniem zawodu; ma świadomość roli społecznej absolwenta uczelni technicznej; rozumie potrzebę formułowania i przekazywania społeczeństwu informacji i opinii dotyczących osiągnięć techniki i innych aspektów działalności inżyniera; potrafi przekazać taką informację i opinie w sposób zrozumiały, z uzasadnieniem różnych punktów widzenia;

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie (plan, cel i warunki zaliczenia)	2
Wy2	Co to jest filozofia?	2
Wy3	Filozofia a inne dziedziny wiedzy (1)	2
Wy4	Filozofia a inne dziedziny wiedzy (2)	2
Wy5	Wybrane zagadnienia z filozofii nauki i techniki (1)	2
Wy6	Wybrane zagadnienia z filozofii nauki i techniki (2)	2
Wy7	Poznanie jako klasyczny problem filozofii	2
Wy8	Wybrane zagadnienia z etyki	2
Wy9	Wybrane zagadnienia z filozofii społecznej (1)	2
Wy10	Wybrane zagadnienia z filozofii społecznej (2)	2
Wy11	Wybrane zagadnienia z filozofii polityki	2
Wy12	Elementy teorii argumentacji	2
Wy13	Pytanie o człowieka	2
Wy14	Kolokwium	2
Wy15	Podsumowanie i zaliczenie kursu	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. prezentacja multimedialna N3. dyskusja problemowa

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01	Kolokwium, wystąpienie końcowe lub praca pisemna
F2	PEU_K01, PEU_K02	Aktywność na zajęciach
P = (2*F!+F2)/3		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
[1] Blackburn S., Oksfordzki słownik filozoficzny, Warszawa 2004;
[2] Chalmers A., Czym jest to, co zwiemy nauką, Wrocław 1997;
[3] Grobler A., Metodologia nauk, Kraków 2004;
[4] Fry H., Hello World. Jak być człowiekiem w dobie maszyn?, Warszawa 2019.
[5] Martens E., Schnädelbach H., Filozofia. Podstawowe pytania, Warszawa 1995;
[6] Zuboff S., Wiek kapitalizmu inwigilacji, Warszawa 2020.

LITERATURA UZUPEŁNIAJĄCA
[1] Anzenbacher A., Wprowadzenie do filozofii, Kraków 2000;
[2] Buksiński T., Współczesne filozofie polityki, Poznań 2006;
[3] Stanford Encyclopedia of Philosophy, https://plato.stanford.edu/
[4] Tegmark, M., Życie 3.0. Człowiek w erze sztucznej inteligencji, Warszawa 2019.

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Patent and copyright (Prawo wynalazcze i autorskie)**
Nazwa przedmiotu w języku angielskim: **Inventive Law and Copyright Law**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **wybieralny**
Kod przedmiotu: **W08MBM-SI3003**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	1				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Brak wymagań

CELE PRZEDMIOTU

C1. Zaznajomienie studentów z podstawowymi wiadomościami z zakresu prawa z uwzględnieniem systemu prawnomiędzynarodowego
C2. Przegląd podstawowych instytucji prawa
C3. Analiza przepisów prawnych

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Ma podstawową wiedzę niezbędną do zrozumienia prawnych uwarunkowań działalności inżynierskiej z zakresu własności przemysłowej i prawa autorskiego

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:
PEU_K01 - Rozumie prawne aspekty i skutki działalności inżynierskiej

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie i ogólna charakterystyka przedmiotu	1
Wy2	Przedmiot i podmiot prawa	2
Wy3	Główne problemy własności przemysłowej	2
Wy4	Główne problemy prawa autorskiego	2
Wy5	Autorskie prawa osobiste i ich ochrona	2
Wy6	Wy6Autorskie prawa majątkowe i ich ochrona2	2
Wy7	Wybrane zagadnienia z zakresy prawa wynalazczego	2
Wy8	Podsumowanie i zaliczenie	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów
N2. prezentacja multimedialna
N3. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_K01	Aktywność w dyskusji,prezentacja, kazus
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
<u>LITERATURA PODSTAWOWA</u> [1] Hazel V.J Mioir, Patent Policy and Innovation: Do Legal Rules Deliver Effective Economic Outcomes? 2013 [2] I Toshiko Takenaka, ntellectual Property in Common Law and Civil Law, 2013 [3] David Booton, Form in Intellectual Property Law, 2017. <u>LITERATURA UZUPEŁNIAJĄCA</u>

OPIEKUN PRZEDMIOTU
dr hab. inż. Mirosław Bocian tel.: 320-27-54 email: miroslaw.bocian@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Podstawy zarządzania**
Nazwa przedmiotu w języku angielskim: **Essentials of Management**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0061**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	1				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Brak wymagań wstępnych.

CELE PRZEDMIOTU

C1. Przyswojenie wiedzy z zakresu procesu zarządzania i jego elementów.
C2. Przyswojenie wiedzy na temat istoty i mechanizmów budowania i funkcjonowania organizacji.
C3. Przyswojenie wiedzy dotyczącej podstawowych instrumentów i narzędzi zarządzania, wykorzystania ich w organizacji oraz analizy problemów zarządzania.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Student potrafi scharakteryzować podstawowe mechanizmy funkcjonowania organizacji, rozróżniać typy organizacji, ich elementy składowe oraz rozpoznawać elementy otoczenia, które wpływają na funkcjonowanie poszczególnych podsystemów w organizacjach.
PEU_W02 - Student potrafi definiować proces zarządzania i jego elementy oraz zna podstawowe metody i techniki zarządzania w ramach poszczególnych funkcji zarządzania: planowania, organizowania, przewodzenia i kontrolowania.
PEU_W03 - Student potrafi formułować zakres i obszary wpływu organizacji na otoczenie w zależności od zidentyfikowanych decyzji podejmowanych przez menedżerów w organizacjach.

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:
PEU_K01 - Student ma świadomość wpływu otoczenia na decyzje podejmowane w organizacji i decyzji podejmowanych w organizacji na otoczenie.
PEU_K02 - Student ma świadomość roli planowania, organizowania, przewodzenia i kontrolowania oraz technik stosowanych i narzędzi stosowanych w każdej z tych funkcji zarządzania na sprawne i skuteczne funkcjonowanie organizacji jako całości.
PEU_K03 - Student ma świadomość istoty innowacji i przedsiębiorczości dla otoczenia.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Organizacja i jej zasoby. Pojęcie zarządzania. Proces zarządzania i jego elementy. Menedżer i jego praca.	2
Wy2	Otoczenie organizacji i jego elementy. Wpływ otoczenia na organizację. Wybrane metody analizy otoczenia.	2
Wy3	Funkcja planowania w organizacji. Wyznaczanie celów. Hierarcha celów. Rodzaje planów w organizacjach. Proces podejmowania decyzji. Strategia i zarządzanie strategiczne. Marketing i planowanie marketingowe.	2
Wy4	Funkcja organizowania. Struktury organizacyjne. Zarządzanie zasobami ludzkimi i jego elementy. Narzędzia i techniki zarządzania zasobami ludzkimi.	2
Wy5	Funkcja przewodzenia. Podstawy zachowań jednostek w organizacjach. Przywództwo i władza. Style kierowania. Motywowanie. Wybrane techniki motywacyjne.	2
Wy6	Funkcja kontrolowania. Etapy i dziedziny kontroli. Kreatywność, innowacyjność i wiedza. Pojęcie i rodzaje innowacji.	2
Wy7	Pojęcie przedsiębiorczości. Rola przedsiębiorczości w gospodarce. Gospodarka oparta na wiedzy.	2
Wy8	Kolokwium zaliczeniowe / Kolokwium zaliczeniowe on-line	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01-W03	kolokwium
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

1. Griffin R.W., Podstawy zarządzania organizacjami, PWN, Warszawa 2022.
2. Koźmiński A.K., Piotrowski W.Zarządzanie. Teoria i praktyka, PWN, Warszawa, 2019.
3. Krzakiewicz K., Cyfert S., Podstawy zarządzania organizacjami, Wydawnictwo UE w Poznaniu, 2020.
4. DeCenzo D.A., Robbins S.P., Podstawy zarządzania, PWE, Warszawa, 2019.

LITERATURA UZUPEŁNIAJĄCA

1. Masłyk-Musiał E., Rakowska A., Krajewska-Bińczyk E., Zarządzanie dla inżynierów, PWE, Warszawa, 2012.
2. Hatch M.J., Teoria organizacji, PWN, Warszawa, 2002.
3. Glinka B., Gudkova S., Przedsiębiorczość, Wolters Kluwer Business, 2011.
4. Aulet B., Przedsiębiorczość zdyscyplinowana. Od startupu do sukcesu w 24 krokach, 2015.
5. Prasa i portale o tematyce zarządzania i przedsiębiorczości.

OPIEKUN PRZEDMIOTU
dr inż. Mateusz Molasy tel.: 713202662 email: mateusz.molasy@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Ergonomia i BHP**
Nazwa przedmiotu w języku angielskim: **Ergonomics and Safety**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0062**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	1				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. ma podstawową wiedzę z zakresu charakterystyki i właściwości czynników fizycznych (energia el., drgania mechaniczne, oświetlenie, pole EM, pyły), chemicznych i biologicznych
2. ma uporządkowaną wiedzę z zakresu matematyki rachunkowej, fizyki, chemii i informatyki

CELE PRZEDMIOTU

C1. Nabycie podstawowej wiedzy z obszaru prawa pracy oraz z zakresu wypadków przy pracy i chorób zawodowych
C2. Nabycie podstawowej wiedzy z zakresu ergonomii oraz biomechaniki pracy
C3. Nabycie podstawowej wiedzy z dziedziny analizy i ochrony przed czynnikami niebezpiecznymi, szkodliwymi i uciążliwymi w środowisku pracy

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - zna podstawowe przepisy i zasady bezpieczeństwa i higieny pracy
PEU_W02 - posiada wiedzę z podstaw ergonomii oraz jest świadomy możliwości praktycznego jej zastosowania w projektowaniu i wytwarzaniu wyrobów
PEU_W03 - zna podstawowe zagrożenia występujące na stanowiskach pracy oraz metody ochrony przed nimi

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Ochrona pracy, przepisy i zasady BHP	2
Wy2	Wypadki przy pracy i choroby zawodowe	2
Wy3	Ocena ryzyka zawodowego na stanowisku pracy	2
Wy4	Ergonomia jako nauka interdyscyplinarna	2
Wy5	Biomechanika pracy - nauka o wykrywaniu zagrożeń dla zdrowia pracownika, będących skutkiem wykonywanej pracy	2
Wy6	Czynniki niebezpieczne i szkodliwe w środowisku pracy - czynniki mechaniczne i energia elektryczna	2
Wy7	Czynniki niebezpieczne i szkodliwe w środowisku pracy - hałas, drgania mechaniczne, oświetlenie	2
Wy8	Podsumowanie zajęć, zaliczenie	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. dyskusja problemowa N3. konsultacje N4. praca własna – samodzielne studia i przygotowanie do egzaminu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01 - PEU_W03	kolokwium zaliczeniowe
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA Monika Blaszczok - Ergonomia bezpiecznej i higienicznej pracy, Politechnika Śląska, Gliwice 2018 LITERATURA UZUPEŁNIAJĄCA B. Rączkowski - BHP w praktyce, ODDK, Gdańsk 2022

OPIEKUN PRZEDMIOTU
dr inż. Jacek Iwko tel.: 42-54 email: jacek.iwko@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Podstawy metrologii**
Nazwa przedmiotu w języku angielskim: **Fundamentals of metrology**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0063**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	1				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma podstawową wiedzę w zakresie matematyki i fizyki na poziomie szkoły średniej.

CELE PRZEDMIOTU

C1. Zrozumienie istoty pomiarów dla poznania stanu rzeczywistego i współzależności wielkości fizycznych.
C2. Poznanie podstawowych pojęć metrologicznych, systemu jednostek miar SI i zasad wykonywania pomiarów podstawowych wielkości fizycznych oraz właściwości podstawowych czujników i przyrządów pomiarowych.
C3. Zapoznanie się ze sposobami przetwarzania sygnałów pomiarowych, systemami pomiarowymi i zasadami właściwego zaplanowania procesu pomiarowego.
C4. Nabycie podstawowej wiedzy o czynnikach zakłócających pomiary.
C5. Nabycie podstawowej wiedzy o planowaniu eksperymentu i opracowywaniu wyników pomiarów wraz z ich niepewnością.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Ma podstawową wiedzę w zakresie metrologii, rozumie istotę pomiarów i zna metody pomiarów.
PEU_W02 - Zna podstawowe właściwości przyrządów i systemów pomiarowych.
PEU_W03 - Ma podstawową wiedzę o dokładności i niepewności pomiarów.

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:
PEU_K01 - Wyszukiwanie informacji oraz jej krytycznej analizy
PEU_K02 - Obiektywne ocenianie argumentów, racjonalne tłumaczenie i uzasadnianie własnego punktu widzenia z wykorzystaniem wiedzy z zakresu podstaw metrologii.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Sprawy organizacyjne. Podstawowe pojęcia metrologii.	1
Wy2	Wielkości i jednostki miar. Układy jednostek miar. Układ SI, wzorce jednostek miar, układ hierarchiczny wzorców jednostek miar.	2
Wy3	Metody pomiarowe, rodzaje i klasyfikacja. Przykłady zastosowań.	2
Wy4	Przyrządy pomiarowe analogowe i cyfrowe: rodzaje; elementy składowe; układy wejściowe i wyjściowe; przetworniki analogowo-cyfrowe; rola mikroprocesorów i komputera zewnętrznego; właściwości metrologiczne i użytkowe; wpływ wielkości zakłócających.	4
Wy5	Niepewność pomiarów i opracowywanie wyników: źródła niepewności pomiarów; podział i zasady szacowania, obliczanie niepewności standardowej typu A.	2
Wy6	Obliczanie niepewności standardowej typu B oraz rozszerzonej na odpowiednim poziomie ufności. Sposoby opracowywania wyników i ich prezentacji.	2
Wy7	Kolokwium	2

	Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. praca własna – samodzielne studia i przygotowanie do egzaminu N3. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01 - PEU_W03	Kolokwium
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
[1] M. Lisowski: Podstawy metrologii. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2011.
[2] J. Ciepłucha: Podstawy metrologii. Wyd. II. Wydawnictwo Politechniki Łódzkiej. Łódź 2008
[3] J. Arendarski: Niepewność pomiarów. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2006.

LITERATURA UZUPEŁNIAJĄCA
[1] J. Piotrowski: Podstawy miernictwa. WNT, Warszawa 2002.
[2] J. Jaworski, R. Morawski, J. Olędzki: Wstęp do metrologii i techniki eksperymentu. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 1992.
[3] J. Piotrowski, K. Kostyro: Wzorcowanie aparatury pomiarowej. WNT, Warszawa 2000.
[4] T. Skubis: Postawy metrologicznej interpretacji wyników pomiarów. Wydawnictwo Politechniki Śląskiej. Gliwice 2004.
[5] S. Białas: Metrologia techniczna z podstawami tolerowania wielkości geometrycznych dla mechaników. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2006.
[6] P.H. Sydenham: Podręcznik metrologii. Tom II. WKiŁ, Warszawa 1990.
[7] Międzynarodowy słownik podstawowych i ogólnych terminów metrologii. Wyd. Główny Urząd Miar, Warszawa 1996.
[8] Wyrażanie niepewności pomiaru – przewodnik. Wyd. Główny Urząd Miar, Warszawa 1996.
[9] Wyrażanie niepewności pomiaru przy wzorcowaniu. Dokument EA-4/02, Europejska Współpraca w Dziedzinie Akredytacji. Wyd. Główny Urząd Miar, Warszawa 1999.

OPIEKUN PRZEDMIOTU
dr inż. Marek Kuran tel.: 27-28 email: marek.kuran@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Technologie informacyjne**
Nazwa przedmiotu w języku angielskim: **Information Technologies**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0064**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	2				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Podstawowa wiedza na temat funkcjonowania komputerów wyniesiona ze szkoły średniej

CELE PRZEDMIOTU

C1. Przedstawienie w przystępny sposób historii liczenia i komputerów.
C2. Opis wewnętrznej struktury komputerów i podstawowych algorytmów wykonywania obliczeń na liczbach całkowitych i zmiennoprzecinkowych; omówienie przyczyn i natury powstających błędów podczas operacji arytmetycznych
C3. Przedstawienie istoty algorytmu, sposobów zapisu algorytmów, prezentacja podstawowych metod tworzenia algorytmów. Omówienie istoty błędów oprogramowania i podstaw złożoności obliczeniowej algorytmów.
C4. Przedstawienie podstawowych pojęć z zakresu ochrony własności intelektualnej, prawa autorskiego, prawa patentowego i znaków towarowych

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - W wyniku przeprowadzonych zajęć student powinien być w stanie zdefiniować podstawowe pojęcia związane z informacją i jej przetwarzaniem
PEU_W02 - Po zakończeniu kursu student powinien być w stanie opisać i wytłumaczyć algorytmy oraz podstawowe sposoby ich konstruowania, a także zdefiniować różne przyczyny powstawania błędów oraz sposoby ich usuwania.
PEU_W03 - Ma elementarną wiedzę w zakresie ochrony własności intelektualnej oraz prawa patentowego.

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Program kursu. Wymagania. Sposób zaliczenia. Informacja.	2
Wy2	Krótka historia matematyki i historia rozwoju systemów komputerowych.	2
Wy3	Arytmetyka komputerów	2
Wy4	Arytmetyka liczb niecałkowitych; błędy absolutne	2
Wy5	Architektura komputerów	2
Wy6	Wprowadzenie do algorytmów	2
Wy7	Algorytmy (część I)	2
Wy8	Sposób zapisu algorytmów (Algorytmy część II)	2
Wy9	Maszyna Turinga (Algorytmy part III)	2
Wy10	Metody algorytmiczne (Algorytmy część IV)	2
Wy11	Czy komputery mogą się mylić?	1
Wy12	Złożoność obliczeniowa	1
Wy13	Zarys prawa Autorskiego	2

Wy14	Zarys prawa patentowego	2
Wy15	Znaki towarowe	2
Wy16	Kolokwium zaliczeniowe	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01-PEU_W03, PEU_K01	kolokwium zaliczeniow
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA 1. Harel D., Feldman Y.A.: Rzecz O Istocie Informatyki: Algorytmika Wydawnictwa Naukowo-Techniczne 2. Gleick J.: Informacja. Bit, wszechświat, rewolucja, Znak LITERATURA UZUPEŁNIAJĄCA 1. Michniewicz, G.,Ochrona własności intelektualnej, PWN 2. Żelazowska W., Prawo własności przemysłowej, C.H. Beck

OPIEKUN PRZEDMIOTU
dr inż. Wojciech Myszka tel.: +48(71)3203269 email: Wojciech.Myszka@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Grafika inżynierska - geometria wykreślna**
Nazwa przedmiotu w języku angielskim: **Engineering Graphics: Descriptive Geometry**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0065**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15	30			
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30	60			
Forma zaliczenia	Zaliczenie na ocenę	Zaliczenie na ocenę			
Grupa kursów					
Liczba punktów ECTS	1	2			
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		2			
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6	1.4			

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Znajomość podstawowych twierdzeń geometrii euklidesowej.
2. Umiejętność posługiwania się przyborami kreślarskimi.
3. Umiejętność kreślenia podstawowych konstrukcji geometrycznych (np. podział odcinka na n równych części, kreślenie sześciokąta foremnego).

CELE PRZEDMIOTU

C1. Opanowanie teoretycznych i praktycznych podstaw metody Monge'a wykreślnego odwzorowania tworów geometrycznych na płaszczyźnie rysunku, stanowiącej podstawę zapisu konstrukcji (rysunku technicznego).
C2. Opanowanie podstaw restytucji tworów geometrycznych na podstawie rzutów Monge'a.
C3. Nabycie umiejętności rozwiązywania zadań miarowych (wykreślne wyznaczanie odległości, kątów, wielkości rzeczywistej).

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Ma uporządkowaną wiedzę dotyczącą odwzorowania na płaszczyźnie rysunku tworu geometrycznego metodą Monge'a oraz elementarną wiedzę z zakresu aksonometrii.
PEU_W02 - Potrafi wskazać odpowiedni algorytm rozwiązania zadania z zakresu odwzorowania położenia i wzajemnych relacji w przestrzeni tworów geometrycznych, a także określania związków miarowych.
PEU_W03 - Potrafi zinterpretować rysunek, wykonany wg metody Monge'a, przedstawiający usytuowanie elementu lub tworu geometrycznego w przestrzeni.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi praktycznie zastosować zasady rzutowania metodą Monge'a w celu odwzorowania elementów i tworów geometrycznych (w tym brył) na płaszczyźnie rysunku.
PEU_U02 - Umie wyznaczyć wielkości rzeczywiste charakteryzujące zagadnienie miarowe geometrii wykreślnej.
PEU_U03 - Potrafi na podstawie rzutów Monge'a przeprowadzić restytucję tworu geometrycznego i przedstawić jej rezultat za pomocą rzutu aksonometrycznego.

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Podstawowe definicje i zasady rzutowania równoległego, prostokątnego wg Monge'a; odwzorowania podstawowych elementów geometrycznych (punktu, prostej, płaszczyzny); relacja przynależności.	1
Wy2	Wyznaczanie elementów wspólnych - krawędzi i punktów przebicia; elementy równoległe i prostopadłe.	2
Wy3	Transformacja położenia (obrót, kład, podniesienie z kładu) i transformacja układu odniesienia (zastosowanie dodatkowej rzutni).	2
Wy4	Bryły - definicje; przekrój bryły jako zbiór elementów wspólnych bryły i płaszczyzny tnącej, punkty przebicia bryły przez prostą.	2
Wy5	Wykrawanie brył zespołem płaszczyzn rzutujących - modyfikacja wyjściowej postaci bryły; rozwinięcia brył.	2
Wy6	Przenikanie brył - definicja linii przenikania, zastosowanie pomocniczych płaszczyzn tnących oraz transformacji układu odniesienia.	2

Wy7	Rzutowanie na trzy wzajemnie prostopadłe płaszczyzny; podstawy aksonometrii; uzupełnianie brakującego rzutu bryły - wykorzystanie rzutu aksonometrycznego.	2
Wy8	Kolokwium zaliczeniowe.	2
		Suma: 15
Forma zajęć – Ćwiczenia		Liczba godzin
Ćw1	Informacje dotyczące przyborów kreślarskich i zasad kreślenia konstrukcji geometrycznych. Rzuty punktu i prostej, odwzorowanie płaszczyzny za pomocą jej śladów; identyfikacja położenia podstawowych elementów geometrycznych w przestrzeni w układzie dwóch prostopadłych rzutni.	2
Ćw2	Identyfikacja przynalezności podstawowych elementów geometrycznych, uzupełnianie brakującego rzutu; szczególne położenia elementów geometrycznych.	2
Ćw3	Krawędź jako element wspólny dwóch płaszczyzn. Punkt przebicia jako element wspólny prostej i płaszczyzny. Przypadki szczególne wyznaczania elementów wspólnych.	2
Ćw4	Krawędź między figurami płaskimi (zastosowanie pomocniczych płaszczyzn rzutujących); punkt przebicia prostą figury płaskiej. Identyfikacja i konstruowanie relacji równoległości i prostopadłości podstawowych elementów geometrycznych.	2
Ćw5	Obrót i kład podstawowych elementów geometrycznych (obrót odcinka, płaszczyzny); zastosowanie transformacji położenia w zagadnieniach miarowych (wyznaczanie wielkości rzeczywistej odcinka, kąta, figury płaskiej).	2
Ćw6	Wyznaczanie rzutów płaskich tworów geometrycznych o zadanych parametrach i zadanym położeniu w przestrzeni (podniesienie z kładu figury płaskiej). Zastosowanie transformacji układu odniesienia w zagadnieniach miarowych oraz identyfikacji relacji położenia (kąt nachylenia płaszczyzny względem rzutni, odległość punktu od płaszczyzny, wyznaczanie rzutów punktu o zadanej odległości od płaszczyzny).	2
Ćw7	Kolokwium K1 (obejmuje materiał ćwiczeń 1 - 6)	2
Ćw8	Odwzorowanie brył elementarnych w rzutach Monge'a, identyfikacja punktów i odcinków prostych należących do ścian brył; wyznaczanie przekrojów wielościanów płaszczyznami rzutującymi.	2
Ćw9	Wyznaczanie przekrojów wielościanów płaszczyznami dowolnymi. Wyznaczanie przekrojów brył zawierających powierzchnie. Wyznaczanie punktów przebicia brył przez proste (zastosowanie pomocniczych płaszczyzn tnących zawierających prostą przebijającą).	2
Ćw10	Rozwinięcie wielościanu oraz bryły zawierającej powierzchnię prostokreślną. Wykrawanie brył płaszczyznami rzutującymi jako modyfikacja wyjściowej postaci bryły - wykrawanie wielościanu.	2
Ćw11	Wykrawanie bryły obrotowej. Wyznaczanie linii przenikania wielościanów.	2
Ćw12	Wyznaczanie linii przenikania brył zawierających powierzchnie.	2
Ćw13	Odwzorowanie bryły na trzech wzajemnie prostopadłych rzutniach. Modyfikacja bryły za pomocą płaszczyzny rzutującej względem jednej z rzutni.	2

Ćw14	Odwzorowanie bryły za pomocą rzutu aksonometrycznego. Wyznaczanie brakującego rzutu bryły zmodyfikowanej za pomocą płaszczyzn tnących. Relacja: rzuty Monge'a - rzut aksonometryczny.	2
Ćw15	Kolokwium nr 2 (obejmuje materiał ćwiczeń 8 - 14).	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład problemowy N2. ćwiczenia problemowe N3. praca własna - przygotowanie do projektu N4. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W03	kolokwium zaliczeniowe
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Ćwiczenia)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02	kolokwium nr 1, ocena co najmniej dostateczna
F2	PEU_U01, PEU_U02, PEU_U03	kolokwium nr 2, ocena co najmniej dostateczna
P = F3		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
<u>LITERATURA PODSTAWOWA</u> [1] Lewandowski Z., Geometria wykreślna, PWN, Warszawa 1980 (i późniejsze wydania), [2] Otto F., Otto E., Podręcznik geometrii wykreślnej, PWN, Warszawa 1998, [3] Zbiór zadań z geometrii wykreślnej, red. Nowakowski T., Oficyna Wyd. Politechniki Wrocławskiej, Wrocław 2001, [4] Bieliński A., Geometria wykreślna, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2005 <u>LITERATURA UZUPEŁNIAJĄCA</u> [1] Szerszeń S., Nauka o rzutach, PWN, Warszawa 1974 (i późniejsze wydania), [2] Przewłocki S., Geometria wykreślna w budownictwie, Wyd. Arkady, Warszawa 1997, [3] Bogaczyk T., Romaszkiewicz-Białas T., 13 wykładów z geometrii wykreślnej, Oficyna Wyd. Politechniki Wrocławskiej, Wrocław 1997, [4] Błach A., Geometria. Przegląd wybranych zagadnień dla uczniów i studentów. Arkady, Warszawa 1998.

OPIEKUN PRZEDMIOTU
dr inż. Marta Kozuń tel.: 320-27-13 email: marta.kozun@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Chemia**

Nazwa przedmiotu w języku angielskim: **Chemistry**

Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**

Poziom i forma studiów: **I stopień, stacjonarne**

Rodzaj przedmiotu: **obowiązkowy**

Kod przedmiotu: **W10MBM-SI0066**

Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	2				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. zakres chemii i fizyki szkoły średniej

CELE PRZEDMIOTU

C1. Zapoznanie studentów z tymi działami chemii, których znajomość jest potrzebna w toku dalszego studiowania przedmiotów pokrewnych z chemią np. materiałoznawstwa, metaloznawstwa, tworzyw sztucznych.
C2. Zapoznanie studentów z podstawową wiedzą chemiczną umożliwiającą zrozumienie praw i reguł chemicznych oraz właściwości fizykochemicznych materiałów stosowanych w technice ze szczególnym uwzględnieniem metali, stopów i polimerów.
C3. Nabycie przez studentów umiejętności łączenia wiedzy z zakresu chemii i takich przedmiotów jak na przykład fizyka, materiałoznawstwo, ekologia.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Ma podstawową wiedzę chemiczną z zakresu budowy materii, stanów skupienia. Zna właściwości substancji w poszczególnych stanach skupienia.
PEU_W02 - Ma podstawową wiedzę z zakresu chemii nieorganicznej z szczególnym uwzględnieniem budowy metali, stopów, przewodnictwa elektronowego. Ma podstawową wiedzę z zakresu chemii organicznej ze szczególnym uwzględnieniem paliw oraz polimerów.
PEU_W03 - Ma podstawową wiedzę z zakresu optyki i nanotechnologii.

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Budowa atomu, kryteria podziału i struktura materii, pierwiastki, związki.	2
Wy2	Układ okresowy pierwiastków, struktura, grupy pierwiastków, konfiguracja elektronowa, odmiany alotropowe, izotopy.	4
Wy3	mechanizmy wiązania chemicznego (jonowe, atomowe, metaliczne), charakterystyka przykładowych materiałów jonowych, kowalencyjnych i metalicznych, przyczyny ich właściwości.	2
Wy4	Charakterystyka podstawowych stanów skupienia; analiza przyczyn i skutków takich wielkości jak ciśnienie, dyfuzja, gęstość, lepkość, napięcie powierzchniowe, zwilżalność; wstępna charakterystyka ciał amorficznych i krystalicznych	4
Wy5	Metale - przyczyny plastyczności, przewodnictwa elektronowego i cieplnego, połysku i nieprzeźroczystości; charakterystyka stopów - kryteria podziału, budowa, zastosowanie podstawowych stopów	4
Wy6	Przewodnictwo - teoria pasmowa, nadprzewodniki, mechanizm przewodzenia prądu w półprzewodnikach "p" i "n"	2

Wy7	Mieszaniny - kryteria podziału, charakterystyka roztworów właściwych (mechanizmy rozpuszczalności), koloidów i zawiesin, mechanizm rozproszenia światła, stężenia	2
Wy8	Elementy krystalografii, komórka elementarna, centrowanie, elementy symetrii, defekty struktury.	4
Wy9	Podstawy chemii organicznej: węglowodory, izomery, gaz ziemny, ropa naftowa - produkty; wstęp do polimerów, charakterystyka wybranych materiałów polimerowych	4
Wy10	Zajęcia zaliczeniowe – kolokwium.	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. wykład informacyjny
N2. wykład tradycyjny z wykorzystaniem transparencji i slajdów
N3. konsultacje
N4. praca własna – samodzielne studia i przygotowanie do egzaminu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01 - PEU_W03	kolokwium zaliczeniowe
P = P		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
Wiarygodne strony internetowe, notatki z wykładu

LITERATURA UZUPEŁNIAJĄCA
opracowania tematyczne dotyczące prezentowanych na Wykładzie zagadnień

OPIEKUN PRZEDMIOTU
dr hab. Marek Jasiorski tel.: 320-32-21 email: marek.jasiorski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Maszynoznawstwo**
Nazwa przedmiotu w języku angielskim: **Theory of Machines**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0067**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	1				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Student ma uporządkowaną wiedzę na temat procesów fizycznych i chemicznych w zakresie szkoły średniej.
2. Student posiada elementarną umiejętność kojarzenia zasad działania wybranych maszyn i pojazdów ze znanymi prawami fizyki i chemii jako podstawy ich funkcjonowania.
3. Student potrafi wykorzystywać posiadaną wiedzę do analizy sposobów działania prostych układów mechanicznych.

CELE PRZEDMIOTU

C1. Poznanie ogólnych zasad działania maszyn i urządzeń oraz ich roli we współczesnym świecie.
C2. Nabycie wiedzy i umiejętności analizy materialnej i funkcjonalnej postaci (struktury) maszyny. Określenie relacji między silnikiem, organami roboczymi i układem napędowym. Zapoznanie się z dyrektywą maszynową UE i jej wymaganiami.
C3. Nabycie podstawowej wiedzy w zakresie związków maszyny z otoczeniem technicznym, będących podstawą procesu konstrukcji maszyn.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Rozumie rolę maszyn i urządzeń we współczesnej technice. Zna podstawowe zasady działania i budowy maszyn roboczych i pojazdów oraz silników jako źródeł energii mechanicznej.
PEU_W02 - W wyniku przeprowadzonych zajęć student ma świadomość struktury podziału maszyn ze względu na funkcję oraz konstrukcję, umiejąc jednocześnie dokonać identyfikacji poszczególnych podzespołów maszyn oraz układów maszynowych.

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie. Omówienie zakresu wykładu i wymagań zaliczeniowych. Rola techniki w rozwoju cywilizacji.	1
Wy2	Pojęcie techniki i systemu technicznego. Macierz transformacji materii, energii i informacji. Definicje maszyn: klasyczna, funkcjonalna oraz UE.	2
Wy3	Analogie występujące pomiędzy środowiskami fizycznymi.	1
Wy4	Klasyfikacja maszyn. Przykłady maszyn i systemów maszynowych.	2
Wy5	Konstrukcja, zasada działania oraz podstawowe parametry silników stosowanych w napędach maszyn.	2
Wy6	Pojęcie układu napędowego. Funkcje realizowane przez układy napędowe maszyn i urządzeń oraz ich struktura. Przykładowe charakterystyki obciążeń.	2
Wy7	Typowe elementy wykorzystywane w konstrukcji maszyn.	2
Wy8	Podstawy systemów sterowania maszyn, układy automatycznej regulacji, pojęcie systemu mechatronicznego. Podstawowe definicje i struktura układów mechatronicznych.	2
Wy9	Pisemne kolokwium zaliczeniowe.	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład informacyjny N2. prezentacja multimedialna

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02	kolokwium
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

[1] Biały W.: Maszynoznawstwo. WNT, Warszawa 2003.
[2] Chwiej M. Maszynoznawstwo ogólne. PWN, Warszawa 1983 (IV wyd.).
[3] Wołek M.: Maszynoznawstwo ogólne. PWN, Warszawa 1978.
[4] Orlik Z.: Maszynoznawstwo. WSziP, Warszawa 1989.
[5] Gnutek Z., Kordylewski W.: Maszynoznawstwo energetyczne. Wyd. Politechniki Wrocławskiej, Wrocław 2003.
[6] Mille A., Kijewski J., Pawlik K., Szolc T.: Maszynoznawstwo. WSziP, Warszawa 2003.
[7] Olszewska M. (red.): Podstawy mechatroniki. Wyd. REA. Warszawa 2006.
[8] Schmid D. (red.): Mechatronika. Wyd. REA. Warszawa 2002.

LITERATURA UZUPEŁNIAJĄCA

[1]Hryniewicz A.: Energia. Wyzwanie XXI wieku. Wyd. Uniwersytetu Jagielońskiego, Kraków 2002.
[2]Krick E.U.: Wprowadzenie do techniki i projektowania technicznego. WNT, Warszawa 1975.
[3]Szumanowski A.: Czas energii. WKiŁ, Warszawa 1988.
[4]Charles Panati: Niezwykłe dzieje zwykłych rzeczy. Książka i Wiedza, Warszawa 2004.
[5]Encyklopedia Techniki. MUZA SA.
[6] Pritschow G.: Techika sterowania obrabiarkami i robotami przemysłowymi. Oficyna Wyd. Politechniki Wrocławskiej 1993.
[7] Ochoa G., Corey M.: Kalendarium nauki i techniki. Wyd. Zysk i S-ka, Poznań.

OPIEKUN PRZEDMIOTU
dr inż. Tomasz Siwulski tel.: 71 320-28-92 email: tomasz.siwulski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Technologia materiałów inżynierskich**
Nazwa przedmiotu w języku angielskim: **Engineering Materials Technology**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0068**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60		60		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	2		2		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			2		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2		1.4		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma podstawową wiedzę z dziedzin fizyki i matematyki. Potrafi posługiwać się podstawowymi przyrządami pomiarowymi, np. suwmiarką.
2. Potrafi analizować informacje, które są zawarte w instrukcjach do ćwiczeń laboratoryjnych.
3. Wykazuje umiejętność pracy w zespole.

CELE PRZEDMIOTU

C1. Poznanie procesów metalurgicznych przetwarzania rud metali, otrzymywania stali i metali nieżelaznych.
C2. Poznanie podstawowych metod badania właściwości mechanicznych stali i metali nieżelaznych oraz zasad formowania wyrobów metodami metalurgii proszków.
C3. Nabywanie i utrwalanie kompetencji społecznych polegających na umiejętności pracy w grupie studenckiej mającej na celu efektywne rozwiązywanie problemów.
C4. Nabycie wiedzy o podstawowych właściwościach mechanicznych materiałów inżynierskich, takich jak: wytrzymałość na rozciąganie, wytrzymałość na ściskanie, udarność, twardość poprzez udział w badaniach wybranych materiałów.
C5. Nabycie wiedzy o sposobach wykonywania badań nieniszczących, takich jak: metody wizualne, penetracyjne, magnetyczne, radiologiczne i ultradźwiękowe poprzez udział w ich przeprowadzaniu na przykładowych częściach.
C6. Nabycie wiedzy w zakresie prób technologicznych oraz formowania wyrobów metodą metalurgii proszków poprzez udział w eksperymencie.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - W wyniku przeprowadzonych zajęć wykładowych student powinien być w stanie zdefiniować podstawowe właściwości fizyczne materiałów inżynierskich, wymienić i opisać sposoby przetwarzania rud metali, scharakteryzować procesy metalurgiczne otrzymywania metali i stopów metali.
PEU_W02 - W wyniku przeprowadzonych zajęć laboratoryjnych student powinien być w stanie zdefiniować właściwości mechaniczne metali i stopów, opisać metody badań niszczących i nieniszczących, scharakteryzować metody przeprowadzania prób technologicznych.
PEU_W03 - W wyniku przeprowadzonych zajęć student powinien być w stanie rozróżniać podstawowe materiały inżynierskie, scharakteryzować ich właściwości fizyczne i mechaniczne, zidentyfikować metody badań właściwości materiałów inżynierskich.

II. Z zakresu umiejętności:
PEU_U01 - W wyniku przeprowadzonych wykładów student powinien umieć analizować procesy metalurgiczne otrzymywania metali, porównywać właściwości materiałów inżynierskich.
PEU_U02 - W wyniku przeprowadzonych zajęć laboratoryjnych student powinien umieć przeprowadzić w ograniczonym zakresie podstawowe próby wytrzymałościowe rozciągania, ściskania, udarności i pomiarów twardości oraz próby technologiczne.
PEU_U03 - W wyniku przeprowadzonych zajęć student powinien umieć pozyskiwać informacje z literatury, mieć umiejętność samokształcenia się, wykonać pomiary, wyznaczać wartości oraz oceniać pewność podstawowych właściwości mechanicznych.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Wykazuje umiejętności potrzebne w zespołowej współpracy dotyczącej doskonalenia metod wyboru strategii mającej na celu optymalne rozwiązywanie powierzonych grupie problemów.
PEU_K02 - Potrafi obiektywnie oceniać argumenty, racjonalnie tłumaczyć i uzasadniać własny punkt widzenia z wykorzystaniem wiedzy z zakresu podstawowych zagadnień inżynierii materiałowej.
PEU_K03 - Przestrzega obyczaje i zasady obowiązujące w środowisku akademickim.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład	Liczba godzin

Wy1	Sprawy organizacyjne.	1
Wy2	Ogólne wiadomości o właściwościach materiałów inżynierskich. Materiały ogniotrwałe i paliwa w procesach pirometalurgicznych.	2
Wy3	Metalurgia żelaza. Przetwórstwo rud, proces wielkopiecowy.	2
Wy4	Wytwarzanie stali, wpływ domieszek na właściwości stali.	2
Wy5	Metalurgia miedzi. Przetwórstwo rud, procesy pirometalurgiczne i hydrometalurgiczne wytwarzania miedzi i ich stopów.	2
Wy6	Metalurgia aluminium. Przetwórstwo rud, procesy otrzymywania tlenku aluminium i wytwarzania oraz rafinacji aluminium.	2
Wy7	Metalurgia cynku. Przetwórstwo rud, procesy pirometalurgiczne i hydrometalurgiczne wytwarzania cynku i jego stopów.	2
Wy8	Otrzymywanie metali trudnotopliwych metodami metalurgii proszków oraz techniki wytwarzania wyrobów z proszków metali.	2
		Suma: 15
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Sprawy organizacyjne, warunki BHP.	1
Lab2	Ogólne wiadomości o metalach i stopach technicznych - wytwarzanie stopów.	2
Lab3	Statyczna próba rozciągania metali.	2
Lab4	Styczna próba ściskania metali i próba udarności.	2
Lab5	Pomiary twardości metali i stopów.	2
Lab6	Badania nieniszczące.	2
Lab7	Próby technologiczne.	2
Lab8	Wytwarzanie elementów maszyn z proszków metali.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. praca własna – przygotowanie do laboratorium N3. eksperyment laboratoryjny N4. przygotowanie sprawozdania N5. praca własna – samodzielne studia i przygotowanie do egzaminu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się

F1	PEU_W01, PEU_W02, PEU_W03	Kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01-PEU_U03, PEU_K01-PEU_K03	Odpowiedzi ustne, kartkówki
P = średnia z F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
1. Mirski Z., Technologia i badanie materiałów inżynierskich : laboratorium. Oficyna Wydawnicza Politechniki Wrocławskiej, 2017.
2. Krynicki L., L. Sozański, Technologia metali. Wydawnictwo Politechniki Wrocławskiej, 1994.

LITERATURA UZUPEŁNIAJĄCA
Materiały uzupełniające do ćwiczeń nr 1-5. Biblioteka W10 (bud. B4, III piętro).

OPIEKUN PRZEDMIOTU

dr inż. Tomasz Wojdat tel.: (71) 320 40 68 email: tomasz.wojdat@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Termodynamika techniczna**
Nazwa przedmiotu w języku angielskim: **Applied thermodynamics**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0069**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60		60		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	2		2		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			2		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2		1.4		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Znajomość zagadnień objętych programem nauczania fizyki w zakresie przedmiotu Fizyka
2. Umiejętność samodzielnego wykonywania ćwiczeń laboratoryjnych, poparta elementarną sprawnością manualną
3. Świadomość konieczności pracy grupowej i umiejętność jej realizacji

CELE PRZEDMIOTU

C1. W oparciu o prawa termodynamiki zrozumienie zasad przemian gazowych i możliwości ich wykorzystania w technice
C2. Znajomość podstaw działania maszyn energetycznych i umiejętność wyznaczania ich sprawności
C3. Znajomość podstaw działania sprężarek i umiejętność wyznaczania ich sprawności
C4. Znajomość podstaw działania maszyn przepływowych oraz podstaw termodynamiki przepływów naddźwiękowych

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Ma podstawową wiedzę z zakresu fizyki umożliwiającą wyjaśnienie faktów oraz zjawisk zachodzących w świecie przyrody i w technice
PEU_W02 - Potrafi interpretować i analizować obiegi maszyn energetycznych

II. Z zakresu umiejętności:
PEU_U01 - Potrafi rozwiązywać zadania i problemy w oparciu o zdobytą wiedzę oraz informacje pozyskane z literatury naukowo-technicznej w języku polskim i angielskim, baz danych i innych źródeł
PEU_U02 - Potrafi prowadzić obliczenia maszyn energetycznych w oparciu o zmienne parametry termodynamiczne

III. Z zakresu kompetencji społecznych:
PEU_K01 - Rozumie znaczenie wykorzystywania metod matematycznych w reprezentowanej dyscyplinie inżynierskiej

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Podstawowe definicje: parametry lokalne, parametry globalne, parametry właściwe, ciśnienie, temperatura, zerowa zasada termodynamiki	2
Wy2	Równanie stanu gazu doskonałego. Równanie stanu gazu rzeczywistego	2
Wy3	Przemiany termodynamiczne. Ciepło przemiany. Pracy przemian - praca absolutna, techniczna i użyteczna	2
Wy4	Pojemność cieplna ciała przy stałym ciśnieniu i stałej objętości. Zmiana energii wewnętrznej. Zmiana entalpii.	2
Wy5	Bilans energii. Pierwsza zasada termodynamiki dla układów otwartych i zamkniętych.	2
Wy6	Równanie politropy, Praca i ciepło przemiany politropowej. Przemiany charakterystyczne – praca i ciepło przemian charakterystycznych	3

Wy7	Druga zasada termodynamiki. Entropia. Podstawy obiegów termodynamicznych i ich sprawność. Obieg Carnota.	3
Wy8	Obiegi porównawcze maszyn energetycznych. Sprawność obiegów porównawczych	4
Wy9	Sprężarki tłokowe i rotodynamiczne, wykres indykatorowy i praca sprężarki.	2
Wy10	Termodynamika przepływów ściśliwych. Bilans energii dla przepływów ściśliwych. Pierwsza zasada termodynamiki dla przepływów ściśliwych	2
Wy11	Przepływ gazów przez dysze, równanie Bernoullego, dynamiczne działanie strugi, wyznaczanie lokalnej prędkości dźwięku	2
Wy12	Podstawowe prawa dotyczące przekazywania ciepła na drodze konwekcji, promieniowania, przewodzenia	2
Wy13	Zaliczenie	2
		Suma: 30
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Wyznaczenie ciepła właściwego gazu dla przemiany politropowej	2
Lab2	Wyznaczanie współczynnika korekcyjnego dla przemiany adiabatycznej	2
Lab3	Wyznaczenie sprawności wolumetrycznej sprężarki tłokowej	2
Lab4	Badanie procesu adiabatycznego wypływu z dyszy. Wyznaczenie elipsy Bendemanna	2
Lab5	Badanie przemiany izotermicznej. Praktyczna realizacja prawa Boyle'a Mariotte'a	3
Lab6	Badanie procesu przenikania ciepła przez przegrodę płaską przy: a) występowaniu konwekcji i promieniowania, b) zastosowaniu ekranu osłabiającego promieniowanie	2
Lab7	Izobaryczne ogrzewanie z wykorzystaniem regeneracji ciepła	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład informacyjny N2. wykład problemowy N3. praca własna – samodzielne studia i przygotowanie do egzaminu N4. konsultacje N5. praca własna – przygotowanie do laboratorium

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_K01	Kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_K01	Kartkówka, sprawozdanie z zajęć laboratoryjnych
F2	PEU_U01, PEU_U02, PEU_K01	Kartkówka, sprawozdanie z zajęć laboratoryjnych
F3	PEU_U01, PEU_U02, PEU_K01	Kartkówka, sprawozdanie z zajęć laboratoryjnych
F4	PEU_U01, PEU_U02, PEU_K01	Kartkówka, sprawozdanie z zajęć laboratoryjnych
F5	PEU_U01, PEU_U02, PEU_K01	Kartkówka, sprawozdanie z zajęć laboratoryjnych
F6	PEU_U01, PEU_U02, PEU_K01	Kartkówka, sprawozdanie z zajęć laboratoryjnych
F7	PEU_U01, PEU_U02, PEU_K01	Kartkówka, sprawozdanie z zajęć laboratoryjnych
P = (F1+F2+F3+F4+F5+F6+F7)/7		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

[1] Szargut, Jan and Termodynamika Techniczna. Wydawnictwo Politechniki Śląskiej. Gliwice, 2009.
[2] Wiśniewski, Stefan. Termodynamika Techniczna. Wydawnictwa Naukowo-Techniczne, 1993.

LITERATURA UZUPEŁNIAJĄCA

[1] Tuliszka, E. and Z. Koszla-Olachowska. Termodynamika Techniczna: Zbiór Zadań : Praca Zbiorowa. Wydaw. Politechniki Poznańskiej, 1980.
[2] Teodorczyk, A. Zbiór Zadań Z Termodynamiki Technicznej. Wydawnictwa Szkolne i Pedagogiczne, 1992.

OPIEKUN PRZEDMIOTU
dr inż. Aleksander Górniak email: aleksander.gorniak@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Ekologia**
Nazwa przedmiotu w języku angielskim: **Ecology**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0070**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	1				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma podstawową wiedzę w zakresie szkoły średniej z chemii, biologii, ekologii.
2. Posługuje się literaturą przedmiotu, wykorzystując zarówno podręczniki jak i wiarygodne źródła internetowe.

CELE PRZEDMIOTU

C1. Zapoznanie z zagadnieniami z zakresu ekologii oraz ochrony środowiska.
C2. Poznanie zagrożeń wynikających z działalności człowieka.
C3. Poznanie nowoczesnych rozwiązań służących ochronie środowiska.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Ma wiedzę na temat zagrożeń wynikających z działalności przemysłowej
PEU_W02 - Zna podstawowe konwencje międzynarodowe i polskie akty prawne w dziedzinie ochrony środowiska.
PEU_W03 - Potrafi scharakteryzować nowoczesne rozwiązania służące ochronie środowiska.

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:
PEU_K01 - Ma świadomość ważności zrozumienie pozatechnicznych skutków działalności człowieka, w tym jej wpływu na środowisko i związanej z tym odpowiedzialności za podejmowane decyzje.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie do przedmiotu - Ekologiczne problemy współczesnego świata.	1
Wy2	Konwencjonalne źródła energii (węgiel, ropa naftowa i gaz ziemny) i ich wpływ na środowisko.	2
Wy3	Odnawialne źródła energii (energia słoneczna, wiatru, wody, geotermalna).	2
Wy4	Sposoby magazynowania energii.	1
Wy5	Biomasa u biopaliwa	1
Wy6	Przyczyny i skutki zanieczyszczenia powietrza (efekt cieplarniany, dziura ozonowa, smog, kwaśne deszcze).	2
Wy7	Ekologiczne rozwiązania stosowane w samochodach (katalizator, DPF, EGR, sonda lambda). Samochody zeroemisyjne.	1
Wy8	Zanieczyszczenia wody. Oczyszczanie ścieków i uzdatnianie wody.	2
Wy9	Zanieczyszczenie i degradacja gleby. Utrata bioróżnorodności.	1
Wy10	Kolokwium zaliczeniowe	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. konsultacje
N2. prezentacja multimedialna

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01 ÷ PEU_W03	Kolokwium pisemne
F2	PEU_K01	
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA Wiarygodne źródła internetowe LITERATURA UZUPEŁNIAJĄCA

OPIEKUN PRZEDMIOTU
dr hab. Agnieszka Baszczuk tel.: 320-32-21 email: agnieszka.baszczuk@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Grafika inżynierska -zapis konstrukcji**
Nazwa przedmiotu w języku angielskim: **Engineering Graphics - Engineering Drawing**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0071**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15			30	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30			60	
Forma zaliczenia	Zaliczenie na ocenę			Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	1			2	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				2	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6			1.4	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Podstawowa wiedza z zakresu geometrii wykreślnej
2. Podstawowe umiejętności rysowania i obsługi sprzętu komputerowego.
3. Umiejętność korzystania z zasobów cyfrowych internetu.

CELE PRZEDMIOTU

C1. Nabycie wiedzy i umiejętności w zakresie rzutowania prostokątnego w odwzorowaniu elementów przestrzeni na płaszczyźnie z wykorzystaniem widoków i przekrojów oraz zasad zapisu konstrukcji.
C2. Nabycie wiedzy i umiejętności w zakresie wymiarowania i tolerowania wymiarów elementów maszynowych, a także oznaczania ich cech powierzchni oraz tolerancji kształtu i położenia.
C3. Nabycie wiedzy i umiejętności w zakresie graficznego przedstawiania połączeń elementów maszyn oraz zasad normalizacji w zapisie konstrukcji, a także zapisu elementów (rysunki wykonawcze) i złożonych układów (rysunki złożeniowe) oraz zasad schematyzacji.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Student zna i jest w stanie objaśnić reguły zapisu konstrukcji i tworzenia dokumentacji technicznej elementów i podzespołów urządzeń mechanicznych.
PEU_W02 - Student wie jak nazwać podstawowe parametry charakteryzujące geometryczne cechy wytworu oraz zaproponować jak te informacje zapisać.
PEU_W03 - Student zna zasady graficznego przedstawienie połączeń elementów maszyn oraz zapisu znormalizowanych elementów maszyn.

II. Z zakresu umiejętności:
PEU_U01 - Student umie sporządzić sposobem odręcznym i komputerowo (CAD) rysunkową dokumentację techniczną oraz schematyzację układów technicznych.
PEU_U02 - Student umie odczytywać zapis dokumentacji technicznej elementu maszynowego i złożonych układów technicznych oraz zapis schematyczny.
PEU_U03 - Student umie identyfikować i zapisać podstawowe połączenia elementów maszyn.

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie. Zasady zapisu konstrukcji. Normalizacja w dokumentacji technicznej. Rzuty prostokątne i aksonometryczne. Kompozycja rysunku.	2
Wy2	Rodzaje widoków w rysunku technicznym. Zastosowanie przekrojów i kładów. Przedstawianie szczegółów.	2
Wy3	Zapis układu wymiarów. Reguły i zasady wymiarowania elementów maszyn. Sposoby zapisu wymiarów tolerowanych oraz pasowań.	2
Wy4	Przedstawianie chropowatości powierzchni. Tolerancje kształtu, położenia oraz tolerancje złożonych.	2
Wy5	Zapis graficzny podstawowych połączeń maszyn - połączenia rozłączne i nierozłączne. Zapis znormalizowanych elementów maszyn.	2
Wy6	Rodzaje rysunków w zapisie konstrukcji. Rysunek wykonawczy, złożeniowy. Zapis schematyczny.	2

Wy7	Kolokwium zaliczeniowe	2
Wy8	Omówienie kolokwium i podsumowanie kursu.	1
		Suma: 15
Forma zajęć – Projekt		Liczba godzin
Proj1	Wprowadzenie. Podstawowe zasady tworzenia rysunku z wykorzystaniem techniki komputerowej. Wykonywanie prostych rysunków z wykorzystaniem programu komputerowego (CAD): organizacja edytora graficznego, podstawowe funkcje rysowania (linia, okrąg, łuk itp.)	2
Proj2	Podstawowe techniki rysunku odręcznego - linia, łuk, okrąg, elipsa. Rysowanie prostych elementów maszyn.	2
Proj3	Widoki elementów maszyn na podstawie rysunków aksonometrycznych. Szkic techniczny odręczny. Kompozycja rysunku. Rysunek komputerowy (funkcje edycji i modyfikacji rysunków)	2
Proj4	Widoki elementów maszyn o większym stopniu złożenia. Rysunek komputerowy (funkcje edycji i modyfikacji rysunków - kontynuacja)	2
Proj5	Przekroje prostych elementów maszyn. Rysowanie elementów symetrycznych (półwidok-półprzekrój).	2
Proj6	Rysowanie obrotowych elementów maszyn (wałki, tuleje). Przekroje i kłady.	2
Proj7	Rysunek wykonawczy. Wymiarowanie. Zasady wymiarowania. Tolerancje. Opis powierzchni.	2
Proj8	Zapis graficzny połączeń spawanych oraz połączeń klejonych. Rysunek wykonawczy elementu typu rama, korpus lub podpora składającego się z części połączonych metodą spawania lub klejenia.	2
Proj9	Zapis graficzny połączeń gwintowych. Rysunek zespołu elementów zawierających połączenie gwintowe.	2
Proj10	Kolokwium zaliczeniowe	2
Proj11	Zadanie konstrukcyjne - omówienie tematu. Szkic konstrukcyjny zespołu maszynowego stanowiącego treść zadania.	2
Proj12	Zadanie konstrukcyjne. Rysunek złożeniowy zespołu maszynowego.	2
Proj13	Zadanie konstrukcyjne. Rysunki wykonawcze elementów zespołu maszynowego.	2
Proj14	Zadanie konstrukcyjne. Rysunki wykonawcze elementów zespołu maszynowego. Rysunek schematyczny.	2
Proj15	Ocena zadań konstrukcyjnych. Zaliczenie.	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem technik multimedialnych N2. praca własna - przygotowanie do projektu N3. dyskusja problemowa N4. samodzielne rozwiązywanie zadań rysunkowych pod kierunkiem prowadzącego.

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	kartkówki (quizy) po wykładach
F2	PEU_W01, PEU_W02, PEU_W03	kolokwium
P = 0,1*F1+0,9*F2		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01-PEU_U03	kolokwium
F2	PEU_U01- PEU_U03	Ocena zadania konstrukcyjnego
F3	PEU_U01- PEU_U03	Ocena zadań rozwiązywanych na zajęciach
P = 0,6*F1+0,3*F2+0,1*F3		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

[1] Dobrzański T., Rysunek techniczny maszynowy. WNT, Warszawa, 2021.
[2] Rydzanicz I., Zapis konstrukcji. Podstawy. Oficyna Wyd. PWr,Wrocław.
[3] MATERIAŁY POMOCNICZE DO WYKŁADU - ePortal PWr
[4] Giesecke F.E. et al., Engineering Graphics. Pearson Education Inc. 2004.

LITERATURA UZUPEŁNIAJĄCA

[1] Suseł M., Makowski K.. Grafika inżynierska z zastosowaniem programu AutoCAD, Oficyna Wydawnicza PWr, 2005
[2] Strony internetowe do nauki AutoCAD np.
https://autocad-beginners.blogspot.com/2018/01/content-of-autocad-tutorials.html
https://strefainzyniera.pl/index.php/artykul/498/oprogramowanie-cadca

OPIEKUN PRZEDMIOTU
Prof. dr hab. inż. Wojciech Wieleba tel.: +4871 320-27-74 email: wojciech.wieleba@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Podstawy materiałoznawstwa**
Nazwa przedmiotu w języku angielskim: **Fundamentals of materials science**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0072**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60		30		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	2		1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2		0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Podstawy fizyki na poziomie szkoły średniej.
2. Podstawowa wiedza z chemii, umiejętność posługiwania się terminologią chemiczną.
3. Podstawowa wiedza z matematyki, umiejętność tworzenia i interpretacji równań i wykresów.

CELE PRZEDMIOTU

C1. Nabycie wiedzy o ważnych w technice grupach stopów metali, systemów ich oznaczania, własnościach oraz kryteriach ich stosowania w określonych warunkach eksploatacyjnych.
C2. Poznanie podstaw krystalografii i własności struktur krystalicznych.
C3. Nauczenie interpretacji i zastosowań wykresów równowagi faz w przewidywaniu i planowaniu własności i zastosowań materiałów. inżynierskich.
C4. Poznanie struktur i własności stopów układu żelazo- cementyt.
C5. Nabycie wiedzy o budowie, własnościach i zastosowaniach tworzyw sztucznych, ceramiki i materiałów kompozytowych.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Zna grupy materiałów inżynierskich oraz kryteria ich klasyfikacji.
PEU_W02 - Zna podział stopów żelaza, potrafi interpretować ich mikrostruktury i określić właściwości.
PEU_W03 - Potrafi określić podstawowe własności i obszary zastosowań oraz grupy gatunków w obszarze tworzyw sztucznych, kompozytów i ceramik.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi zinterpretować mikrostruktury wyrobów po różnych procesach wytwarzania i powiązać je z właściwościami mechanicznymi.
PEU_U02 - Potrafi, na etapie projektowania, dobrać stal niestopową i żeliwo niestopowe, dokonać świadomego wyboru stanu dostawy oraz składu chemicznego.

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Własności mechaniczne i fizyczne materiałów metalicznych. Zależności między procesem wytwarzania, strukturą i właściwościami materiałów.	2
Wy2	Elementy krystalografii, wiązanie metaliczne, sieci krystaliczne metali.	2
Wy3	Defekty struktury krystalicznej.	2
Wy4	Równowaga i kryteria równowagi. Zarodkowanie i krystalizacja.	2
Wy5	Stopy. Budowa i rodzaje stopów. Fazy międzymetaliczne. Charakterystyka faz występujących w stopach metali.	2
Wy6	Wykresy równowagi fazowej układów dwuskładnikowych. Reguła faz.	2
Wy7	Wykres równowagi żelazo-cementyt. Analiza wykresu.	2
Wy8	Wpływ zawartości węgla na mikrostruktury i własności stopów żelaza.	2
Wy9	Klasyfikacja i zasady oznaczania stali niestopowych.	2
Wy10	Klasyfikacja i zasady oznaczania żeliw i staliw niestopowych.	2

Wy11	Polimery i tworzywa sztuczne – klasyfikacja, właściwości i zastosowanie.	2
Wy12	Ceramika i szkła – klasyfikacja, właściwości i zastosowanie.	2
Wy13	Materiały kompozytowe – klasyfikacja, właściwości i zastosowanie.	2
Wy14	Kolokwium zaliczeniowe	2
Wy15	Kolokwium zaliczeniowe	2
		Suma: 30

Forma zajęć – Laboratorium		Liczba godzin
Lab1	Wprowadzenie. Cel i metody badań materiałów. Budowa i obsługa mikroskopu metalograficznego	2
Lab2	Badania makroskopowe, analiza powierzchni przełomów, makrostruktury materiałów i wad pochodzenia technologicznego.	2
Lab3	Analiza wykresów równowagi układów dwuskładnikowych.	2
Lab4	Badania mikrostruktury stopów jedno i wielofazowych w stanie nietrawionym i trawiony.	2
Lab5	Analiza wykresu równowagi fazowej żelazo - cementy.	2
Lab6	Wpływ zawartości węgla na mikrostruktury i właściwości stali i staliw.	2
Lab7	Żeliwa – klasyfikacja, mikrostruktury w stanie nietrawionym i trawionym, właściwości, zastosowanie.	2
Lab8	Podsumowanie i zaliczenie zajęć laboratoryjnych.	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów
N2. praca własna – samodzielne studia i przygotowanie do egzaminu
N3. eksperyment laboratoryjny
N4. praca własna – przygotowanie do laboratorium
N5. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02	kartkówka
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA [1] Haimann.R; Metaloznawstwo; Wyd.PWr; 2000 [2] Dobrzański.L.A, Materiały inżynierskie i projektowanie materiałowe. Podstawy nauki o materiałach i metaloznawstwo, WNT, 2006 [3] Blicharski M., Wstęp do inżynierii materiałowej, WNT, 2012 [4] Dudziński W., Widanka K., Ćwiczenia laboratoryjne z materiałoznawstwa, Oficyna Wydawnicza PWr, 2012 LITERATURA UZUPEŁNIAJĄCA [1] Dudziński W., Materiały konstrukcyjne w budowie maszyn, Wyd.PWr; 1994 [2] Ashby M. F., Jones D.R.H., Materiały inżynierskie, t. 1 i 2, WNT; 1996

OPIEKUN PRZEDMIOTU
dr hab. inż. Dominika Grygier tel.: 320-38-45 email: dominika.grygier@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Mechanika I**
Nazwa przedmiotu w języku angielskim: **Mechanics I**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0073**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30	30			
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60	60			
Forma zaliczenia	Zaliczenie na ocenę	Zaliczenie na ocenę			
Grupa kursów					
Liczba punktów ECTS	2	2			
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		2			
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2	1.4			

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Analiza matematyczna (różniczkowanie, całkowanie)
2. Algebra (na poziomie szkoły średniej) + algebra liniowa (macierze, wyznaczniki)
3. Geometria euklidesowa i trygonometria

CELE PRZEDMIOTU

C1. Rozwiązywanie problemów technicznych statycznych i kinematycznych w oparciu o prawa mechaniki klasycznej
C2. Wykonywanie statycznych analiz wytrzymałościowych elementów maszyn

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - potrafi zdefiniować podstawowe pojęcia w mechanice (siła, moment siły), zna równania mechaniki klasycznej w statyce, zna wybrane metody rozwiązywania kratownic, belek i ram,
PEU_W02 - posiada wiedzę z geometrii mas (momenty statyczne, bezwładności, dewiacji)
PEU_W03 - posiada wiedzę w zakresie podstawowych pojęć z kinematyki punktu i kinematyki ciała sztywnego (prędkość, przyspieszenie, liczba stopni swobody, równania toru i ruchu)

II. Z zakresu umiejętności:
PEU_U01 - potrafi rozwiązywać typowe konstrukcje inżynierskie (kratownice, belki, ramy) w warunkach obciążeń statycznych: reakcje w podporach, siły wewnętrzne (formie analitycznych funkcji i ich wykresów)
PEU_U02 - potrafi wyznaczyć położenia środków mas, momenty statyczne i momenty bezwładności podstawowych układów mechanicznych oraz główne centralne osie i momenty bezwładności w układzie płaskim
PEU_U03 - potrafi obliczać prędkości i przyspieszenia dowolnie wybranych punktów typowych układów mechanicznych i ich elementów

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Program, wymagania, literatura. Zarys algebry wektorów	2
Wy2	Siła, moment siły, wektor główny i moment główny układu sił, warunki równowagi, aksjomaty statyki. Zmiana bieguna momentu	2
Wy3	Zbieżny układ sił. Kratownice. Metoda wydzielania węzłów	2
Wy4	Wyznaczanie sił reakcji w przypadkach płaskich układów sił (zastosowania w belkach, kratownicach, płaskich ramach itp)	2
Wy5	Metoda Rittera wyznaczania sił w wybranych prętach kratownicy. Redukcja płaskiego układu sił. Metoda Culmanna.	2
Wy6	Siły wewnętrzne w belkach statycznie wyznaczalnych (metody analityczne)	2
Wy7	Wyznaczanie sił wewnętrznych w ramach	2
Wy8	Środki mas w układach dyskretnych i ciągłych. Momenty statyczne	2
Wy9	Momenty bezwładności, transformacja równoległa i obrotowa	2
Wy10	Główne centralne osie i momenty bezwładności w układzie płaskim	2
Wy11	Kinematyka punktu (tor, prędkość, przyspieszenie). Ruch krzywoliniowy, przyspieszenie styczne i normalne. Kinematyka w naturalnym układzie współrzędnych i układzie biegunowym	2
Wy12	Pojęcie ciała sztywnego. Stopnie swobody. Klasyfikacja ruchów ciała sztywnego. Wzory na prędkość i przyspieszenie w ruchu ogólnym	2
Wy13	Kinematyka ruchu obrotowego ciała sztywnego. Prędkość i przyspieszenie obrotowe. Ruch płaski. Metody wyznaczania prędkości w ruchu płaskim (chwilowy środek obrotu, centroida)	2

Wy14	Kolokwium 1	2
Wy15	Kolokwium 2	2
		Suma: 30
Forma zajęć – Ćwiczenia		Liczba godzin
Ćw1	Podstawowe działania na wektorach: sumowanie analityczne i wykreślne, mnożenie skalarne i wektorowe itp.	2
Ćw2	Wyznaczanie sił w prętach układów płaskich (kratownicach) metodą wydzielania węzłów z zastosowaniem równań równowagi węzłów oraz wykreślnie z zastosowaniem wieloboku sił	2
Ćw3	Wyznaczanie sił reakcji w podporach w dowolnych układach płaskich metodami analitycznymi	2
Ćw4	Wyznaczanie sił reakcji w podporach w układach przestrzennych (jeden przykład)	1
Ćw5	Wyznaczanie sił w dowolnie wybranych prętach kratownicy (metodą Rittera)	1
Ćw6	Wyznaczanie sił wewnętrznych w belkach	2
Ćw7	Wyznaczanie sił wewnętrznych w belkach (c. d). Belki z przegubami.	2
Ćw8	Wyznaczanie sił wewnętrznych w ramach (proste ramy płaskie co najwyżej z jednym węzłem)	2
Ćw9	Wyznaczanie środków mas i momentów statycznych	2
Ćw10	Wyznaczanie momentów bezwładności w układach płaskich dyskretno-ciągłych i momentów dewiacji względem dowolnej osi z zastosowaniem tw. Steinera	2
Ćw11	Wyznaczanie położenia głównych centralnych osi i wartości głównych centralnych momentów bezwładności w układach płaskich (jeden przykład)	2
Ćw12	Rozwiązywanie zadań z kinematyki punktu materialnego w kartezjańskim układzie odniesienia	2
Ćw13	Rozwiązywanie zadań z kinematyki ruchu obrotowego i postępowego ciała sztywnego	2
Ćw14	Wyznaczanie prędkości w ruchu płaskim ciała sztywnego. Metoda superpozycji i chwilowego środka obrotu dla prędkości.	2
Ćw15	Kolokwium 1	2
Ćw16	Kolokwium 2	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. ćwiczenia rachunkowe N3. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	sprawdzian pisemno-ustny
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Ćwiczenia)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03	sprawdzian pisemny
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

1. B. Gabryszewska, A. Pszonka: „Mechanika”, cz. I, Statyka, PWr, 1988
2. J. Leyko :"Mechanika ogólna", Tom 1 Statyka i kinematyka, PWN 2022
3. J. Zawadzki, W. Siuta:„Mechanika ogólna”, PWN, Warszawa 1971
4. J. Misiak : „Mechanika ogólna. Statyka i kinematyka”. Tom I, WNT, Warszawa 1993
5. Cz. Witkowski, „Zbiór zadań z mechaniki”. Część I. „Kinematyka”. PWr. 1999
6. Z. Jaśniewicz, „Zbiór zadań ze statyki”, PWr. 1996
7. J. Nizioł: " Metodyka rozwiązywania zadań z mechaniki", PWN 2023

LITERATURA UZUPEŁNIAJĄCA

1. J. Giergiel : „Mechanika ogólna”, WNT, Warszawa 1980
2. B. Skalmierski: „Mechanika” PWN, Warszawa 1977
3. S. Piasecki, J. Rżysko: „Mechanika” WNT, Warszawa 1977,
4. W. Siuta: „Mechanika techniczna”, WNT, Warszawa 1968

OPIEKUN PRZEDMIOTU

dr hab. inż. Daniel Lewandowski tel.: 320-28-99 email: daniel.lewandowski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Grafika inżynierska 3D**
Nazwa przedmiotu w języku angielskim: **3D Engineering Graphics**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0074**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				30	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				60	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				2	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				2	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				1.4	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Wymagana jest wiedza z zakresu kursu "Grafika inżynierska - geometria wykreślna"
2. Wymagana jest wiedza z zakresu kursu "Grafika inżynierska - zapis konstrukcji"
3. Wymagane są podstawowe umiejętności obsługi sprzętu komputerowego

CELE PRZEDMIOTU

C1. Nabycie wiedzy i umiejętności w zakresie modelowania przestrzennego części i zespołów maszyn
C2. Nabycie wiedzy i umiejętności w zakresie badania i analiz maszyn i urządzeń na modelach wirtualnych (wirtualne prototypy)
C3. Nabycie wiedzy i umiejętności w zakresie wykonywania dokumentacji technicznej 2D części i zespołów na podstawie modeli 3D

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Student powinien umieć budować modele przestrzenne części maszyn
PEU_U02 - Student powinien umieć budować modele przestrzenne zespołów maszyn i urządzeń z modeli części oraz przeprowadzić analizy poprawności modeli i ich parametrów
PEU_U03 - Student powinien umieć wykonać dokumentację rysunkową 2D na podstawie modelu przestrzennego

III. Z zakresu kompetencji społecznych:
PEU_K01 - Student nabywa umiejętności ponoszenia odpowiedzialności za wykonaną pracę

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Wprowadzenie do modelowania bryłowego - podstawowe operacje modelowania brył,zasady tworzenia szkicu płaskiego, relacje w szkicu (relacje geometryczne i wymiarowe)	2
Proj2	Modelowania bryłowe podstawowe - zaawansowane operacje na szkicach płaskich, modelowanie bryłowe metodami wyciągnięcia	2
Proj3	Modelowanie bryłowe podstawowe - operacje na bryłach: fazowanie, zaokrąglanie, pochylanie ścian, elementy konstrukcyjne (punkt. oś, płaszczyzna), tworzenie żeber, kreator otworów, operacje powielania elementów brył	2
Proj4	Modelowania bryłowe podstawowe - zaawansowane operacje na szkicach płaskich - relacje funkcyjne parametrów, modelowanie bryłowe metodami obrotu, operacje obróbki modeli - modele skorupowe	2
Proj5	Modelowania bryłowe podstawowe - modelowanie bryłowe metodami obrotu, modele jedno i wielobryłowe	2
Proj6	Zaawansowane operacje bryłowe- wyciągnięcie po ścieżce, wyciągnięcie złożone, podział brył, części typu "zwój"	2
Proj7	Projekt zespołu: koncepcja, wykonanie części zespołu (urządzenia) poznanymi metodami modelowania i obróbki brył	2

Proj8	Projekt zespołu: przygotowanie do budowania zespołu - złożenia części, wiązania i relacje części w zespole	2
Proj9	Projekt zespołu: budowanie zespołu z modeli części, edycja części w zespole, biblioteki części standardowych	2
Proj10	Projekt zespołu: modelowanie części w środowisku zespołu, adaptacyjność części	2
Proj11	Projekt zespołu: analiza poprawności funkcjonalnej zespołu (analizy parametrów, analiza kinematyczna, analiza kolizji) usuwanie błędów projektowych, analizy obciążeń	2
Proj12	Projekt zespołu: analizy obciążeń, reakcji i sił w węzłach, prezentacja modelu	2
Proj13	Projekt zespołu: generowanie dokumentacji płaskiej dla części - rysunki wykonawcze części	2
Proj14	Projekt zespołu: generowanie dokumentacji płaskiej dla zespołu- rysunki złożeniowe zespołu	2
Proj15	Zaliczenie przedmiotu: praca zaliczeniowa wykonywana na zajęciach	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. prezentacja projektu N2. dyskusja problemowa N3. praca własna - przygotowanie do projektu N4. samodzielna praca własna przy komputerze pod kierunkiem prowadzącego

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03 PEU_K01	kolokwium, udział w dyskusjach problemowych
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA Autodesk Inventor Professional 2021 PL / 2021+ / Fusion 360 Metodyka projektowania Andrzej Jaskulski LITERATURA UZUPEŁNIAJĄCA Zbiór ćwiczeń Autodesk Inventor 2020 Kurs podstawowy Fabian Stasiak

OPIEKUN PRZEDMIOTU
dr inż. Tadeusz Lewandowski tel.: 71 320-24-65 email: tadeusz.lewandowski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Mechanika płynów**
Nazwa przedmiotu w języku angielskim: **Fluid Mechanics**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0075**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30	15			
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60	30			
Forma zaliczenia	Zaliczenie na ocenę	Zaliczenie na ocenę			
Grupa kursów					
Liczba punktów ECTS	2	1			
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		1			
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2	0.7			

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Student ma uporządkowaną wiedzę z zakresu matematyki, obejmującą algebrę i analizę matematyczną
2. Uporządkowana wiedza z zakresu fizyki, mechaniki.
3. Uporządkowana wiedza z zakresu podstaw projektowania maszyn.

CELE PRZEDMIOTU

C1. Poznanie podstawowych praw mechaniki w odniesieniu do przepływów cieczy i gazów.
C2. Umiejętność wykorzystania podstawowych praw mechaniki płynów w budowie i projektowaniu maszyn.
C3. Umiejętność wykorzystania podstawowych praw mechaniki płynów w eksploatacji maszyn.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - PEU_W01 - Umieć definiować podstawowe prawa w mechanice płynów
PEU_W02 - PEU_W02 - Objaśniać zasady działania maszyn i zjawisk zachodzących w ich budowie i eksploatacji.
PEU_W03 - PEU_W03 - Wskazywać na powiązania między podstawowymi prawami mechaniki płynów, a zasadami działań
elementów wyposażenia maszyn.

II. Z zakresu umiejętności:
PEU_U01 - PEU_U01 - Analizować przebieg zjawisk związanych z przepływami w eksploatacji maszyn.
PEU_U02 - PEU_U02 - Uporządkowana wiedza w zakresie teorii budowy maszyn.
PEU_U03 - PEU_U03 - Umie łączyć prawa mechaniki płynów z zagadnieniami projektowania i eksploatacji maszyn.

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wstęp, właściwości cieczy i gazów, siły i naprężenia w płynach, Płyny newtonowskie i nienewtonowskie.	2
Wy2	Metody analizy ruchu płynów, linie prądu, przepływy potencjalne i wirowe. Metody wizualizacji przepływów. Kinematyka płynów	2
Wy3	Podstawowe równania mechaniki płynów, równanie ciągłości, równanie zachowania pędu dla cieczy doskonałych i rzeczywistych (równanie Eulera i Naviera-Stokesa)	2
Wy4	Równania hydrostatyki, naczynia połączone, napór cieczy na ściany, pływalność i stateczność ciał pływających.Równowaga płynu.	3
Wy5	Dynamika płynu nielepkiego, równanie Bernoulliego, przykłady zastosowań: pomiary prędkości, wypływ cieczy przez otwory, ssące działanie strugi.	2
Wy6	Zasada pędu i momentu pędu, reakcja hydrodynamiczna, podstawy teorii maszyn przepływowych.	2
Wy7	Dynamika płynów lepkich. Klasyfikacja przepływów, przepływ laminarny. podstawy teorii warstwy przyściennej. Równanie Naviera-Stockesa	2
Wy8	Przykłady rozwiązań równań N-S, przepływy w przewodach osiowo-symetrycznych.	2
Wy9	Przejście przepływu laminarnego w turbulentny. Doświadczenie Reynoldsa. Elementy teorii przepływów turbulentnych.Metody obliczania przepływów turbulentnych. Oderwanie warstwy przyściennej.	4
Wy10	Hydrodynamiczna teoria smarowania w łożyskach, przepływy przez szczeliny.	1
Wy11	Opływ ciał, opory opływu, wypór hydrodynamiczny, płat nośny, charakterystyki hydrodynamiczne profili.	2

Wy12	Przepływ płynów w przewodach pod ciśnieniem. Przepływ w przewodzie zamkniętym o przekroju kołowym. Straty hydrauliczne wywołane tarciem. Straty hydrauliczne wywołane oporami miejscowymi.	2
Wy13	Ustalony przepływ płynów w systemach hydraulicznych.Nieustalony przepływ płynów w przewodach.	2
Wy14	Metody numeryczne w mechanice płynów.	2
		Suma: 30
Forma zajęć – Ćwiczenia		Liczba godzin
Ćw1	Wprowadzenie do ćwiczeń z mechaniki płynów. Rozwiązywanie zadań z zakresu podstawowych właściwości płynów.	1
Ćw2	Zadania ilustrujące zastosowanie równania Eulera i prawa Pascala. Obliczanie sił hydrostatycznych. Naczynia połączone. Pomiary manometryczne.	2
Ćw3	Statyka płynów. Napór na powierzchnie proste i zakrzywione.	2
Ćw4	Statyka płynów. Zagadnienia wyporu. Płyn w równowadze.	2
Ćw5	Zastosowanie równania Bernoulliego i równania ciągłości do obliczania przepływu cieczy i do pomiaru prędkości przepływu. Pomiar prędkości miejscowej.	3
Ćw6	Obliczanie strat ciśnienia w przewodach zamkniętych. Wyznaczanie charakterystyki rurociągu.	2
Ćw7	Obliczanie przepływów przez szczeliny.	2
Ćw8	Kolokwium zaliczeniowe.	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład problemowy N2. wykład tradycyjny z wykorzystaniem transparencji i slajdów N3. ćwiczenia rachunkowe

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01 - PEU_W03	kolokwium
P = 0.5*F1+0.5*FC		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Ćwiczenia)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03	kolokwium
P = F1=FC		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

Bukowski J., Kijkowski P.: Kurs mechaniki płynów. PWN Warszawa 1980.
Jeżowiecka-Kabsch K., Szewczyk H.: Mechanika płynów. Oficyna Wydawnicza PWr, Wrocław 2001.
Troskolański A.T.: Hydromechanika, WNT, Warszawa 1967.

LITERATURA UZUPEŁNIAJĄCA

Prosnak W.J.: Mechanika płynów. Tom I. PWN, Warszawa 1970.
Burka S.E., Nałęcz T.J.: Mechanika płynów w przykładach. PWN, Warszawa 1994.
Zieliński A.: Wybrane zagadnienia z mechaniki płynów. Oficyna Wydawnicza PWr, Wrocław 2011

OPIEKUN PRZEDMIOTU
dr inż. Krzysztof Patralski tel.: 2667 email: krzysztof.patralski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Materiałoznawstwo**
Nazwa przedmiotu w języku angielskim: **Materials science**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0076**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	90		60		
Forma zaliczenia	Egzamin		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	3		2		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			2		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.8		1.4		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Podstawowe wiadomości z fizyki i chemii.
2. Zaliczenie wykładu z Podstaw materiałoznawstwa (wymaganie nie ma charakteru formalnego- dotyczy wiedzy i umiejętności formułowanych w karcie przedmiotu – Podstawy materiałoznawstwa).
3. Zaliczenie wykładu z Podstaw materiałoznawstwa (wymaganie nie ma charakteru formalnego- dotyczy wiedzy i umiejętności formułowanych w karcie przedmiotu – Podstawy materiałoznawstwa)

CELE PRZEDMIOTU

C1. Nabycie wiedzy o ważnych w technice grupach stopów metali, systemów ich oznaczania, własnościach oraz kryteriach ich stosowania w określonych warunkach eksploatacyjnych.
C2. Nabycie umiejętności rozumienia równowagi między wytrzymałością, a plastycznością materiałów metalicznych oraz możliwością sterowania tymi własnościami poprzez skład chemiczny i mikrostrukturę kształtowaną w procesie wytwarzania gotowych wyrobów.
C3. Nabycie wiedzy o podstawach obróbki cieplnej, cieplno-chemicznej i plastycznej stopów żelaza.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Elementarna wiedza na temat podstawowych materiałów konstrukcyjnych, ich właściwości i możliwości zastosowania w budowie maszyn, urządzeń i pojazdów.
PEU_W02 - Rozumie przemiany fazowe zachodzące w stopach metali i wie jaki mają wpływ na dobór parametrów obróbki cieplnej i cieplno-chemicznej wyrobów znajdujących zastosowania w budowie maszyn, urządzeń i pojazdów.
PEU_W03 - Rozumie przemiany fazowe zachodzące w stopach metali i wie jaki mają wpływ na dobór parametrów obróbki cieplnej i cieplno-chemicznej wyrobów znajdujących zastosowania w budowie maszyn, urządzeń i pojazdów.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi dobrać rodzaj i parametry obróbki cieplnej dla określonych gatunków stopów w celu uzyskania zadanych własności
PEU_U02 - Potrafi zinterpretować mikrostruktury wyrobów po różnych procesach wytwarzania i powiązać je z własnościami.

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Przemiany fazowe w stopach żelaza z węglem podczas nagrzewania i chłodzenia.	2
Wy2	Obróbka cieplna podstawowa stopów żelaza z węglem. Wyżarzanie. Hartowanie i odpuszczanie.	2
Wy3	Wykresy CTP. Hartowność.	2
Wy4	Obróbka powierzchniowa: hartowanie powierzchniowe, nawęglanie, azotowanie.	2
Wy5	Odkształcenie plastyczne i wyżarzanie rekrystalizujące metali.	2
Wy6	Wpływ pierwiastków stopowych na przemiany fazowe w stalach.	2
Wy7	Stale stopowe konstrukcyjne.	2
Wy8	Wysokostopowe stale odporne na korozję.	2
Wy9	Stale o szczególnych własnościach: stale żarowytrzymałe i żaroodporne.	2

Wy10	Stale do kształtowania na zimno. Wielofazowe stale nowej generacji.	2
Wy11	Stale stopowe narzędziowe.	2
Wy12	Klasyfikacja i zasady oznaczania żeliw i staliw stopowych.	2
Wy13	Stopy aluminium – klasyfikacja, oznaczanie, struktury i właściwości, obróbka cieplna, kryteria doboru.	2
Wy14	Stopy metali lekkich i ciężkich (magnez, tytan, beryl, cynk, ołów, nikiel, kobalt) – klasyfikacja, oznaczanie, struktury i właściwości, obróbka cieplna, kryteria doboru.	2
Wy15	Stopy miedzi – klasyfikacja, struktury i właściwości, zastosowanie	2
		Suma: 30
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Odkształcenie plastyczne i wyżarzanie rekrystalizujące stali.	2
Lab2	Wpływ obróbki cieplnej na mikrostrukturę i właściwości stali.	2
Lab3	Mikrostruktury stali po obróbce powierzchniowej.	2
Lab4	Mikrostruktury i właściwości stali narzędziowych.	2
Lab5	Mikrostruktury i właściwości stali odpornych na korozję.	2
Lab6	Mikrostruktury i własności stopów aluminium.	2
Lab7	Mikrostruktury i własności stopów miedzi.	2
Lab8	Podsumowanie i zaliczenie zajęć laboratoryjnych.	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. praca własna – samodzielne studia i przygotowanie do egzaminu N3. praca własna – przygotowanie do laboratorium N4. eksperyment laboratoryjny N5. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	Egzamin
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02	Kartkówka
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
1] Haimann.R; Metaloznawstwo; Wyd.PWr; 2000
[2] Dobrzański.L.A, Materiały inżynierskie i projektowanie materiałowe. Podstawy nauki o materiałach i metaloznawstwo, WNT, 2006
[3] Blicharski M., Wstęp do inżynierii materiałowej, WNT, 2012
[4] Dudziński W., Widanka K., Ćwiczenia laboratoryjne z materiałoznawstwa, Oficyna Wydawnicza PWr, 2012

LITERATURA UZUPEŁNIAJĄCA
[1] Dudziński W., Materiały konstrukcyjne w budowie maszyn, Wyd.PWr; 1994
[2] Ashby M. F., Jones D.R.H., Materiały inżynierskie, t. 1 i 2, WNT; 1996

OPIEKUN PRZEDMIOTU

dr hab. inż. Dominika Grygier tel.: 320-38-45 email: dominika.grygier@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Równania różniczkowe zwyczajne**
Nazwa przedmiotu w języku angielskim: **Ordinary differential equations**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0077**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15	15			
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30	30			
Forma zaliczenia	Zaliczenie na ocenę	Zaliczenie na ocenę			
Grupa kursów					
Liczba punktów ECTS	1	1			
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		1			
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6	0.7			

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Zna rachunek różniczkowy i całkowy funkcji jednej zmiennej, a także wykorzystywane w nim inne gałęzie matematyki, ze szczególnym uwzględnieniem algebry liniowej.
2. Umie obliczać pochodne funkcji jednej zmiennej, umie obliczać całki nieoznaczone i oznaczone metodami przez części i przez podstawienie.
3. Umie obliczać wyznaczniki i zna ich własności, umie obliczać wartości własne i wektory własne macierzy.

CELE PRZEDMIOTU

C1. Zdobycie podstawowej wiedzy o równaniach różniczkowych zwyczajnych I i II rzędu oraz na temat układów równań różniczkowych.
C2. Zdobycie umiejętności dobrania właściwej metody rozwiązywania równań różniczkowych zwyczajnych oraz układów równań różniczkowych.
C3. Kształtowanie i utrwalanie umiejętności wyszukiwania informacji oraz jej analizy.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Ma teoretyczną wiedzę dotyczącą równań różniczkowych i metod ich rozwiązywania.
PEU_W02 - Ma wiedzę na temat metod rozwiązywania układów równań różniczkowych.
PEU_W03 - Ma wiedzę dotyczącą zastosowania równań różniczkowych jako modelu matematycznego do opisu zjawisk fizycznych.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi rozwiązać równania różniczkowe I rzędu.
PEU_U02 - Potrafi rozwiązać równania różniczkowe II rzędu.
PEU_U03 - Potrafi rozwiązać układy równań różniczkowych.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Rozumie konieczność systematycznej pracy nad wszelkimi zadaniami; umie oszacować czas potrzebny na realizację zleconego zadania.
PEU_K02 - Zna zakres posiadanej przez siebie wiedzy i posiadanych umiejętności, potrafi rozpoznać braki w wiedzy i uzupełnić je posługując się literaturą.
PEU_K03 - Postępuje etycznie i rozumie znaczenie uczciwości intelektualnej.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Równania różniczkowe I rzędu: pojęcia wstępne. Równania różniczkowe I rzędu o zmiennych rozdzielonych.	1
Wy2	Równania różniczkowe I rzędu jednorodne. Równania różniczkowe I rzędu liniowe niejednorodne. Metoda uzmienniania stałych.	2
Wy3	Krzywe ortogonalne. Metoda geometryczna wyznaczania krzywych całkowych na podstawie izoklin.	2
Wy4	Równania II sprowadzalne do równań I rzędu. Równania różniczkowe II rzędu liniowe jednorodne o stałych współczynnikach.	2
Wy5	Równania różniczkowe liniowe II rzędu liniowe jednorodne. Wrońskian.	2
Wy6	Równania różniczkowe liniowe niejednorodne. Metoda współczynników nieoznaczonych. Metoda uzmienniania stałych.	2
Wy7	Układy równań różniczkowych. Metoda eliminacji.	2

Wy8	Kolokwium	2
		Suma: 15
Forma zajęć – Ćwiczenia		Liczba godzin
Ćw1	Rozwiązywanie równań różniczkowych I rzędu o zmiennych rozdzielonych	1
Ćw2	Rozwiązywanie równań jednorodnych. Rozwiązywanie równań różniczkowych I rzędu liniowych niejednorodnych - metoda uzmienniania stałej.	2
Ćw3	Wyznaczanie krzywych ortogonalnych. Rozwiązywanie równań różniczkowych II rzędu sprowadzalnych do I rzędu.	2
Ćw4	Rozwiązywanie równań różniczkowych II rzędu liniowych jednorodnych i niejednorodnych o stałych współczynnikach. Metoda przewidywania.	2
Ćw5	Rozwiązywanie równań różniczkowych II rzędu niejednorodnych o stałych współczynnikach metodą uzmienniania stałych.	2
Ćw6	Rozwiązywanie równań liniowych jednorodnych z użyciem wzoru Liouville'a.	2
Ćw7	Rozwiązywanie układów równań metodą eliminacji.	2
Ćw8	Kolokwium	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. ćwiczenia rachunkowe N3. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01 + PEU_W02 + PEU_W03	Kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Ćwiczenia)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się

F1	PEU_U01 +PEU_U02 + PEU_U03, PEU_K01	Kolokwium
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA 1. M. Gewert, Z. Skoczylas, Równania różniczkowe zwyczajne. Teoria, przykłady, zadania, Oficyna Wydawnicza GIS, Wrocław 2007. 2. W. Żakowski, W. Leksiński , Matematyka cz. IV, WNT, Warszawa 1984. 3. F. Leja, Rachunek różniczkowy i całkowy ze wstępem do równań różniczkowych, PWN, Warszawa 2008. 4. S. Łanowy, F. Przybylak, B. Szlęk, Równania różniczkowe, Wydawnictwo Politechniki Śląskiej, Gliwice 2003. 5. H. Bereś, K. Bereś, Elementy równań różniczkowych. Cz. 1, Wydawnictwo Politechniki Świętokrzyskiej, Kielce 2003. 6. 5. H. Bereś, K. Bereś, Elementy równań różniczkowych. Cz. 2 Rozwiązania zadań, Wydawnictwo Politechniki Świętokrzyskiej, Kielce 2005. 7. W. Krysicki, L. Włodarski, Analiza matematyczna w zadaniach. Część 2, PWN Warszawa 2011. LITERATURA UZUPEŁNIAJĄCA 1. N. Matwiejew, Metody całkowania równań różniczkowych zwyczajnych, PWN, Warszawa, 1986. 2. N. Matwiejew, Zadania z równań różniczkowych zwyczajnych, PWN, Warszawa 1976.

OPIEKUN PRZEDMIOTU
dr inż. Dorota Aniszewska tel.: 320-27-90 email: dorota.aniszewska@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Tworzywa sztuczne**
Nazwa przedmiotu w języku angielskim: **Polymers**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0078**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60		30		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	2		1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2		0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma podstawową wiedzę w obszarze materiałoznawstwa i chemii.

CELE PRZEDMIOTU

C1. Nabycie podstawowej wiedzy dotyczącej budowy, otrzymywania, modyfikacji i własności tworzyw polimerowych.
C2. Nabycie podstawowej wiedzy dotyczącej technologii stosowanych do przetwórstwa tworzyw polimerowych.
C3. Zdobycie umiejętności doboru tworzyw polimerowych w podstawowych zastosowaniach.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Zna podstawowe grupy polimerów, ich budowę, własności.
PEU_W02 - Zna technologie stosowane do przetwórstwa tworzyw polimerowych.
PEU_W03 - Zna podstawowe zastosowania tworzyw polimerowych.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi identyfikować materiały polimerowe,
PEU_U02 - Potrafi wskazać technologię przetwórstwa do wytwarzania wybranego wyrobu z tworzywa sztucznego.
PEU_U03 - Umie dobierać materiały polimerowe do określonych zastosowań.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Potrafi identyfikować materiały polimerowe,
PEU_K02 - Potrafi wskazać technologię przetwórstwa do wytwarzania wybranego wyrobu z tworzywa sztucznego.
PEU_K03 - Umie dobierać materiały polimerowe do określonych zastosowań.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wiadomości podstawowe, historia materiałów polimerowych, nazewnictwo, zalety i wady tworzyw polimerowych.	2
Wy2	Porównanie wybranych własności tworzyw polimerowych z metalami.	2
Wy3	Klasyfikacja i podział tworzyw polimerowych. Procesy polimeryzacji i wytwarzania tworzyw sztucznych.	2
Wy4	Modele mechaniczne zachowania się polimerów. Zachowanie się tworzyw w trakcie przetwórstwa. Reologia polimerów.	2
Wy5	Modyfikacja polimerów, mieszanie z dodatkami. Przygotowanie tworzyw do przetwórstwa.	2
Wy6	Technologie i techniki łączenia wyrobów z tworzyw polimerowych	2
Wy7	Technologia wtryskiwania i jej odmiany	2
Wy8	Praktyczne aspekty technologii wtryskiwania	2
Wy9	Technologia wytłaczania i jej odmiany	2
Wy10	Technologia termoformowania	2
Wy11	Narzędzia stosowane w technologiach przetwórstwa tworzyw	2
Wy12	Przetwórstwo żywic i wytwarzanie kompozytów, technologie niszowe	2
Wy13	Zastosowanie tworzyw polimerowych	2
Wy14	Biodegradowalność polimerów	2
Wy15	Test zaliczeniowy	2
		Suma: 30
Forma zajęć – Laboratorium		Liczba godzin

Lab1	Wprowadzenie, omówienie zasad zaliczenia laboratorium	1
Lab2	Tworzywa polimerowe - własności, zastosowanie i i metody identyfikacji	2
Lab3	Technologie łączenia wyrobów z tworzyw polimerowych	2
Lab4	Własności mechaniczne materiałów polimerowych	2
Lab5	Tarcie i zużycie materiałów polimerowych	2
Lab6	Technologie przetwórstwa pierwotnego - wytłaczanie	2
Lab7	Technologie przetwórstwa pierwotnego - wtryskiwanie	2
Lab8	Technologie przetwórstwa wtórnego - termoformowanie próżniowe	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. praca własna – przygotowanie do laboratorium N3. eksperyment laboratoryjny N4. przygotowanie sprawozdania

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01	kartkówka
F2	PEU_U02	kartkówka, odpowiedzi ustne
F3	PEU_U03	kartkówka, odpowiedzi ustne
F4	PEU_K01, PEU_K02, PEU_K03	odpowiedzi ustne, przygotowanie sprawozdania
P = (F1+F2+F3+F4)/4		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA 1. Materiały polimerowe; Koszkul, Józef; Wydawnictwo Politechniki Częstochowskiej; Częstochowa; 1999, 2. Kucharczyk, Wojciech Żurowski, Przetwórstwo tworzyw sztucznych dla mechaników, Politechnika Radomska; Radom; 2005; 3. Izabella Hyla, Tworzywa sztuczne : własności, przetwórstwo, zastosowanie, Wydawnictwo Politechniki Śląskiej; Gliwice; 2000. LITERATURA UZUPEŁNIAJĄCA 1. Piotr Jasiulek, Łączenie tworzyw sztucznych metodami spawania zgrzewania, klejenia i laminowania, Krosno, Wydaw. i Handel Książkami "KaBe", 2004; 2. Physical properties of polymers; Mark James; Cambridge University Press; 2004; 3. Processing of polymers; Defonseka Chris.; Boston : De Gruyter; 2020;

OPIEKUN PRZEDMIOTU
dr inż. Roman Wróblewski tel.: 320-21-70 email: r.m.wroblewski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Informatyka podstawy programowania (MATLAB)**
Nazwa przedmiotu w języku angielskim: **Basic programming (MATLAB)**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0079**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				30	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				60	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				2	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				2	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				1.4	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma wiedzę w zakresie matematyki obejmującą podstawowe zagadnienia z algebry i analizy.
2. Potrafi wykorzystywać podstawowe narzędzia informatyczne.
3. Posiada podstawową wiedzę w zakresie programowania komputerowego.

CELE PRZEDMIOTU

C1. Poznanie zasad programowania w systemie Matlab, przeznaczonego do wykonywania obliczeń inżynierskich i naukowych.
C2. Poznanie zasad integracji obliczeń oraz wizualizacji (grafika 2D i 3D).
C3. Poznanie zasad modelowania układów technicznych z wykorzystaniem modułu Simulink.
C4. Zdobycie umiejętności w posługiwaniu się funkcjonalnością arkuszy kalkulacyjnych oraz środowisk obliczeniowych.
C5. Nabycie umiejętności myślenia i działania w sposób kreatywny i logiczny.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Student potrafi sformułować algorytm postępowania dla obliczeń matematycznych z zakresu algebry i analizy, obejmujących m.in.: rachunek macierzowy, całkowy i różniczkowy oraz zagadnienia związane z rozwiązywaniem układów równań algebraicznych.
PEU_U02 - Student potrafi wykorzystać możliwości grafiki dwuwymiarowej i trójwymiarowej do wizualizacji danych i wyników obliczeń.
PEU_U03 - Student potrafi zbudować prosty model obiektu i uruchomić symulację w systemie Matlab/Simulink.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Student potrafi myśleć i działać w sposób kreatywny wykorzystując nowoczesne narzędzia informatyczne.
PEU_K02 - Student potrafi wyszukiwać i korzystać z literatury zalecanej do kursu oraz samodzielnie zdobywać wiedzę.
PEU_K03 - Student rozumie konieczność systematycznej i samodzielnej pracy nad opanowaniem materiału kursu.

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Wstęp do programowania w środowisku Matlab.	2
Proj2	Wprowadzenie do obliczeń algebraicznych i logicznych.	2
Proj3	Rachunek wektorowy i macierzowy.	2
Proj4	Wizualizacja danych z wykorzystaniem grafiki 2D i 3D.	2
Proj5	Przygotowanie m-skryptów.	2
Proj6	Zastosowanie funkcji.	2
Proj7	Instrukcje matematyczne.	2
Proj8	Wprowadzenie do środowiska Simulink.	2
Proj9	Zastosowanie Simulink w obszarze automatyki.	2
Proj10	Symulacja i wizualizacja zjawisk fizycznych w środowisku Simulink.	2

Proj11	Rachunek różniczkowy z wykorzystaniem arkuszy kalkulacyjnych.	2
Proj12	Całkowanie numeryczne z wykorzystaniem arkuszy kalkulacyjnych.	2
Proj13	Rachunek macierzowy.	2
Proj14	Rozwiązywanie zagadnień matematycznych z wykorzystaniem funkcjonalności arkuszy kalkulacyjnych.	2
Proj15	Ocena zdobytych umiejętności.	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. ćwiczenia rachunkowe N2. praca własna - przygotowanie do projektu N3. prezentacja multimedialna N4. konsultacje N5. przygotowanie sprawozdania

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02, PEU_K03	Ocena przygotowania do realizacji kolejnych tematów projektu. Sprawdzenie zdobytych wiadomości na podstawie zadań, ćwiczeń oraz sprawozdania.
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
MATLAB : dla naukowców i inżynierów. Pratap, Rudra (1964-) Autor | Sikorski, Witold (1950-) Tłumacz | Wydawnictwo Naukowe PWN Wydawca | Witkom. 2015
MATLAB: an introduction with applications, Amos Gilat 2017

LITERATURA UZUPEŁNIAJĄCA
https://www.mathworks.com

OPIEKUN PRZEDMIOTU
dr inż. Emilia Mazgajczyk tel.: 71 320 41 83 email: emilia.mazgajczyk@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Techniki wytwarzania - odlewnictwo**
Nazwa przedmiotu w języku angielskim: **Chipless processes - Casting**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0080**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60		30		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	2		1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2		0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma podstawową wiedzę o procesach metalurgicznych przetwarzania rud metali oraz otrzymywania stopów żelaza i metali nieżelaznych. Ma uporządkowaną wiedzę o rodzajach metalicznych materiałów inżynierskich – ich właściwościach, zastosowaniach i zasadach doboru. Ma wiedzę w zakresie struktur stali, żeliwa i stopów metali nieżelaznych, zasad ich klasyfikacji i oznaczania.
2. Potrafi określić cechy mikrostruktury materiałów metalicznych, identyfikować fazy na podstawie wykresów równowagi, rozróżniać mikrostruktury pod względem zawartości węgla w stali, wpływu obróbki cieplnej.
3. Potrafi czytać i interpretować rysunki i schematy stosowane w dokumentacji technicznej.

CELE PRZEDMIOTU

C1. Nabycie podstawowej wiedzy o podstawowych technikach wytwarzania wyrobów metodami odlewniczymi.
C2. Zdobycie umiejętności doboru oraz krytycznej analizy dobranej technologii odlewania i podstawowych parametrów procesu
C3. Nabycie i utrwalenie kompetencji społecznych obejmujących inteligencję emocjonalną polegającą na umiejętności współpracy w grupie mającej na celu efektywne rozwiązywanie problemów. Nabycie poczucia odpowiedzialności, przestrzegania obyczajów obowiązujących w środowisku akademickim i społeczeństwie.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Zna podstawowe technologie ręcznego i maszynowego wytwarzania form odlewniczych.
PEU_W02 - Zna podstawowe metody otrzymywania i obróbki metalurgicznej stopów odlewniczych.
PEU_W03 - Posiada podstawową wiedzę o projektowaniu wyrobów odlewanych i procesach wytwarzania oraz zasadach doboru technologii odlewania zależnej od rodzaju stopu

II. Z zakresu umiejętności:
PEU_U01 - Potrafi, dla prostego wyrobu, przeanalizować i zaprojektować proces wytwarzania oprzyrządowania odlewniczego.
PEU_U02 - Potrafi dobrać odpowiednią technologię odlewania oraz określić podstawowe parametry procesu.
PEU_U03 - Potrafi dobrać odpowiednią metodę obróbki stopu odlewniczego oraz określić podstawowe parametry procesu.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Potrafi wyszukiwać informacje oraz je krytycznie analizować, obiektywnie oceniać argumenty, racjonalnie tłumaczyć i uzasadniać własny punkt widzenia z wykorzystaniem wiedzy z zakresu odlewnictwa.
PEU_K02 - Ma świadomość znaczenia zespołowej współpracy dotyczącej doskonalenia metod wyboru strategii mającej na celu optymalne rozwiązywanie powierzonych grupie studentów problemów.
PEU_K03 - Rozumie potrzebę przestrzegania obyczajów i zasad obowiązujących w środowisku akademickim i społeczeństwie.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Sprawy organizacyjne. Omówienie specyfiki techniki wytwarzania przedmiotów ze stanu ciekłego, podstawowe pojęcia i algorytmy wytwarzania odlewów.	1
Wy2	Zasady projektowania i budowa oprzyrządowania odlewniczego.	2
Wy3	Materiały stosowane do wytwarzania mas formierskich i rdzeniowych oraz metody wytwarzania i badania właściwości tych mas.	2
Wy4	Metody ręcznego i maszynowego wytwarzania form i rdzeni odlewniczych.	2
Wy5	Wytwarzanie form i rdzeni z mas chemoutwardzalnych i termoutwardzalnych.	2
Wy6	Wytwarzanie odlewów metodą precyzyjną traconych modeli. Wytwarzanie odlewów w formach trwałych.	2

Wy7	Wytapianie stopów odlewniczych. Obróbka metalurgiczna stopów odlewniczych i cieplna odlewów.	2
Wy8	Omówienie podstawowych przyczyn powstawania wad odlewów. Podsumowanie kursu. Sprawdzian wiadomości.	2
		Suma: 15

Forma zajęć – Laboratorium		Liczba godzin
Lab1	Sprawy organizacyjne. Wprowadzenie. BPH laboratorium odlewnictwa. Specyfika kształtowania wyrobów ze stanu ciekłego metalu. Podstawowe pojęcia i algorytmy wytwarzania odlewów.	1
Lab2	Badanie materiałów i mas formierskich.	2
Lab3	Budowa modeli i rdzennic. Technologia pełnej formy.	2
Lab4	Ręczne wytwarzanie form i rdzeni odlewniczych.	2
Lab5	Maszynowe wytwarzanie form i rdzeni odlewniczych.	2
Lab6	Wytwarzanie odlewów w formach z mas chemoutwardzalnych i termoutwardzalnych.	2
Lab7	Wytwarzanie odlewów w formach trwałych.	2
Lab8	Badanie właściwości stopów odlewniczych.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. praca własna – przygotowanie do laboratorium N3. praca własna – samodzielne studia i przygotowanie do egzaminu N4. przygotowanie sprawozdania N5. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03,	kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02, PEU_K03,	kartkówka, sprawozdanie
P = average F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

[1] Granat K. Laboratorium z odlewnictwa, skrypt PWr, Wrocław 2007;
[2] Perzyk M. i inni; Odlewnictwo WNT Warszawa 2000;
[3] Murza-Mucha P., Techniki wytwarzania – Odlewnictwo. PWN, Warszawa 1978;
[4] Tabor A. Odlewnictwo wyd. „Akapit” Kraków 1996;

LITERATURA UZUPEŁNIAJĄCA

[1] Lewandowski J. L.; Tworzywa na formy odlewnicze, wyd.: „Akapit” Kraków 1997;
[2] Błaszkowski K. Technologia formy i rdzenia, Warszawa 1990;
[3] Poradnik inżyniera – Odlewnictwo WNT Warszawa 1986;
[4] Perzyk M. i inni: Materiały do projektowania procesów odlewniczych, skr. P. Warsz. Warszawa 1981;
[5] Jaworski R. Ćwiczenia laboratoryjne z Budowy Maszyn, cz. I Odlewnictwo, skrypt PWr, Wrocław 1981;

OPIEKUN PRZEDMIOTU

dr inż. Mateusz Stachowicz tel.: 713204235 email: mateusz.stachowicz@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Podstawy wytrzymałości materiałów**
Nazwa przedmiotu w języku angielskim: **Fundamentals of materials strength**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0081**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30	15			
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60	30			
Forma zaliczenia	Zaliczenie na ocenę	Zaliczenie na ocenę			
Grupa kursów					
Liczba punktów ECTS	2	1			
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		1			
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2	0.7			

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Znajomość matematyki wyższej - w szczególności algebry wektorów, rachunku całkowego i równań różniczkowych.
2. Znajomość podstaw inżynierii materiałowej.
3. Znajomość mechaniki ciała sztywnego w szczególności w zakresie zasad statyki układów prętowych, belek i geometrii mas.

CELE PRZEDMIOTU

C1. Poznanie podstaw i zakresu zastosowań mechaniki jednorodnych i niejednorodnych ciał odkształcalnych
C2. Umie scharakteryzować podstawowe przypadki obciążenia prętów oraz wyznaczyć siły przekrojowe w układach hiperstatycznych
C3. Nabycie umiejętności obliczeń wytrzymałościowych w układach mechanicznych i wykorzystać je do określania naprężeń dopuszczalnych oraz ugięć konstrukcji w określonych przypadkach obciążeniowych

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Student potrafi zdefiniować uogólnione prawo Hooke'a i potrafi je wykorzystać do obliczeń naprężeń i odkształceń w elementach konstrukcyjnych poddanych złożonemu stanowi naprężeń
PEU_W02 - Student potrafi sformułować warunki wytrzymałościowe dla różnych konstrukcji prętowych i belkowych oraz posiada wiedzę niezbędną do zaprojektowania przekrojów elementów konstrukcyjnych
PEU_W03 - Zna najbardziej użyteczne hipotezy wytężeniowe i zakres ich stosowania oraz posiada wiedzę niezbędną do rozwiązywania klasycznych zadań z mechaniki

II. Z zakresu umiejętności:
PEU_U01 - Potrafi stosować prawo Hooke'a do obliczeń naprężeń i odkształceń
PEU_U02 - Potrafi przeprowadzić analizę wytrzymałościową konstrukcji prętowych i belkowych
PEU_U03 - Potrafi zaprojektować pręt ściskanym odporny na utratę stateczności

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie. Podstawowe założenia i pojęcia. Doświadczalne wyznaczanie własności wytrzymałościowych. Naprężenia dopuszczalne i współczynnik bezpieczeństwa	2
Wy2	Rozciąganie i ściskanie. Zagadnienia statycznie wyznaczalne i niewyznaczalne. Układy prętowe obciążone termicznie. Spiętrzenie naprężeń	2
Wy3	Teoria stanu naprężenia. Koło Mohra dla płaskiego stanu naprężenia. Związki fizyczne dla przestrzennego stanu naprężenia	2
Wy4	Teoria stanu stanu odkształcenia. Podstawy technicznych pomiarów odkształceń.	2
Wy5	Skręcanie prętów o przekroju kołowym	2
Wy6	Skręcanie prętów o przekroju dowolnym. Skręcanie profili cienkościennych	2
Wy7	Czyste ścinanie. Ścinanie techniczne. Obliczanie połączeń rozłącznych i nierozłącznych - przykłady obliczeń	2
Wy8	Ogólny przypadek zginania belki. Zginanie proste. Belki o stałej wytrzymałości na zginanie.	2

Wy9	Zginanie ukośne. Zginanie z udziałem siły poprzecznej. Środek ścinania	2
Wy10	Przemieszczenia w belkach. Równanie różniczkowe linii ugięcia	2
Wy11	Wyboczenie prętów ściskanych	2
Wy12	Zginanie z rozciąganiem lub ściskaniem. Rdzeń przekroju	2
Wy13	Energia sprężysta odkształcenia objętościowego i postaciowego. Zależności między energią sprężystą, naprężeniem i odkształceniem.	2
Wy14	Hipotezy wytężenia materiału w złożonym stanie naprężeń. Naprężenie zredukowane.	2
Wy15	Kolokwium zaliczeniowe	2
		Suma: 30

Forma zajęć – Ćwiczenia		Liczba godzin
Ćw1	Układy prętowe statycznie wyznaczalne i niewyznaczalne przy rozciąganiu i ściskaniu	2
Ćw2	Transformacja płaskiego stanu naprężeń i odkształceń. Uogólnione prawo Hooke'a.	3
Ćw3	Skręcanie prętów o przekroju kołowym. Skręcanie profili cienkościennych	2
Ćw4	Wyznaczanie naprężeń w zginanej belce	2
Ćw5	Wyznaczanie linii ugięcia belki	2
Ćw6	Wyboczenie prętów - obliczenia	2
Ćw7	Kolokwium zaliczeniowe	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. ćwiczenia rachunkowe

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	kolokwium zaliczeniowe
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Ćwiczenia)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03	kolokwium zaliczeniowe
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

Zielnica J., Wytrzymałość Materiałów, WPP, wyd. III, Poznań 2000, str. 554.
Niezgodziński M. E., Niezgodziński T.: Wytrzymałość materiałów. PWN, Warszawa 1998.
Niezgodziński M. E., Niezgodziński T.: Wzory, wykresy i tablice wytrzymałościowe. WNT, Warszawa 1996.
Niezgodziński M. E., Niezgodziński T.: Zadania z wytrzymałości materiałów. WNT, Warszawa 1997.
M. Ostwald: Podstawy wytrzymałości materiałów. Wydawnictwo Politechniki Poznańskiej, Poznań 1997
Jakubowicz A., Orłoś Z., Wytrzymałość materiałów, WNT, Warszawa, 1984
Magnucki K., Szyc W., Wytrzymałość materiałów w zadaniach: pręty, płyty i powłoki obrotowe, Wydawnictwo Naukowe PWN, 2000.

LITERATURA UZUPEŁNIAJĄCA

Broek D.: Elementary engineering - fracture mechanics. Noordhoff Int. Publishing, Leyden, 1974.
Ashby M. F.: Jones D. R.: Materiały inżynierskie. Własności i zastosowania. WNT, Warszawa 1995.
R. C. Hibbeler - Mechanics of Materials, Pearson Prentice Hall
S. Timoshenko, Strength of Materials Part 1, Elementary Theory and Problems, D. Van Nostrand Company, Inc
Willems N., Easley T. J., Rolfe S. T., Strength of Materials, Mc GrawHill Book Company, 1981.
Gere M., Timoshenko S., Mechanics of Materials, PWS-Kent Publishing Company, Boston, 1984.

OPIEKUN PRZEDMIOTU

dr hab. inż. Grzegorz Lesiuk tel.: 713204216 email: grzegorz.lesiuk@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Statystyka inżynierska**
Nazwa przedmiotu w języku angielskim: **Statistics for Engineers**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0082**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15			15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30			30	
Forma zaliczenia	Zaliczenie na ocenę			Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	1			1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6			0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma podstawową wiedzę w zakresie matematyki potwierdzone pozytywnymi ocenami na świadectwie dojrzałości

CELE PRZEDMIOTU

C1. Zapoznanie studentów z modelami statystycznymi i możliwościami ich zastosowania
C2. Zapoznanie studentów z metodami statystycznymi i możliwościami ich zastosowań
C3. Zapoznanie studentów z z rozkładami prawdopodobieństwa i możliwościami ich zastosowań

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - zna podstawowe pojęcia i fakty z zakresu statystyki matematycznej
PEU_W02 - zna podstawowe rozkłady prawdopodobieństwa ich parametry i metody ich szacowania

II. Z zakresu umiejętności:
PEU_U01 - potrafi stosować analizę statystyczną do otrzymanych danych i wyciągać wnioski z przeprowadzonej analizy
PEU_U02 - potrafi stosować podstawowe narzędzia do określenia typu rozkładu prawdopodobieństwa oraz oszacować jego parametry

III. Z zakresu kompetencji społecznych:
PEU_K01 - nabywanie i utrwalanie kompetencji w zakresie rozumie konieczność samokształcenia, w tym poprawiania umiejętności koncentracji uwagi i skupienia się na rzeczach istotnych oraz rozwijania zdolności do samodzielnego stosowania posiadanej wiedzy i umiejętności oraz wyszukiwanie informacji oraz jej krytycznej analizy

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Statystyczne metody analizy danych – istota modelowania statystycznego. Opisowa analiza danych: formy reprezentacji danych statystycznych, miary położenia, zmienności, asymetrii i koncentracji.	2
Wy2	Opracowanie i prezentacja materiału statystycznego. Grupowanie danych – szeregi proste i rozdzielcze. Histogram i dystrybuanta empiryczna.	2
Wy3	Zmienne losowe i ich rozkłady. Charakterystyki liczbowe rozkładu. Wybrane rozkłady dyskretne i ciągłe.	2
Wy4	Estymacja przedziałowa. Przedziały ufności dla wartości średniej, wariancji, wskaźnika struktury.	2
Wy5	Hipotezy statystyczne parametryczne. Testowanie hipotez o wartości przeciętnej, o równości dwóch wartości przeciętnych. Testowanie hipotez o wskaźniku struktury i o równości dwóch wskaźników struktury. Testowanie hipotez o wariancji i o równości dwóch wariancji.	2
Wy6	Testowanie hipotez nieparametrycznych. Test zgodności chi-kwadrat, Kołmogorowa-Smirnowa. Test niezależności chi-kwadrat Pearsona.	2
Wy7	Analiza korelacji i regresji. Metoda najmniejszych kwadratów. Liniowa funkcja regresji. Estymacja parametrów funkcji regresji. Przedziały ufności parametrów regresji liniowej.	2
Wy8	Zaliczenie	1
		Suma: 15
Forma zajęć – Projekt		Liczba godzin
Proj1	Sprawy organizacyjne. Wprowadzenie do korzystania z arkusza kalkulacyjnego. Funkcje matematyczne i statystyczne Excela. Statystyka opisowa – obliczanie miar położenia, zmienności, asymetrii i koncentracji.	2

Proj2	Budowa szeregów rozdzielczych. Wyznaczanie parametrów szeregu rozdzielczego (średnia, odchylenie standardowe itp.). Graficzna prezentacja zbioru danych – histogram i dystrybuanta empiryczna oraz wykres ramkowy.	2
Proj3	Podstawowe rozkłady spotykane w statystyce matematycznej: rozkład normalny, wykładniczy, Weibulla itp. Wyznaczanie parametrów rozkładu. Określenie rodzaju rozkładu na podstawie histogramu i dystrybuanty.	2
Proj4	Obliczenia w zakresie estymacji punktowej i przedziałowej wartości oczekiwanej, wskaźnika struktury (frakcji), wariancji i odchylenia standardowego.	2
Proj5	Obliczenia w zakresie weryfikacji hipotez statystycznych. Parametryczne testy istotności dla wartości oczekiwanej i dla wariancji populacji generalnej. Test dla dwóch wariancji, dla dwóch średnich i dwóch wskaźników struktury.	2
Proj6	Obliczenia w zakresie nieparametrycznych testów istotności – test zgodności chi-kwadrat2 Pearsona, test zgodności lambda Kołmogorowa.	2
Proj7	Obliczenia w zakresie analiza korelacji i regresji. Metoda najmniejszych kwadratów. Liniowa funkcja regresji. Estymacja parametrów funkcji regresji. Przedziały ufności parametrów regresji liniowej.	2
Proj8	Zaliczenie	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. ćwiczenia rachunkowe N2. wykład tradycyjny z wykorzystaniem transparencji i slajdów N3. dyskusja problemowa

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02	Zaliczenie
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się

F1	PEU_U01, PEU_U02, PEU_K01	Zaliczenie
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA [1] Bobrowski D: Probabilistyka w zastosowaniach technicznych. Warszawa 1986, WNT[2] Nowak R.: Statystyka dla fizyków. Warszawa 2002, Wydawnictwo Naukowe PWN[3] Ostasiewicz W. (red.): Statystyczne metody analizy danych. Wrocław 1999, Wydawnictwo AE we Wrocławiu[4] Zeliaś A., Pawełek B., Wanat S.: Metody statystyczne. Zadania i sprawdziany. Warszawa 2002, PWE LITERATURA UZUPEŁNIAJĄCA [1] Bąk I., Markowicz I., Mojsiewicz M., Wawrzyniak K.: Statystyka w zadaniach. Część I i II. Warszawa 2001. Wydawnictwo Naukowo-Techniczne[2] Cieciura M., Zacharski J.: Metody probabilistyczne w ujęciu praktycznym. Warszawa 2007, VIZJA PRESS&IT Sp. z o. o.[3] Dobosz M.: Wspomagana komputerowo statystyczna analiza wyników badań. Warszawa 2001, Akademicka Oficyna Wydawnicza EXIT.[4] Frątczak E., Gach-Ciepiela U., Babiker H.: Analiza historii zdarzeń. Elementy teorii, wybrane przykłady zastosowań. Warszawa 2005, Szkoła Główna Handlowa w Warszawie.[5] Kukiełka L: Podstawy badań inżynierskich. Warszawa 2002, Wydawnictwo Naukowe PWN. [6] Maliński M.: Statystyka matematyczna wspomagana komputerowo. Gliwice 2000, Wydawnictwo Politechniki Śląskiej [7] Paleczek W.: Metody analizy danych na przykładach. Częstochowa 2004, Politechnika Częstochowska[8] Turzeniecka D.: Ocena niepewności wyniku pomiarów. Poznań 1997, Wydawnictwo Politechniki Poznańskiej

OPIEKUN PRZEDMIOTU
dr hab. inż. Artur Kierzkowski tel.: 71 320-20-04 email: artur.kierzkowski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Mechanika II**
Nazwa przedmiotu w języku angielskim: **Mechanics II**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0083**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30	30			
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60	60			
Forma zaliczenia	Egzamin	Zaliczenie na ocenę			
Grupa kursów					
Liczba punktów ECTS	2	2			
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		2			
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2	1.4			

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Analiza matematyczna (różniczkowanie, całkowanie), algebra liniowa, geometria euklidesowa, trygonometria
2. Równania różniczkowe (zwyczajne, liniowe) w zakresie metody rozdzielania zmiennych i metody równania charakterystycznego
3. Mechanika w zakresie statyki i kinematyki

CELE PRZEDMIOTU

C1. Rozwiązywanie problemów technicznych mechanizmów w zakresie kinematyki - prędkości i przyspieszenia.
C2. Znajomość metod analitycznych w zakresie stosowania zasad dynamiki klasycznej dla typowych układów mechanicznych (układy dyskretne: punkt, układ punktów z więzami holonomicznymi, ciało sztywne).
C3. Rozwiązywanie problemów technicznych konstrukcji i układów mechanicznych pod obciążeniami dynamicznymi.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Potrafi zdefiniować podstawowe pojęcia w dynamice układów mechanicznych (pęd, kręt, siła bezwładności, praca, energia kinetyczna i potencjalna)
PEU_W02 - Zna podstawowe pojęcia w dziedzinie drgań swobodnych i wymuszonych układów mechanicznych o jednym stopniu swobody (częstość drgań własnych, charakterystyki częstotliwościowe, rezonans).
PEU_W03 - Zna podstawowe zasady dynamiki (ruchu środka masy, pędu, krętu, d'Alemberta). Zna pojęcie układów zachowawczych i zasadę zachowania energii. Zna równania dynamiki ruchu obrotowego i płaskiego ciała sztywnego. Zna dynamikę ruchu kulistego.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi obliczać prędkości i przyspieszenia w ruchu płaskim i kulistym ciała sztywnego. Potrafi wyprowadzić równania ruchu punktu materialnego swobodnego i nieswobodnego dla zmiennych w czasie obciążeń dynamicznych stosując II zasadę dynamiki Newtona.
PEU_U02 - Potrafi obliczać częstości drgań swobodnych dla układów o jednym stopniu swobody z liniowym tłumieniem wiskotycznym i bez tłumienia. Potrafi wyprowadzać równania ruchu i obliczać jego parametry (prędkości i przyspieszenia kątowe) dla ciał sztywnych obciążonych momentem
PEU_U03 - Potrafi wyznaczać siły reakcji więzów w warunkach obciążeń dynamicznych. Potrafi obliczać energię kinetyczną i potencjalną dla złożonych układów mechanicznych. Potrafi stosować zasadę zachowania energii do wyznaczania równań różniczkowych ruchu układów zachowawczych.

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Program, wymagania, literatura. Przypomnienie podstaw kinematyki. Prędkości w ruchu płaskim.	2
Wy2	Przyspieszenia w ruchu płaskim. Chwilowy środek przyspieszeń.	2
Wy3	Kinematyka punktu w układzie złożonym. Ruch względny. Przyspieszenie Coriolisa.	2
Wy4	Podstawowe zasady mechaniki klasycznej. Kinematyka a dynamika. Modele dyskretne i ciągłe układów dynamicznych w mechanice.	2
Wy5	Druga zasada dynamiki Newtona (zastosowania w dynamice punktu swobodnego i nieswobodnego). Pojęcie sił bezwładności i zasada d'Alemberta. Zasada kinetostatyki.	2
Wy6	Drgania układu jedno-masowego o jednym stopniu swobody z liniowym tłumieniem wiskotycznym i bez tłumienia. Zapis zespolony. Drgania swobodne.	2
Wy7	Drgania wymuszone harmonicznie, charakterystyki częstotliwościowe, rezonans. Wymuszenia dynamiczne i kinematyczne.	2
Wy8	Pęd i zasada zachowania pędu. Zmiana pędu i impuls siły. Kręt i zasada zachowania krętu.	2
Wy9	Pojęcie pracy. Praca elementarna. Energia kinetyczna i potencjalna. Zasada równoważności pracy i energii kinetycznej. Zasada zachowania energii mechanicznej. Układy zachowawcze. Przykłady zastosowań.	2

Wy10	Układy wielo-masowe. Więzy, stopnie swobody. Wykorzystanie drugiej zasady dynamiki Newtona w układach wielo-masowych nieswobodnych.	2
Wy11	Zasada ruchu środka masy i zasada pędu w układach wielo-masowych.	2
Wy12	Kręt ogólny i zasada krętu w układach wielo-masowych. Wprowadzenie do dynamiki ciała sztywnego. Dynamika ruchu postępowego i obrotowego ciała sztywnego.	2
Wy13	Wykorzystanie zasady krętu i równania dynamiki ruchu obrotowego w określaniu częstości drgań swobodnych układów złożonych. Masy i sztywności zastępcze.	2
Wy14	Wyznaczanie reakcji dynamicznych w ruchu obrotowym. Metoda redukcji sił bezwładności. Sposoby wyważania układów wirujących.	2
Wy15	Kręt w ruchu płaskim ciała sztywnego i dynamika ruchu płaskiego ciała. Energia kinetyczna ciała sztywnego w ruchu ogólnym. Twierdzenie Königa.	2
		Suma: 30
	Forma zajęć – Ćwiczenia	Liczba godzin
Ćw1	Rozwiązywanie zadań z kinematyki punktu, ruchu obrotowego i płaskiego ciała sztywnego. Obliczenia prędkości w ruchu płaskim: metodą superpozycji i metodą chwilowego środka obrotu.	2
Ćw2	Rozwiązywanie zadań z przyspieszeń w ruchu płaskim dla mechanizmów. Metoda superpozycji oraz metoda chwilowego środka przyspieszeń.	2
Ćw3	Rozwiązywanie zadań z kinematyki ruchu złożonego. Ruch względny. Przyspieszenie Coriolisa.	2
Ćw4	Rozwiązywanie zadań z dynamiki punktu materialnego swobodnego z zastosowaniem II zasady dynamiki Newtona (ruch prostoliniowy i krzywoliniowy pod wpływem sił: stałych, zmiennych w czasie, zależnych od prędkości ruchu).	2
Ćw5	Rozwiązywanie zadań z dynamiki punktu z wykorzystaniem zasady d'Alemberta i metody kinetostatyki.	2
Ćw6	Rozwiązywanie przykładów zadań z dynamiki punktu materialnego nieswobodnego z zastosowaniem II zasady dynamiki Newtona.	2
Ćw7	Rozwiązywanie zadań z dynamiki ruchu względnego punktu materialnego.	2
Ćw8	Rozwiązywanie zadań z drgań swobodnych punktu materialnego o jednym stopniu swobody (wyznaczanie częstości drgań swobodnych i równań ruchu) - tłumionych i bez tłumienia.	2
Ćw9	Rozwiązywanie zadań z drgań wymuszonych punktu materialnego o jednym stopniu swobody. Wyznaczanie częstości rezonansowej.	2
Ćw10	Rozwiązywanie zadań z dynamiki punktu materialnego z wykorzystaniem zasad: zmiany pędu i impulsu siły, zachowania energii mechanicznej, równoważności pracy i zmiany energii kinetycznej.	2
Ćw11	Rozwiązywanie zadań z dynamiki ruchu postępowego i obrotowego ciała sztywnego z wykorzystaniem zasady ruchu środka masy, zasady krętu i równania dynamiki ruchu obrotowego ciała sztywnego.	2
Ćw12	Rozwiązywanie zadań z zakresu reakcji dynamicznych w podporach ciała poruszającego się ruchem obrotowym. Wykorzystanie metody kinetostatyki.	2

Ćw13	Rozwiązywanie zadań z zakresu wyznaczania równań ruchu dla ciał sztywnych poruszających się ruchem płaskim.	2
Ćw14	Kolokwium 1	2
Ćw15	Kolokwium 2	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. ćwiczenia rachunkowe N3. konsultacje N4. praca własna – samodzielne studia i przygotowanie do egzaminu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	egzamin pisemno-ustny
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Ćwiczenia)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01,PEU_U02,PEU_U03	Kolokwium
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA 1. B. Gabryszewska, A. Pszonka: „Mechanika”, cz. II „Kinematyka i dynamika”, PWr, 1998 2. J. Zawadzki, W. Siuta: „Mechanika ogólna”, PWN, Warszawa 19713. 3. J. Misiak : „Mechanika ogólna. Dynamika”. Tom II, WNT, Warszawa 1993 4. J. Leyko :"Mechanika ogólna", Tom 1 Statyka i kinematyka, PWN 2022 5. J. Leyko :"Mechanika ogólna", Tom 2 Dynamika, PWN 2022 6. J. Nizioł: " Metodyka rozwiązywania zadań z mechaniki", PWN 2023 7. I. W. Mieszczerski, "Zbiór zadań z Mechaniki", PWN 1971 LITERATURA UZUPEŁNIAJĄCA 1. J. Giergiel : „Mechanika ogólna”, WNT, Warszawa 1980 2. B. Skalmierski: „Mechanika” PWN, Warszawa 19773. 3. M. Klasztorny: „Mechanika” Dolnośląskie Wyd. Edukacyjne, Wrocław 2000 4. W. Krysicki, L. Włodarski, "Analiza matematyczna w zadaniach II", PWN 2000

OPIEKUN PRZEDMIOTU
dr hab. inż. Daniel Lewandowski tel.: 320-28-99 email: daniel.lewandowski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Metrologia przemysłowa**
Nazwa przedmiotu w języku angielskim: **Industrial Metrology**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0084**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)			15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)			30		
Forma zaliczenia			Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS			1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)			0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma podstawową wiedzę w zakresie matematyki i fizyki na poziomie szkoły ponadpodstawowej.
2. Posiada umiejętność odczytywania rysunków i schematów zawartych w dokumentacji technicznej.
3. Posiada podstawową wiedzę w zakresie konstrukcji elementów maszyn. Posiada podstawową wiedzę w zakresie technik wytwarzania elementów maszyn

CELE PRZEDMIOTU

C1. Nabycie wiedzy na temat realizacji procesów pomiarowych oraz kontroli w warunkach przemysłowych
C2. Nabycie wiedzy na temat rodzajów i właściwości sprzętu do pomiaru wielkości geometrycznych wykorzystywanych przemysłowych procesach wytwarzania
C3. Wyszukiwanie istotnych informacji oraz ich krytyczna analiza.
C4. Zdobycie wiedzy i umiejętności w zakresie doboru sprzętu pomiarowego, analizy wyników pomiarów, oceny błędów pomiarów i sposobu wyrażania niepewności pomiarowej

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Rozumie wymagania wymiarowe stawiane wyrobom zawartych w dokumentacji technicznej. Potrafi korzystać z norm dotyczących tolerancji wymiarów liniowych i pasowań a także tolerancji geometrycznych. Potrafi obliczać wartości błędów pomiaru, szacować niepewność pomiarową dla różnego rodzaju pomiarów.
PEU_U02 - Umie dokonać doboru odpowiedniego sprzętu pomiarowego oraz dokonać jego konfiguracji w zależności od postawionego zadania pomiarowego. Potrafi korzystać z sprzętu pomiarowego stosowanego w przemyśle maszynowym do pomiaru wielkości geometrycznych.
PEU_U03 - Potrafi rozwiązywać w podstawowym zakresie problemy związane z praktycznym użytkowaniem narzędzi i stanowisk pomiarowych. Potrafi rozpoznać źródła błędów, ich wartości oraz oszacować niepewność pomiarową.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Wyszukiwanie informacji oraz jej krytycznej analizy
PEU_K02 - Obiektywne ocenianie argumentów, racjonalne tłumaczenie i uzasadnianie własnego punktu widzenia z wykorzystaniem wiedzy z zakresu metrologii.

TREŚCI PROGRAMOWE

Forma zajęć – Laboratorium		Liczba godzin
Lab1	Sprawy organizacyjne.	1
Lab2	Badanie wpływu charakterystyk metrologicznych systemów pomiarowych na ich właściwości pomiarowe	2
Lab3	Projekt i weryfikacja poprawności wykonania sprawdzianu do kontroli wymiarów	2
Lab4	Wzorcowanie wybranych przyrządów pomiarowych	2
Lab5	Wyznaczenie niepewności pomiaru. Budowa budżetu niepewności.	2
Lab6	Pomiary współrzędnościowe 2D na mikroskopie pomiarowym z wykorzystaniem QM Data 200	2
Lab7	Pomiary współrzędnościowe 2D na mikroskopie pomiarowym elementów obrotowych w biegunowym układzie współrzędnych	2
Lab8	Pomiary współrzędnościowe 3D na współrzędnościowej maszynie pomiarowej	2

	Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. eksperyment laboratoryjny N2. praca własna – przygotowanie do laboratorium N3. przygotowanie sprawozdania N4. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01; PEU_U02; PEU_U03; PEU_K01; PEU_K02;	sprawozdanie z ćwiczeń laboratoryjnych, odpowiedź ustna, kartkówka
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

[1] Jakubiec W., Malinowski J.: "Metrologia wielkości geometrycznych". WNT, Warszawa 2018.
[2] Instrukcje do ćwiczeń laboratoryjnych. (www.metrologia.pwr.edu.pl)

LITERATURA UZUPEŁNIAJĄCA

[1] Lisowski M.: „Podstawy Metrologii". Oficyna Wydawnicza PWr, Wrocław 2015
[2] Adamczak S., Makieła W.: " Metrologia w budowie maszyn. Zadania z rozwiązaniami. Wydanie II, zmienione". WNT, Warszawa 2022.
[3] Ratajczyk E., Woźniak A.: "Współrzędnościowe Systemy Pomiarowe". Oficyna Wydawnicza PW, Warszawa 2016

OPIEKUN PRZEDMIOTU

dr inż. Marek Kuran tel.: 27-28 email: marek.kuran@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Podstawy konstrukcji maszyn I**

Nazwa przedmiotu w języku angielskim: **Fundamentals of Machine Design I**

Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**

Poziom i forma studiów: **I stopień, stacjonarne**

Rodzaj przedmiotu: **obowiązkowy**

Kod przedmiotu: **W10MBM-SI0085**

Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30		15	30	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	90		60	60	
Forma zaliczenia	Egzamin		Zaliczenie na ocenę	Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	3		2	2	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			2	2	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.8		14.0	1.4	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Wiedza:1. Ma podstawową wiedzę o rodzajach materiałów inżynierskich, ich budowie, własnościach i właściwościach, obróbce, zastosowaniach i zasadach doboru. 2. Posiada elementarną wiedzę z zakresu mechaniki, wytrzymałości materiałów i technik wytwarzania. 3. Ma wiedzę w zakresie metod odwzorowywania tworów geometrycznych na płaszczyźnie oraz zasad zapisu konstrukcji elementów maszynowych i wykonywania ich schematów.
2. Umiejętności:1. Potrafi czytać i interpretować rysunki i schematy stosowane w dokumentacji technicznej, potrafi wykonywać dokumentacje techniczną. 2. Ma umiejętność samokształcenia się oraz potrafi pozyskiwać informacje z różnych źródeł, dokonywać ich interpretacji, a także wyciągać wnioski oraz formułować i uzasadniać opinie. 3. Potrafi zastosować w procesie konstruowania wiedzę zdobytą na przedmiotach: Metaloznawstwo, Mechanika, Wytrzymałość materiałów, Grafika inżynierska.
3. Kompetencje: 1. Potrafi myśleć i działać w sposób przedsiębiorczy. 2. Ma świadomość powagi i skutków działalności inżyniera mechanika i rozumie potrzebę działania profesjonalnego (zarówno indywidualnie jak i zespołowo).

CELE PRZEDMIOTU

C1. Nabycie podstawowej wiedzy dotyczącej procesu projektowo-konstrukcyjnego, algorytmicznych i heurystycznych metod tworzenia koncepcji oraz kryteriów ich oceny i wyboru.
C2. Zdobycie wiedzy z zakresu budowy, działania i eksploatacji głównych elementów maszynowych (połączeń) oraz zasad ich doboru i konstruowania.
C3. Zdobycie praktycznej umiejętności realizacji prostego typowego zadania konstrukcyjnego poprzez rozwiązanie zadania, którego treścią jest skonstruowanie prostego urządzenia o napędzie śrubowym (np. prasa śrubowa, ściągacz do łożysk, podnośnik nożycowy, podnośnik samochodowy itp.) z jednoczesnym wykorzystaniem wiedzy dotyczącej połączeń stosowanych w budowie maszyn (śrubowych, sworzniowych, kołkowych, wpustowych, wielowypustowych, wielokarbowych, wciskowych , spawanych i sprężystych).

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Ma wiedzę o metodach tworzenia koncepcji, kryteriach ich oceny i wyboru oraz o algorytmie projektowo-konstrukcyjnym.
PEU_W02 - Ma podstawową wiedzę na temat połączeń w budowie maszyn, ich konstrukcji i obliczeń wytrzymałościowych oraz zastosowaniu.
PEU_W03 - Ma wiedzę o czynnikach wpływających na wytrzymałość zmęczeniową elementów maszynowych i sposobie ich uwzględniania w obliczeniach konstrukcyjnych.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi samodzielnie formułować i rozwiązywać proste zadania techniczne.
PEU_U02 - Potrafi dobrać i obliczyć podstawowe połączenia stosowane w budowie maszyn.
PEU_U03 - Potrafi dobrać optymalne (w świetle przyjętych kryteriów) elementy maszynowe i zna ich ograniczenia.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Potrafi wyszukiwać informacje i dokonywać ich krytycznej analizy.
PEU_K02 - Potrafi pracować samodzielnie i w zespole.
PEU_K03 - Obiektywnie ocenia zadanie, założenia projektowe oraz potrafi uzasadnić wybrane rozwiązanie i sposób jego realizacji.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Program i wymagania. Zdefiniowanie pojęcia wytworu technicznego i konstrukcji. Cechy konstrukcyjne, zasady konstrukcji. Racje istnienia wytworu.	2
Wy2	Projektowanie, a konstruowanie - różnice. Algorytm projektowo- konstrukcyjny, charakterystyka jego etapów, przykłady.	2
Wy3	Algorytmiczne i heurystyczne metody tworzenia koncepcji (metoda pytań elementarnych, tablice i skrzynki morfologiczne, analogia biologiczna i antropomorficzna, burza mózgów, metoda 6 3 5 oraz delficka).	2
Wy4	Kryteria oceny koncepcji. Metody wyboru najlepszego rozwiązania: metoda bilansowania cech pozytywnych i negatywnych, metoda ważenia kryteriów metoda ważenia wariantów rozwiązań. Przykład.	2

Wy5	Naprężenia zmęczeniowe, wytrzymałość zmęczeniowa i sposób jej wyznaczania. Wykres zmęczeniowy Smitha i Haighea.	2
Wy6	Czynniki wpływające na obniżenie wytrzymałości zmęczeniowej elementu maszynowego i sposób ich uwzględnienia w obliczeniach konstrukcyjnych. Zmęczeniowy współczynnik spiętrzenia naprężeń β.	2
Wy7	Metody podwyższania wytrzymałości zmęczeniowej. Naprężenia dopuszczalne k - sposób ich wyznaczania. Współczynnik bezpieczeństwa i rzeczywisty współczynnik bezpieczeństwa.	2
Wy8	Rzeczywisty współczynnik bezpieczeństwa w przypadku złożonego stanu naprężeń. Etapy realizacji obliczeń wytrzymałościowych elementów maszynowych obciążonych siłami zmiennymi. Przykład obliczeniowy (wałek w przekładni zębatej).	2
Wy9	Połączenia w budowie maszyn, klasyfikacja i ogólna ich charakterystyka. Połączenia gwintowe, charakterystyka gwintów oraz wyznaczenie sił i momentów na gwincie.	2
Wy10	Sprawność i samohamowność złącza śrubowego. Minimalna wysokość nakrętki w złączu śrubowym.	2
Wy11	Sposób obliczania złączy śrubowych, wykres złącza śrubowego podatnego.	2
Wy12	Połączenia wpustowe, wielowypustowe, wielokarbowe i kołkowe. Ich charakterystyka i zasady obliczeń.	2
Wy13	Połączenia sworzniowe i spawane. Charakterystyka, sposoby kształtowania i zasady obliczeń.	2
Wy14	Połączenia wciskowe. Analityczne podstawy doboru geometrii i pasowania elementów połączenia wciskowego.	2
Wy15	Stalowe łączniki sprężyste. Podstawy wytrzymałościowych obliczeń wybranych rodzajów sprężyn. Kształtowanie walcowych sprężyn śrubowych.	2
		Suma: 30
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Wprowadzenie. Szkolenie BHP. Identyfikacja znormalizowanych elementów maszyn.	1
Lab2	Wyznaczanie sztywności statycznej, energii przejmowanej i rozpraszanej elementów sprężysto-tłumiących.	2
Lab3	Wyznaczanie charakterystyki tarciowej poprzecznego łożyska ślizgowego.	2
Lab4	Wyznaczanie oporów ruchu łożysk tocznych stożkowych.	2
Lab5	Teoretyczna oraz praktyczna identyfikacja zjawiska rezonansu w wale maszynowym z jedną nie wyważoną masą.	2
Lab6	Badanie połączeń wciskowych.	2
Lab7	Badanie przekładni pasowej z pasem klinowym pod kątem wpływu poślizgu sprężystego w cięgnie na jej sprawność.	2
Lab8	Wyznaczanie charakterystyki złącza śrubowego podatnego.	2
		Suma: 15
Forma zajęć – Projekt		Liczba godzin
Proj1	Opracowanie założeń konstrukcyjnych dla konstruowanego urządzenia.	3

Proj2	Schematy różnych wariantów rozwiązań oraz szkic konstrukcyjny (bez uszczegółowień) wybranego rozwiązania wraz z uzasadnieniem jego przyjęcia.	5
Proj3	Przeprowadzenie obliczeń konstrukcyjnych dla napędu śrubowego i innych elementów w konstruowanym urządzeniu.	12
Proj4	Sporządzenie rysunku złożeniowego projektowanego urządzenia i rysunków wykonawczych wskazanych przez prowadzącego zajęcia.	10
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. ćwiczenia rachunkowe N3. konsultacje N4. eksperyment laboratoryjny N5. praca własna – samodzielne studia i przygotowanie do egzaminu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01 - PEU_W03	egzamin, kartkówki
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01 - PEU_U03, PEU_K01 - PEU_K03	Kartkówki, odpowiedzi ustne, sprawozdanie z ćwiczeń laboratoryjnych
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01 - PEU_U03, PEU_K01 - PEU_K03	obrona projektu, kartkówki, ocena części obliczeniowej projektu, ocena przygotowania projektu
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

1. A. Dziama; Metodyka konstruowania maszyn, PWN, Warszawa, 1985.
2. Podstawy konstrukcji maszyn. Praca zbiorowa pod red. Z. Osińskiego. Warszawa, PWN 1999.
3. Dietrych J. i inni; Podstawy konstrukcji maszyn. Tom I i II. Warszawa, WNT.
4. Beitz G.; Nauka konstruowania . Warszawa, WNT 1984.
5. Ćwiczenia z podstaw konstrukcji maszyn. Poradnik. Praca zbiorowa pod red. Z. Lawrowskiego, skrypt PWr., Wrocław , 1982.
6. Roloff / Matek, Maschinenelemente - Normung, Berechnung, Gestaltung, Wiesbaden, Vieweg 1994.

LITERATURA UZUPEŁNIAJĄCA

1. Dietrych M. i inni; Podstawy konstrukcji maszyn. Tom I i II. Warszawa, WNT.1966.
2. Skarbiński M., Skarbiński J.; Technologiczność konstrukcji maszyn. Warszawa, WNT 1982.
3. Niemann G., Winter H.; Maschinenelemente. Band II. Berlin, Springer-Verlag 1985.
4. Niezgodzinski M., Niezgodziński T.; Wzory, wykresy i tablice wytrzymałościowe, Warszawa, PWN 2000.
5. Robert Mott, Edward Vavrek, Jyhwen Wang, Machine elements in mechanical design, Pearson, 2017
6. Norton, Robert L., Machine Design: An Integrated Approach, Pearson, 2019

OPIEKUN PRZEDMIOTU
dr inż. Tadeusz Leśniewski tel.: 71 320-40-31 email: Tadeusz.Lesniewski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Teoria mechanizmów i manipulatorów**
Nazwa przedmiotu w języku angielskim: **Theory of Machines and Manipulators**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0086**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30			30	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60			90	
Forma zaliczenia	Egzamin			Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	2			3	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				3	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2			2.1	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Wiedza w zakresie analizy matematycznej, algebry macierzy
2. Wiedza w zakresie podstawowych praw statyki, kinematyki i dynamiki
3. Umiejętność analizy równań, wyznaczania pochodnych, prostych działań na macierzach i wektorach

CELE PRZEDMIOTU

C1. Nabycie wiedzy w zakresie struktury, kinematyki i dynamiki mechanizmów i manipulatorów
C2. Poznanie i rozumienie własności podstawowych typów mechanizmów i manipulatorów
C3. Nabycie umiejętności wyznaczania wielkości kinematycznych i dynamicznych

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Rozumie podstawy teoretyczne budowy strukturalnej mechanizmów maszyn i robotów
PEU_W02 - Zna metody analizy kinematycznej i dynamicznej układów kinematycznych
PEU_W03 - Potrafi interpretować wyniki analiz, oceniać ich poprawność

II. Z zakresu umiejętności:
PEU_U01 - Potrafi ocenić poprawność strukturalną układów kinematycznych i jej skutki
PEU_U02 - Potrafi wyznaczać wielkości kinematyczne i dynamiczne
PEU_U03 - Potrafi budować modele prostych, płaskich mechanizmów i manipulatorów

III. Z zakresu kompetencji społecznych:
PEU_K01 - Posiada przekonanie o odpowiedzialności za wykonaną pracę

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Struktura mechanizmów, własności ruchowe, więzy bierne	3
Wy2	Kinematyka mechanizmów - metody graficzno-analityczne	3
Wy3	Metody analityczne kinematyki (wektory, rzuty, pochodne)	2
Wy4	Przekładnie zębate obiegowe	2
Wy5	Charakterystyka manipulatorów. Układy płaskie szeregowe i równoległe	2
Wy6	Kinematyka manipulatorów płaskich, jakobian	2
Wy7	Opis macierzowy układów przestrzennych	2
Wy8	Notacja Denavita-Hartenberga	2
Wy9	Wprowadzenie do dynamiki mechanizmów	2
Wy10	Analiza kinetostatyczna	3
Wy11	Analiza sił z uwzględnienieniem tarcia w parach kinematycznych, sprawność	3
Wy12	Badanie ruchu układów płaskich	2
Wy13	Nierównomierność biegu maszyny, sposoby regulacji	2
		Suma: 30

Forma zajęć – Projekt		Liczba godzin
Proj1	Wprowadzenie do modelowania mechanizmów w programie SAM (Simulation and Analysis of Mechanisms) – przykłady symulacji	2
Proj2	Struktura mechanizmów: zasady schematyzacji, analiza strukturalna - klasyfikacja par kinematycznych, określanie ruchliwości (kartkówka, zadanie projektowe)	2
Proj3	Reguły modelowania w SAM, samodzielne tworzenie prostych modeli, symulacja pracy, prezentacja wyników.	2

Proj4	Modelowanie mechanizmów z wymiarami, definiowanie napędów, mas, obciążeń.	2
Proj5	Analiza kinematyczna - wyznaczanie położeń (zadanie projektowe)	2
Proj6	Analiza kinematyczna – wyznaczanie prędkości i przyśpieszeń – metody wektorowe (kartkówka, zadanie projektowe).	2
Proj7	Analiza kinematyczna – wyznaczanie prędkości i przyśpieszeń w programie SAM (zadanie projektowe)	2
Proj8	Analiza kinematyczna metodami analitycznymi: równania konturowe, wektory, rzuty, pochodne (zadanie projektowe).	2
Proj9	Manipulatory płaskie – macierzowy opis kinematyki (zadanie projektowe).	2
Proj10	Modelowanie manipulatorów w programie SAM: zadanie proste i odwrotne (zadanie projektowe).	2
Proj11	Analiza mechanizmów obiegowych, wyznaczanie przełożeń (kartkówka, zadanie projektowe).	2
Proj12	Modelowanie przekładni obiegowych i mechanizmów dźwigniowo-zębatych w programie SAM (zadanie projektowe).	2
Proj13	Wyznaczanie sił oddziaływania i wielkości równoważących (kartkówka, zadanie projektowe).	2
Proj14	Wyznaczanie sił oddziaływania z uwzględnieniem tarcia (kartkówka, zadanie projektowe).	2
Proj15	Analiza sił dynamicznych w programie SAM	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład problemowy N2. wykład tradycyjny z wykorzystaniem transparencji i slajdów N3. praca własna - przygotowanie do projektu N4. konsultacje N5. praca własna – samodzielne studia i przygotowanie do egzaminu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	egzamin pisemny
P = Ocena z egzaminu		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03	obrona projektu, kartkówka
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

1. Gronowicz A.: Podstawy analizy układów kinematycznych. Oficyna Wydawnicza PWr., Wrocław 2003; 2. Morecki A., Knapczyk J., Kędzior K.: Teoria mechanizmów i manipulatorów. WNT 2002;
3. Miller S.: Teoria maszyn i mechanizmów. Analiza układów mechanicznych. Oficyna Wydawnicza PWr. Wrocław 1996;
4. Gronowicz A. i inni: Teoria maszyn i mechanizmów. Zestaw problemów analizy i projektowania. Oficyna Wydawnicza PWr. Wrocław 2002

LITERATURA UZUPEŁNIAJĄCA

1. Olędzki A.: Podstawy teorii maszyn i mechanizmów. WNT 1987;
2. Morecki A., Oderfeld J.: Teoria maszyn i mechanizmów. PWN 1987;
3. Waldron K., Kinzel G.: Kinematics, Dynamics and Design of Machinery. John Wiley &Sons, Inc. 1999

OPIEKUN PRZEDMIOTU
dr inż. Sławomir Wudarczyk tel.: 71 320-27-10 email: Slawomir.Wudarczyk@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Techniki wytwarzania - spawalnictwo**
Nazwa przedmiotu w języku angielskim: **Chipless Processes -Welding Metallurgy**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0087**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60		30		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	2		1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2		0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma wiedzę o podstawowych własnościach mechanicznych materiałów inżynierskich; ma uporządkowaną wiedzę o rodzajach metalicznych materiałów inżynierskich - ich budowie, właściwościach, zastosowaniach i zasadach doboru. Ma dostateczną wiedzę w zakresie struktur stali i żeliw, zasad ich klasyfikacji i oznaczania; ma podstawową wiedzę na temat obróbki cieplnej i cieplno-chemicznej, ma wiedzę o stalach stopowych oraz metalach i stopach nieżelaznych.

CELE PRZEDMIOTU

C1. Zapoznanie studentów z procesami i technikami spawalniczymi stosowanymi w budowie maszyn.
C2. Nabycie wiedzy w zakresie technik spawalniczych oraz umiejętności doboru parametrów dla tych procesów.
C3. Nabywanie i utrwalanie kompetencji społecznych obejmujących umiejętność współpracy w grupie studenckiej mającej na celu efektywne rozwiązywanie problemów inżynierskich.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Zna podstawowe metody spajania i parametry procesów oraz posiada wiedzę z zastosowań metod spawania, zgrzewania i lutowania w wytwarzaniu wyrobów.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi dobrać odpowiednią metodę łączenia elementów wyrobu oraz określić podstawowe parametry procesu.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Ma świadomość odpowiedzialności za pracę własną oraz gotowość podporządkowania się zasadom pracy w zespole i ponoszenia odpowiedzialności za wspólnie realizowane zadania, prawidłowo ocenia priorytety zadań własnych i grupowych.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie do spawalnictwa. BHP prac spawalniczych.	2
Wy2	Spawanie ręczne elektrodami otulonymi. Spawanie łukiem krytym.	2
Wy3	Spawanie w osłonie gazów ochronnych TIG, MIG, MAG.	2
Wy4	Spawanie laserowe.	2
Wy5	Zgrzewanie rezystancyjne. Zgrzewanie tarciowe.	2
Wy6	Lutowanie miękkie i twarde.	2
Wy7	Klejenie.	2
Wy8	Test zaliczający.	1
		Suma: 15

Forma zajęć – Laboratorium		Liczba godzin
Lab1	Spawalnictwo – wprowadzenie i BHP.	1
Lab2	Spawanie ręczne elektrodami otulonymi.	2
Lab3	Spawanie w osłonie gazów ochronnych TIG, MIG, MAG.	2
Lab4	Naprężenia i odkształcenia spawalnicze. Spawanie łukiem krytym.	2

Lab5	Zgrzewanie elektryczne oporowe i zgrzewanie tarciowe.	2
Lab6	Lutowanie twarde i miękkie.	2
Lab7	Spawanie gazowe stali. Cięcie termiczne - tlenowe i plazmowe.	2
Lab8	Spawanie zrobotyzowane.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. prezentacja multimedialna N3. praca własna – przygotowanie do laboratorium N4. eksperyment laboratoryjny

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01	Test zaliczeniowy
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_K01	kartkówka
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA [1] Ambroziak A. (red.): Techniki Wytwarzania. Spawalnictwo. Laboratorium PWr, skrypt, 2010 [2] Pilarczyk J. (red.): Poradnik inżyniera. Spawalnictwo. tom 1 i 2. PWN, 2003 LITERATURA UZUPEŁNIAJĄCA [1] Klimpel A.: Spawanie, Zgrzewanie i Cięcie Metali., WNT, 1999 [2] Ferenc J., Ferenc K.: Konstrukcje spawane: połączenia, PWN, 2018

OPIEKUN PRZEDMIOTU
dr inż. Tomasz Piwowarczyk tel.: 4255 email: tomasz.piwowarczyk@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Techniki wytwarzania - przeróbka plastyczna**
Nazwa przedmiotu w języku angielskim: **Chipless processes - Plastic Forming**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0088**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60		30		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	2		1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2		0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Posiada wiedzę o podstawowych własnościach mechanicznych materiałów inżynierskich.
2. Posiadać podstawową wiedzę z zakresu fizyki i matematyki.
3. Posiada umiejętności w zakresie metod pomiaru, technik mierzenia i oceny wyników pomiaru.

CELE PRZEDMIOTU

C1. Poznanie różnych technologii wytwarzania wyrobów poprzez obróbkę plastyczną. Poznanie wpływu stosowanego sposobu kształtowania na własności wytwarzanych wyrobów.
C2. Poznanie zjawisk ograniczających procesy kształtowania plastycznego.
C3. Poznanie nowoczesnych technologii związanych z kształtowaniem plastycznym.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Zna podstawowe technologie plastycznego kształtowania i istotne parametry procesu.
PEU_W02 - Potrafi w sposób prawidłowy definiować problem z zakresu plastycznego kształtowania i odpowiednio go scharakteryzować.
PEU_W03 - Potrafi dobrać odpowiednią technologię kształtowania plastycznego oraz określić podstawowe parametry procesu.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi wyszukiwać informacje dotyczące plastycznego kształtowania oraz przeprowadzać ich krytyczną analizę
PEU_U02 - Potrafi wykorzystać wiedzę teoretyczną z zakresu obróbki plastycznej zdobytą na wykładzie i zastosować ją w praktyce
PEU_U03 - Potrafi przeprowadzić wybrane badania laboratoryjne i prawidło ocenić ich wyniki.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Potrafi myśleć i działać w sposób kreatywny
PEU_K02 - Nabywa umiejętność pracy zespołowej.
PEU_K03 - Rozumie skutki działalności inżynierskiej.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie, Historia obróbki plastycznej.	2
Wy2	Wpływ odkształcania na strukturę i właściwości materiału.	2
Wy3	Procesy kształtowania brył. Analiza procesu walcowania blach i profili.	2
Wy4	Przebieg i analiza procesu wyciskania	2
Wy5	Przebieg i analiza procesów kucia.	2
Wy6	Wytwarzanie wyrobów metalowych w procesie ciągnienia.	2
Wy7	Procesy kształtowania blach.Analiza procesów cięcia, gięcia i tłoczenia.	2
Wy8	Kolokwium zaliczeniowe.	1
		Suma: 15

Forma zajęć – Laboratorium		Liczba godzin
Lab1	Odkształcanie na zimno i wyżarzanie metal. BHP	2
Lab2	Walcowanie blach i kształtowników.	2
Lab3	Wyciskanie hutnicze i części maszyn.	2
Lab4	Wytwarzanie wyrobów metalowych w procesie ciągnienia.	2
Lab5	Tłoczenie- cięcie, gięcie i wytłaczanie.	2
Lab6	Kucie swobodne i matrycowe.	3
Lab7	Badanie tłoczności blach.	2

	Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. praca własna – przygotowanie do laboratorium N3. przygotowanie sprawozdania N4. eksperyment laboratoryjny

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01÷ PEU_W03	kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01÷PEU_U03 PEU_K01÷PEU_K03	kartkówki, sprawozdanie z ćwiczeń laboratoryjnych, udział w dyskusjach problemowych
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
Gronostajski J., Obróbka plastyczna metali, Wrocław 1974Morawiecki M., Sadok L., Wosiek E., Teoretyczne podstawy technologicznych procesów przeróbki plastycznej, Wyd. Śląsk, Katowice 1981http://www.metalplast.pwr.wroc.pl/instrukcje.html

LITERATURA UZUPEŁNIAJĄCA
Romanowski P., Poradnik obróbki plastycznej na zimno, Wydawnictwo Naukowo- Techniczne, Warszawa 1976.
Erbel S., Kuczyński K., Marciniak Z., Obróbka plastyczna, PWN, Warszawa 1981.

OPIEKUN PRZEDMIOTU
dr inż. Marcin Kaszuba tel.: 713202175 email: marcin.kaszuba@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Wytrzymałość materiałów**
Nazwa przedmiotu w języku angielskim: **Strength of Materials**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0089**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30	15			
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60	60			
Forma zaliczenia	Egzamin	Zaliczenie na ocenę			
Grupa kursów					
Liczba punktów ECTS	2	2			
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		2			
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2	1.4			

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Znajomość podstaw mechaniki ciała stałego: analizy tensorowej, praw statyki.
2. Znajomość podstaw wytrzymałości materiałów
3. Znajomość matematyki wyższej w zakresie rachunku całkowego i różniczkowego - rozwiązywanie równań różniczkowych

CELE PRZEDMIOTU

C1. Rozwiązywanie problemów technicznych w oparciu o prawa mechaniki.
C2. Wykonywanie analiz wytrzymałościowych elementów maszyn
C3. Uzyskanie wiedzy z zakresu metod energetycznych w mechanice ciała odkształcalnego

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Student wie jak wyznaczać naprężenia i przemieszczenia w tarczach wirujących oraz w rurach i zbiornikach grubościennych, zna teorię cienkościennych powłok osiowo-symetrycznych, obciążonych ciśnieniem
PEU_W02 - Zna podstawy teoretyczne i metody wyznaczania naprężeń w złożonym stanie naprężenia w dowolnym elemencie konstrukcyjnym
PEU_W03 - Umie zdefiniować energię sprężystą układu i formułować tw. Castigliano i Menabrea-Castigliano

II. Z zakresu umiejętności:
PEU_U01 - Umie sprawdzić warunek wytrzymałościowy i ocenić stan wytężenia w tarczach wirujących oraz w rurach i
zbiornikach grubościennych, zna teorię cienkościennych powłok osiowo-symetrycznych, obciążonych ciśnieniem
PEU_U02 - Umie zastosować twierdzenie Castigliano do wyznaczenia przemieszczeń konstrukcji jak również metodę Menabrea-Castigliano do obliczeń układów hiperstatycznych
PEU_U03 - Student potrafi zaprojektować układy mechaniczne oraz przeprowadzić ich analizę wytrzymałościową

III. Z zakresu kompetencji społecznych:
PEU_K01 - Świadomość społecznych skutków działalności inżynierskiej i związanej z tym odpowiedzialności za podejmowane decyzje
PEU_K02 - Student jest gotowy do wzięcia odpowiedzialności za realizowane zadania; potrafi pracować indywidualnie
i zespołowo.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wieloosiowy stan wytężenia; analiza wybranych, inżynierskich przypadków obciążeniowych oraz ocena stanu wytężenia w oparciu o wybrane hipotezy wytężeniowe	2
Wy2	Metody energetyczne do wyznaczania przemieszczeń w układach prętowych. Układy statycznie niewyznaczalne	2
Wy3	Wyznaczanie przemieszczeń metodą Maxwella-Mohra. Metoda sił.	2
Wy4	Zginanie prętów silnie zakrzywionych	2
Wy5	Ściskanie mimośrodowe prętów smukłych	2
Wy6	Cylindry grubościenne jedno- i wielowarstwowe	2
Wy7	Tarcze i krążki wirujące.	2
Wy8	Płyty kołowe obciążone symetrycznie i prostokątne	2
Wy9	Powłoki osiowo-symetryczne	2
Wy10	Obciążenie elementu zależne od czasu i temperatury (pełzanie i relaksacja).	2
Wy11	Zmęczenie materiału – podstawy obliczeń	2
Wy12	Podstawy mechaniki pękania. Określanie prędkości propagacji pęknięć	2
Wy13	Obciążenia udarowe elementów prętowych	2

Wy14	Naprężenia stykowe. Naprężenia przy ściskaniu kul i wałków	2
Wy15	Naprężenia własne – przyczyny powstawania, zapobieganie, badania	2
		Suma: 30

Forma zajęć – Ćwiczenia		Liczba godzin
Ćw1	Obliczenia elementów konstrukcyjnych w złożonym stanie naprężeń.	3
Ćw2	Obliczanie przemieszczeń konstrukcji w układach statycznie wyznaczalnych z wykorzystaniem metod energetycznych	2
Ćw3	Układy statycznie niewyznaczalne - rozwiązywanie zadań z wykorzystaniem tw. Menabrea-Castigliano	2
Ćw4	Cylindry grubościenne jedno- i wielowarstwowe - obliczenia	2
Ćw5	Tarcze i krążki wirujące - obliczenia	2
Ćw6	Płyty kołowe obciążone symetrycznie i prostokątne	2
Ćw7	Kolokwium zaliczeniowe	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. ćwiczenia rachunkowe

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	egzamin
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Ćwiczenia)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02	kolokwium zaliczeniowe

P = F1

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

[1] M. E. Niezgodziński, T. Niezgodziński: Wytrzymałość materiałów, PWN, 1998.
[2] Z. Dyląg, A. Jakubowicz, Z. Orłoś: Wytrzymałość materiałów. Tom I. WNT, 1999.
[3] M. Zakrzewski, J. Zawadzki: Wytrzymałość materiałów, PWN, 1983.
[4] Z. Brzoska: Wytrzymałość materiałów. PWN, 1979.
[5] R. Żuchowski: Wytrzymałość materiałów, Oficyna Wydawnicza PWr., 1996.
[6] M.E. Nizgodziński, T. Niezgodziński: Obliczenia zmęczeniowe elementów maszyn, PWN, Warszawa 1973
[7] Jakowluk A.: Procesy pełzania i zmęczenia w materiałach, WN-T, 1998,
[8] German J. Podstawy mechaniki pękania, Wyd. Politechniki Krakowska, 2011

LITERATURA UZUPEŁNIAJĄCA

[1] S. Katarzyński, S. Kocańda, M. Zakrzewski: Badania własności mechanicznych metali. WNT, 1967.
[2] J. Walczak: Wytrzymałość materiałów oraz podstawy teorii sprężystości i plastyczności, PWN, 1973.
[3] S. Kocańda: Zmęczeniowe niszczenie metali, WN-T, Warszawa 1978,
[4] S. Kocańda, J. Szala., Podstawy obliczeń zmęczeniowych, PWN, Warszawa 1985,
[5] Brózda J.: Wprowadzenie do mechaniki pękania, Politechnika Śląska, Instytut Spawalnictwa, Gliwice 2008

OPIEKUN PRZEDMIOTU
dr hab. inż. Grzegorz Lesiuk tel.: 713204216 email: grzegorz.lesiuk@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Układy napędowe pojazdów**
Nazwa przedmiotu w języku angielskim: **Vehicles Drive Systems**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0090**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30		30		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	1		1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6		0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. pozytywna ocena z mechaniki, analizy matematycznej oraz podstaw konstrukcji maszyn.
2. podstawowa znajomość działania różnych układów maszyn i urządzeń mechanicznych.
3. podstawowa umiejętność pracy grupowej

CELE PRZEDMIOTU

C1. Celem zajęć jest poszerzenie wiedzy z zakresu budowy układów napędowych pojazdów oraz ich elementów. Student zapoznaje się ze sposobami opracowywania i sporządzania charakterystyk poszczególnych podzespołów układów napędowych, charakterystyk trakcyjnych oraz pierwotnych źródeł energii.
C2. Celem zajęć jest nabycie praktycznej wiedzy dotyczącej metod obliczania i doboru poszczególnych elementów napędowych oraz określenia metod zapobiegających niepożądanym zjawiskom np. mocy krążącej itp. Zna potrzebę dalszego rozwoju zawodowego.
C3. Celem zajęć jest nabycie praktycznych umiejętności planowania eksperymentu, przeprowadzenia go a także interpretacji wyników. Student ma świadomość wpływu wybranych rozwiązań na środowisko i potrafi posługiwać się poprawna terminologią. Nabywa odpowiedzialności za pracę własną i grupową.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - potrafi dobierać i zna charakterystyki pierwotnych źródeł energii oraz opisać przepływ mocy poprzez poszczególne elementy układu napędowego w układach hydrostatycznych, hydrokinetycznych i mechanicznych; dobiera podzespoły układów napędowych na podstawie obliczeń i charakterystyk.
PEU_W02 - potrafi wskazać układy napędowe obecnie stosowanie oraz udoskonalać je do własnych potrzeb w oparciu o rozrój technologii;
PEU_W03 - potrafi opisać i objaśnić zasady działania różnych podzespołów układów napędowych, wskazywać możliwość występowania zjawisk niepożądanych i wskazać metody ich eliminacji.

II. Z zakresu umiejętności:
PEU_U01 - potrafi posługując się również obcojęzyczna literaturą dokonywać interpretacji wyników uzyskanych w trakcie eksperymentu laboratoryjnego oraz korzystać z katalogów;
PEU_U02 - potrafi przeanalizować i opracowywać wyniki w celu uzyskania charakterystyk lub mierzonych parametrów w układach napędowych pojazdów i maszyn przy różnych nastawach układu sterowania;
PEU_U03 - potrafi zaproponować własne koncepcje układów napędowych i ich układów sterowania realizujących podobne funkcje.

III. Z zakresu kompetencji społecznych:
PEU_K01 - potrafi i rozumie potrzebę ciągłego doszkalania się i pozyskiwania nowych informacji;
PEU_K02 - jest odpowiedzialny za podejmowane decyzje zarówno w aspekcie ochrony środowiska naturalnego jak i działalności inżyniera mechanika;
PEU_K03 - potrafi pracować w grupie i rozwiązywać powierzone mu zadania również na różnych stanowiskach i ponosi odpowiedzialność za grupowe osiągnięcie zamierzonego celu.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Konwencjonalne i niekonwencjonalne źródła energii. Metody magazynowania energii mechanicznej, elektrycznej i hydraulicznej. Charakterystyki źródeł energii -zasady sterowania. Niekonwencjonalne źródła energii (np. paliwowe i inne) - przykłady aplikacji i trendy rozwoju	2

Wy2	Systematyka układów napędowych (układy jednoźródłowe, wieloźródłowe, szeregowe, równoległe, hybrydowe) - przykłady aplikacji. Podstawowe funkcje realizowane przez układy napędowe. Budowa i zasada działania poszczególnych elementów znajdujących się za źródłem energii do podłoża (przekładnie, różne typy mechanizmów różnicujących prędkość kół, zwolnice, teoria koła ogumionego).	2
Wy3	Układy napędowe o "sztywnym" i "elastycznym" sprzężeniu kinematycznym. Zagadnienie niezgodności kinematycznej i mocy krążącej w układach napędowych - podstawy fizykalne, skutki techniczne, sposoby eliminacji - przykłady. Sprawność przekładni mechanicznych.	2
Wy4	Podstawy doboru struktury układu napędowego oraz zagadnienia doboru pierwotnego źródła energii: a) typowy układ napędowy mechaniczny b) typowy układ napędowy hydrokinetyczny.Opory ruchu pojazdów i zapotrzebowanie energetyczne maszyn i pojazdów. Teoria koła ogumionego, opory toczenia, współczynnik przyczepności. Charakterystyki trakcyjne pojazdów on-road i off-road.	2
Wy5	Pojazdy elektryczne i ich podział. Parametry określające przydatności silnika elektrycznego stosowanego w układach napędowych pojazdów elektrycznych i hybrydowych. Budowa, metody regulacji prędkości i momentu, mapy sprawności. Obliczanie zredukowanego momentu napędowego i momentu bezwładności do wału silnika. Dobór motoreduktorów i określenia dynamiki układu przeniesienia napędu.	2
Wy6	Hybrydowe szeregowe i równoległe układy napędowe. Metody obliczeń zapotrzebowania mocy podczas ruchu oraz dobór obu źródeł energii, pojemności wtórnego źródła energii, cyklogramy miejskie, poza miejskie.	2
Wy7	Podstawy hamowania rekuperacyjnego pojazdów. Odzysk energii, strategie sterowania układem hamulcowym. Kolokwium zaliczeniowe 45min.	3
		Suma: 15
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Badania eksperymentalne hydrostatycznego układu napędowego jazdy pojazdu przemysłowego	2
Lab2	Badania eksperymentalne hydrostatycznego układu napędowego unoszenia wysięgnika pojazdu przemysłowego	2
Lab3	Wyznaczanie charakterystyki zewnętrznej silnika spalinowego z zapłonem samoczynnym	2
Lab4	Eksperymentalne wyznaczanie charakterystyki wybranego odbiornika energii i określenie sprawności przeniesienia napędu.	2
Lab5	Badanie wpływu sztywności więzi sprężystej w układzie napędowym na jego obciążenia dynamiczne	2
Lab6	Badania eksperymentalne napędu hybrydowego podwozia na gąsienicach elastomerowych	2
Lab7	Porównanie procesu rozruchu układu napędowego z silnikiem asynchronicznym	2
Lab8	Zajęcia organizacyjne. Przedstawienie zasad zaliczenia kursu, planu, BHP. Ogólne wiadomości o realizowanym kursie.	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. eksperyment laboratoryjny N3. prezentacja multimedialna N4. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01 PEU_W02 PEU_W03	egzamin pisemny
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01-PEU_U03 PEU_K01-PEU_K03	kartkówka, sprawozdanie z ćwiczeń, odpowiedź ustna
P = pozytywne oceny z wszystkich ćwiczeń laboratoryjnych		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA Szumanowski A. , tytuł: Układy napędowe z akumulacja energii, PWN, Pieczonka K. , tytuł: Maszyny urabiające, Politechnika Wrocławska, Szydelski Z. , tytuł: Napęd i sterowanie hydrauliczne, WKŁ, Kaczmarek T., tytuł: Napęd elektryczny robotów, Wydawnictwo Politechniki Poznańskiej, Wróbel T. , tytuł: Silniki krokowe, Wydawnictwo Naukowo-Techniczne, Kosmol J., tytuł: Serwonapędy obrabiarek sterowanych numerycznie, Wydawnictwo Naukowo-Techniczne, LITERATURA UZUPEŁNIAJĄCA Dębicki M., tytuł: Teoria samochodu, WNT , rok: Szumanowski A. , tytuł: Czas energii, WKiŁ, rok: 1988 Mitschke M. , tytuł: Dynamika samochodu. Napęd i hamowanie., WKiŁ, Michałowski K. Ocioszyński J.,tytuł: Pojazdy samochodowe o napędzie elektrycznym i hybrydowym, WKiŁ, rok: 1989

OPIEKUN PRZEDMIOTU
dr inż. Aleksander Skurjat tel.: 71 320-23-46 email: Aleksander.Skurjat@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Metrologia wielkości geometrycznych**
Nazwa przedmiotu w języku angielskim: **Geometric metrology**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0091**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30		30		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	1		1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6		0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma podstawową wiedzę w zakresie matematyki i fizyki na poziomie szkoły ponadpodstawowej.
2. Posiada umiejętność odczytywania rysunków i schematów zawartych w dokumentacji technicznej.
3. Posiada podstawową wiedzę w zakresie konstrukcji elementów maszyn. Posiada podstawową wiedzę w zakresie technik wytwarzania elementów maszyn

CELE PRZEDMIOTU

C1. Nabycie wiedzy o wielkościach i jednostkach miar związanych z opisem geometrii wyrobu.
C2. Nabycie wiedzy na temat rodzajów i właściwości sprzętu do pomiaru wielkości geometrycznych
C3. Zdobycie umiejętności posługiwania się sprzętem do pomiaru wielkości geometrycznych
C4. Zdobycie wiedzy i umiejętności w zakresie doboru sprzętu pomiarowego, analizy wyników pomiarów, oceny błędów pomiarów i sposobu wyrażania niepewności pomiarowej
C5. Wyszukiwanie istotnych informacji oraz ich krytyczna analiza
C6. Nabywanie i utrwalanie kompetencji społecznych obejmujących inteligencję emocjonalną, polegającą na współpracy w grupie studenckiej mającej na celu efektywne rozwiązywanie problemów. Odpowiedzialność, uczciwość i rzetelność w postępowaniu, przestrzeganie, obyczajów obowiązujących w środowisku akademickim

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Potrafi zidentyfikować wielkości związane z opisem geometrii wyrobu, umie nazwać jednostki miar służących do ich opisu, rozróżnia uniwersalny i dedykowany sprzęt do pomiaru wielkości geometrycznych, wie jak scharakteryzować jego cechy i właściwości metrologiczne. Zna i potrafi objaśnić pojęcia stosowane w metrologii wielkości geometrycznej
PEU_W02 - Potrafi zdefiniować elementy procesu pomiarowego i ich wpływ na efekt pomiaru

II. Z zakresu umiejętności:
PEU_U01 - Rozumie wymagania wymiarowe stawiane wyrobom, zawarte w dokumentacji technicznej. Potrafi korzystać z norm dotyczących tolerancji wymiarów liniowych i pasowań a także tolerancji geometrycznych. Potrafi szacować niepewność pomiarową dla różnego rodzaju pomiarów.
PEU_U02 - Umie dokonać doboru odpowiedniego sprzętu pomiarowego oraz dokonać jego konfiguracji w zależności od postawionego zadania pomiarowego. Potrafi korzystać z sprzętu pomiarowego stosowanego w przemyśle maszynowym do pomiaru wielkości geometrycznych

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Sprawy organizacyjne. Podstawowe pojęcia metrologii. Wielkości i jednostki miar. Układy jednostek miar SI, wzorce jednostek miar, spójność pomiarowa.	2
Wy2	Klasyfikacja sprzętu pomiarowego do pomiaru geometrii wyrobów i jego charakterystyki metrologiczne.	3
Wy3	Niepewność pomiarowa, jej źródła w pomiarach wielkości geometrycznych. Rola niepewności w orzekaniu o zgodności lub niezgodności wyrobu ze specyfikacją.	2
Wy4	Rodzaje charakterystyk wymiarowych wyrobu. Sposoby ich specyfikacji oraz tolerowanie zgodnie z zapisem norm z serii ISO GPS	2
Wy5	Rodzaje charakterystyk geometrycznych wyrobu. Sposoby ich specyfikacji oraz tolerowanie zgodnie z zapisem norm z serii ISO GPS	2

Wy6	Rodzaje charakterystyk struktury geometrycznej powierzchni wyrobu. Sposoby ich specyfikacji oraz tolerowanie zgodnie z zapisem norm z serii ISO GPS	2
Wy7	Podstawy współrzędnościowej techniki pomiarowej geometrii wyrobów.	2
		Suma: 15
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Sprawy organizacyjne. Ogólne zasady posługiwania się sprzętem pomiarowym	1
Lab2	Pomiary wymiarów liniowych	2
Lab3	Pomiary wymiarów kątowych i stożków	2
Lab4	Pomiary odchyłek geometrycznych	2
Lab5	Pomiary struktury geometrycznej powierzchni	2
Lab6	Identyfikacja i pomiary gwintów zewnętrznych	2
Lab7	Identyfikacja i pomiary kół zębatych walcowych	2
Lab8	Podstawy pomiarów współrzędnościowych	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. eksperyment laboratoryjny N3. przygotowanie sprawozdania N4. praca własna – przygotowanie do laboratorium N5. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01; PEU_W02;	kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się

F1	PEU_U01; PEU_U02;	sprawozdanie z ćwiczeń laboratoryjnych, kartkówka, odpowiedzi ustne
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

[1] Jakubiec W., Malinowski J.: "Metrologia wielkości geometrycznych". WNT, Warszawa 2018.
[2] Instrukcje do ćwiczeń laboratoryjnych. (www.metrologia.pwr.edu.pl)

LITERATURA UZUPEŁNIAJĄCA

[1] Lisowski M.: „Podstawy Metrologii". Oficyna Wydawnicza PWr, Wrocław 2015
[2] Adamczak S., Makieła W.: " Metrologia w budowie maszyn. Zadania z rozwiązaniami. Wydanie II, zmienione". WNT, Warszawa 2022.
[3] Adamczak S., Makieła W.: "Pomiary geometryczne powierzchni". WNT, Warszawa 2009.
[4] Jakubiec W., Malinowski J., Płowucha W.: "Pomiary gwintów w budowie maszyn". WNT, Warszawa 2010.
[5] Ochęduszko K., "Koła zębate. Tom 3. Sprawdzanie". WNT Warszawa 2013
[6] Ratajczyk E., Woźniak A.: "Współrzędnościowe Systemy Pomiarowe". Oficyna Wydawnicza PW, Warszawa 2016

OPIEKUN PRZEDMIOTU

dr inż. Marek Kuran tel.: 27-28 email: marek.kuran@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Hydrostatyczne układy napędowe**
Nazwa przedmiotu w języku angielskim: **Hydrostatic drive systems**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0092**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30		30		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	1		1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6		0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Posiada podstawową wiedzę z mechaniki płynów.
2. Potrafi rozwiązywać równania różniczkowe zwyczajne stanowiące modele matematyczne elementów i układów hydrostatycznych.
3. Znajomość podstawowych zagadnień z mechaniki klasycznej.

CELE PRZEDMIOTU

C1. Zapoznanie studentów z podstawowymi prawami hydrostatycznych układów napędowych.
C2. Zaznajomienie studentów z elementami hydraulicznymi i zasadą ich działania.
C3. Zaznajomienie z konfiguracją prostych hydrostatycznych układów napędowych.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - W wyniku przeprowadzonych zajęć student powinien być w stanie definiować wymagania stawiane cieczom roboczym hydrostatycznych układów napędowych.
PEU_W02 - W wyniku przeprowadzonych zajęć student powinien być w stanie opisywać zasadę działania podstawowych elementów układu hydrostatycznego.
PEU_W03 - W wyniku przeprowadzonych zajęć student powinien być w stanie scharakteryzować pracę podstawowych hydrostatycznych układów napędowych.

II. Z zakresu umiejętności:
PEU_U01 - W wyniku przeprowadzonych zajęć student powinien umieć analizować pracę elementów i układów hydrostatycznych.
PEU_U02 - - W wyniku przeprowadzonych zajęć student powinien umieć obliczać podstawowe parametry hydrostatycznego układu napędowego.
PEU_U03 - - W wyniku przeprowadzonych zajęć student powinien umieć interpretować podstawowe charakterystyki
elementów i układów hydrostatycznych.

III. Z zakresu kompetencji społecznych:
PEU_K01 - W wyniku przeprowadzonych zajęć student powinien posiąść zdolności analizowania informacji o różnym poziomie złożoności.
PEU_K02 - W wyniku przeprowadzonych zajęć student powinien posiąść zdolności obiektywnego oceniania argumentów, racjonalnego tłumaczenia i uzasadniania własnego punktu widzenia z wykorzystaniem wiedzy z zakresu hydrostatycznych układów napędowych.
PEU_K03 - - W wyniku przeprowadzonych zajęć student powinien posiąść zdolności przestrzegania obyczajów i zasad obowiązujących w środowisku akademickim.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie, omówienie treści wykładu, wymagań i formy zaliczenia.	1
Wy2	Podstawowa symbolika elementów i układów hydraulicznych.	1
Wy3	Zanieczyszczenia – źródła, przyczyny i skutki – filtracja.	1
Wy4	Ciecze hydrauliczne – właściwości i cechy.	2
Wy5	Straty hydrauliczne i objętościowe w maszynach wyporowych i w układzie.	2
Wy6	Pompy wyporowe – podział, charakterystyki, sprawności.	2
Wy7	Zawory – podział, rodzaje, funkcje.	2
Wy8	Silniki hydrauliczne wyporowe - podział, charakterystyki, sprawności.	2
Wy9	Zaliczenie wykładu.	2
		Suma: 15
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Wprowadzenie, omówienie treści laboratoriów, wymagań i formy zaliczenia. Wstępne szkolenie BHP.	1

Lab2	Eksperymentalne wyznaczenie właściwości cieczy roboczej – moduł sprężystości objętościowej.	2
Lab3	Eksperymentalne wyznaczenie charakteru oporów w przewodach hydraulicznych – opory liniowe.	2
Lab4	Opory miejscowe w układach hydraulicznych. Zwężka jako opór miejscowy – zjawisko kawitacji.	2
Lab5	Eksperymentalne wyznaczenie charakterystyki pompy wyporowej.	2
Lab6	Charakterystyki statyczne konwencjonalnego rozdzielacza suwakowego.	2
Lab7	Opis stanów nieustalonych układu hydraulicznego – eksperymentalne wyznaczenie podstawowych wskaźników dynamicznych.	2
Lab8	Zaliczenie laboratorium.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. prezentacja multimedialna N2. eksperyment laboratoryjny N3. praca własna – przygotowanie do laboratorium

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01-PEU_W03, PEU_K01-PEU_K03	kolokwium, odpowiedź ustna
P = p		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01- PEU_U03, PEU_K01-PEU_K03	sprawozdania, kartkówka, odpowiedź ustna
P = F, p		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA Stryczek S.; Napęd hydrostatyczny - Elementy i układy. WNT 2015. Osiecki A.: Napęd hydrostatyczny maszyn, WNT, Warszawa 1996. Kollek W.: Pompy zębate. Konstrukcje i eksploatacja. Zakład Narodowy im. Ossolińskich, Wrocław 1996 LITERATURA UZUPEŁNIAJĄCA Stosiak M.: Identyfikacja oddziaływania drgań i metody ich redukcji w wybranych zaworach hydraulicznych. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2015. Kudźma Z.: Tłumienie pulsacji ciśnienia i hałasu w układach hydraulicznych w stanach przejściowych i ustalonych. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2012.

OPIEKUN PRZEDMIOTU
dr hab. inż. Michał Stosiak tel.: 71 320-45-99 email: Michal.Stosiak@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Metoda elementów skończonych**
Nazwa przedmiotu w języku angielskim: **Finite Element Method**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0093**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15			30	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30			60	
Forma zaliczenia	Zaliczenie na ocenę			Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	1			2	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				2	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6			1.4	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Podstawy wytrzymałości materiałów, analizy wytrzymałościowej układów prętowych, tarczowych i płytowych. Znajomość rodzajów materiałów inżynierskich.
2. Algebra macierzy.
3. Znajomość podstawowych narzędzi CAD. Umiejętność przeprowadzenia analizy wytrzymałościowej metodami klasycznymi w zakresie sprężystym dla prostych elementów konstrukcyjnych.

CELE PRZEDMIOTU

C1. Nabycie wiedzy w zakresie podstaw teorii metody elementów skończonych.
C2. Nabycie umiejętności zbudowania odpowiedniego modelu do obliczeń MES.
C3. Umiejętność przeprowadzenia symulacji komputerowych w programie MES.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Zna podstawy teorii metody elementów skończonych
PEU_W02 - Zna zasady budowy modeli numerycznych (geometrycznych i dyskretnych) elementarnych konstrukcji do obliczeń MES
PEU_W03 - Posiada podstawową wiedzę o możliwościach zastosowania metody elementów skończonych w obliczeniach inżynierskich

II. Z zakresu umiejętności:
PEU_U01 - Posiada umiejętność posługiwania się systemami komputerowymi do prowadzenia obliczeń numerycznych z wykorzystaniem MES.
PEU_U02 - Potrafi zastosować odpowiedni rodzaj modelu geometrycznego i dyskretnego do rozwiązania określonego zadania teorii sprężystości.
PEU_U03 - Potrafi przeprowadzić obliczenia MES w zakresie statyki, drgań własnych i stateczności sprężystej.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Nabywa umiejętności ponoszenia odpowiedzialności za wykonaną pracę.
PEU_K02 - Myśleć i działać w sposób kreatywny.
PEU_K03 - Nabywa umiejętność pracy zespołowej.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Rozwój metod numerycznych	1
Wy2	Miejsce metody elementów skończonych w procesie modelowania układów rzeczywistych	1
Wy3	Istota MES, funkcje interpolacyjne, warunki zbieżności metody	2
Wy4	Klasyfikacja elementów skończonych	2
Wy5	Zasady budowy macierzy sztywności elementów skończonych.	4
Wy6	Modelowanie warunków brzegowych w modelach numerycznych.	2
Wy7	Przykłady praktycznego zastosowania nowoczesnych metod obliczeniowych w projektowaniu CAD (MES)	2
Wy8	Kolokwium	1
		Suma: 15
Forma zajęć – Projekt		Liczba godzin

Proj1	Omówienie programu zajęć laboratoryjnych. Wprowadzenie do środowiska programu obliczeniowego.	1
Proj2	Zasady budowania modelu fizycznego, idealizacja układu, uproszczenia stosowane w modelach fizycznych.	2
Proj3	Dyskretyzacja modeli bryłowych, analiza czynników (rodzaj elementu skończonego, gęstość dyskretyzacji) wpływających na dokładność obliczeń.	6
Proj4	Płaski stan naprężenia na przykładzie tarczy prostokątnej z otworem. Analiza dokładności przy zastosowaniu różnych typów elementów skończonych i wpływ gęstości podziału w porównaniu z rozwiązaniem teoretycznym zagadnienia Kirscha.	4
Proj5	Analiza zginania płyty przy zastosowaniu różnych typów i gęstości podziału elementów powłokowych i bryłowych. Wpływ liczby warstw w modelu bryłowym na dokładność obliczeń przemieszczeń i naprężeń w porównaniu z rozwiązaniem teoretycznym. Wykorzystanie symetrii.	4
Proj6	Analiza stanu naprężeń i sił w elementach kratownicy, przy zastosowaniu raz modelu prętowego i raz modelu belkowego. Analiza stateczności sprężystej elementów kratownicy obliczanej za pomocą modelu belkowego.	6
Proj7	Zagadnienie stateczności sprężystej ściskanej osiowo powłoki walcowej. Analiza wpływu geometrii powłoki (średnicy, długości i grubości) na wartość obciążenia krytycznego. Stateczność lokalna i globalna.	2
Proj8	Zagadnienie osiowo-symetryczne na przykładzie grubościennej rury poddanej ciśnieniu wewnętrznemu. Zagadnienie kontaktowe na przykładzie dwóch rur złożonych z zaciskiem. Analiza rozkładu przemieszczeń promieniowych, naprężeń promieniowych i obwodowych.	2
Proj9	Wykonanie projektu - symulacji komputerowej stanu wytężenia wybranej struktury nośnej.	3
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. ćwiczenia problemowe N3. praca własna - przygotowanie do projektu N4. prezentacja projektu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	Kolokwium zaliczeniowe
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03 PEU_K01, PEU_K02, PEU_K03	Ocena za wykonanie projektu
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

Rusiński E., Czmochowski J., Smolnicki T. Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000

Rakowski G., Kacprzyk Z.: Metoda elementów skończonych w mechanice konstrukcji, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2016

Zienkiewicz O.C.: Metoda elementów skończonych, Arkady 1972

LITERATURA UZUPEŁNIAJĄCA

Szmelter J., Dacko M., Dobrociński S., Wieczorek M.: Metoda elementów skończonych w statyce konstrukcji, Arkady 1979

Gawroński W., Kruszewski J., Ostachowicz W., Tarnowski K., Wittbrodt E.: Metoda elementów skończonych w dynamice konstrukcji, Arkady, Warszawa 1984

Waszczyszyn Z., Cichoń Cz., Radwańska M.: Metoda elementów skończonych w stateczności konstrukcji, Arkady, Warszawa 1990

Kleiber M.: Wprowadzenie do metody elementów skończonych, PWN, Warszawa-Poznań 1989

Cichoń Cz., Cecot W., Krok J., Pluciński P.: Metody Komputerowe w liniowej mechanice konstrukcji, Wydawnictwo Politechniki Krakowskiej, Kraków, 2010

Olszowski B. Wybrane metody numeryczne, Wydawnictwo Politechniki Krakowskiej, Kraków, 2007

OPIEKUN PRZEDMIOTU

dr inż. Artur Górski tel.: 71 320-28-47 email: artur.gorski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Podstawy konstrukcji maszyn II**
Nazwa przedmiotu w języku angielskim: **Fundamentals of Machine Design II**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0094**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30			30	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60			90	
Forma zaliczenia	Egzamin			Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	2			3	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				3	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2			2.1	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Wiedza:1. Ma podstawową wiedzę z zakresu metaloznawstwa, materiałów konstrukcyjnych, mechaniki, wytrzymałości materiałów i technik wytwarzania, grafiki inżynierskiej. 2. Posiada podstawową wiedzę z zakresu Podstaw Konstrukcji Maszyn I (proces projektowo-konstrukcyjny, połączenia stosowane w budowie maszyn) oraz wykonywania dokumentacji technicznej za pomocą programu AutoCAD.
2. Umiejętności: 1. Ma umiejętność samokształcenia się oraz potrafi pozyskiwać informacje z różnych źródeł, dokonywać ich interpretacji, a także wyciągać wnioski oraz formułować i uzasadniać opinie. 2. Potrafi zastosować w procesie konstruowania wiedzę zdobytą na przedmiotach: Metaloznawstwo, Mechanika, Wytrzymałość materiałów, Grafika inżynierska, Podstawy Konstrukcji Maszyn I.
3. Kompetencje:1. Potrafi myśleć i działać w sposób przedsiębiorczy. 2. Ma świadomość powagi i skutków działalności inżyniera mechanika i rozumie potrzebę działania profesjonalnego (zarówno indywidualnie jak i zespołowo).

CELE PRZEDMIOTU

C1. Nabycie podstawowej wiedzy dotyczącej projektowania wałów maszynowych (obliczenia konstrukcyjne, dobór cech geometrycznych, rezonans, osadzanie elementów na wale) oraz elementów podtrzymujących wały - łożyska (charakterystyka łożysk tocznych, kryteria doboru, zasady łożyskowania i pasowania).
C2. Zdobycie wiedzy z zakresu budowy, działania, doboru, obliczeń konstrukcyjnych i eksploatacji sprzęgieł oraz zespołów przenoszących i zmieniających ruch obrotowy (przekładnie mechaniczne pasowe, łańcuchowe i zębate).
C3. Zdobycie praktycznej umiejętności realizacji prostego typowego zadania konstrukcyjnego poprzez rozwiązanie zadania, którego treścią jest optymalna konstrukcja zespołu napędowego maszyny roboczej (np. taśmociągu, młyna kulowego, kruszarki, pieca obrotowego itp.) Proces konstruowania jest wspomagany komputerowo zarówno na etapie doboru cech konstrukcyjnych (używa się komputerowych programów wspomagających obliczenia konstruowanych elementów) jak i na etapie graficznego ich zapisu (AutoCAD).

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Zna algorytm obliczeń konstrukcyjnych wałów maszynowych i elementów podtrzymujących wały.
PEU_W02 - Ma poszerzoną wiedzę w zakresie budowy sprzęgieł, ich zastosowania i doboru oraz obliczeń.
PEU_W03 - Ma podstawową wiedzę na temat budowy, działania, zasad doboru i obliczeń konstrukcyjnych zespołów przenoszących i zmieniających ruch obrotowy (przekładnie mechaniczne: pasowe, łańcuchowe i zębate).

II. Z zakresu umiejętności:
PEU_U01 - Potrafi samodzielnie formułować i rozwiązywać proste zadania techniczne.
PEU_U02 - Potrafi dobrać i obliczyć wały, łożyska, sprzęgła i przekładnie mechaniczne.
PEU_U03 - Potrafi skonstruować optymalny (w świetle przyjętych kryteriów) napęd dowolnej maszyny roboczej.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Potrafi wyszukiwać informacje i dokonywać ich krytycznej analizy.
PEU_K02 - Potrafi pracować samodzielnie i w zespole.
PEU_K03 - Obiektywnie ocenia zadanie, założenia projektowe oraz potrafi uzasadnić wybrane rozwiązanie i sposób jego realizacji.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Program kursu i wymagania. Wały i osie – charakterystyka ogólna. Teoretyczne podstawy doboru cech konstrukcyjnych wałów maszynowych. Zasady kształtowania wałów i osi. Zasady i sposoby ustalania elementów na wałach i osiach.	2
Wy2	Zagadnienie wytrzymałości zmęczeniowo – kształtowej wałów. Zjawisko rezonansu. Obliczenia zespołów obrotowych ze względu na wystąpienie rezonansowych drgań giętych.	2
Wy3	Charakterystyka tarcia tocznego i ślizgowego. Podział łożysk, ogólna charakterystyka łożysk tocznych i ślizgowych. Kryteria i sposób doboru łożysk tocznych.	2

Wy4	Zasady łożyskowania zespołów obrotowych. Pasowanie, smarowanie i uszczelnianie łożysk tocznych.	2
Wy5	Ogólna klasyfikacja sprzęgieł. Charakterystyka sprzęgieł nierozłącznych, zasady ich doboru i obliczeń.	2
Wy6	Charakterystyka sprzęgieł rozłącznych. Analiza procesu włączania. Praca rozruchu i praca tarcia w rozruchu, bilans cieplny i trwałość sprzęgła. Promień tarcia w sprzęgle ciernym.	2
Wy7	Przekładnie pasowe, podział, ogólna charakterystyka i kryteria doboru. Sprzężenie cierne pasa z kołem. Poślizg sprężysty, przełożenie rzeczywiste, współczynnik napędu.	2
Wy8	Wyznaczenie sił i naprężeń w pasie. Wymagana siła napięcia wstępnego w pasie oraz sposoby jej regulacji.	2
Wy9	Sprawność przekładni pasowej i trwałość pasa. Charakterystyka materiałów na pasy. Konstrukcja kół pasowych (dobór cech konstrukcyjnych). Obliczenia konstrukcyjne przekładni pasowych z pasem klinowym.	2
Wy10	Przekładnie cięgnowe cd. Przekładnie łańcuchowe, ich charakterystyka i sposób obliczania.	2
Wy11	Przekładnie zębate, podział i charakterystyka. Podstawowe prawo zazębienia. Poślizg międzyrębny. Omówienie zarysów cykloidalnych i ewolwentowego.	2
Wy12	Zarys odniesienia. Normalizacja kół ewolwentowych. Pojęcia podstawowe: moduł, kąt zarysu, kąt i linia przyporu, odcinek i wskaźnik przyporu. Rola tych parametrów w działaniu i obliczeniach przekładni zębatych. Sposoby obróbki kół zębatych.	2
Wy13	Graniczna liczba zębów ze względu na podcięcie zęba u podstawy. Podstawowe rodzaje korekcji zazębienia. Zaostrzenie zęba u wierzchołka.	2
Wy14	Modele obciążenia zęba przy wyznaczaniu naprężeń. Współczynnik obciążenia. Rozkład sił w zazębieniu prostym i skośnym.	2
Wy15	Encyklopedyczne omówienie zalecanych przez ISO metod obliczeń wytrzymałościowych (sprawdzających) kół zębatych.	2
		Suma: 30
Forma zajęć – Projekt		Liczba godzin
Proj1	Opracowanie założeń konstrukcyjnych dla konstruowanego zespołu napędowego (opis: istoty działania , danych sytuacyjnych, danych ilościowych, warunków eksploatacji itp.).	2
Proj2	Schematy różnych wariantów rozwiązań , oraz szkic konstrukcyjny (bez uszczegółowień) wybranego rozwiązania wraz z uzasadnieniem jego przyjęcia.	4
Proj3	Przyjęcie dla każdego podzespołu układu napędowego kryterium optymalizacji i znalezienie przy pomocy odpowiedniego programu komputerowego najlepszego rozwiązania.	12
Proj4	Sporządzenie rysunku złożeniowego i rysunków wykonawczych (wskazanych przez Prowadzącego zajęcia). Rysunki wykonawcze zrobić obowiązkowo za pomocą programu Auto-CAD.	12
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. ćwiczenia rachunkowe N3. konsultacje N4. praca własna - przygotowanie do projektu N5. praca własna – samodzielne studia i przygotowanie do egzaminu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01 - PEU_W03	egzamin, kartkówki
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01 - PEU_U03, PEU_K01 - PEU_K03	obrona projektu, kartkówki, ocena części obliczeniowej projektu, ocena przygotowania projektu
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

1.Podstawy konstrukcji maszyn. Praca zbiorowa pod red. Z. Osińskiego. Warszawa, PWN 1999.
2.Dietrych J. i inni; Podstawy konstrukcji maszyn. Tom II i III, Warszawa, WNT.
3. Dziama A. i inni; Przekładnie zębate. Warszawa, PWN 1995.
4. Dietrych M. i inni; Podstawy konstrukcji maszyn. Tom III i IV. W-a, WNT 1996.
5. Ćwiczenia z podstaw konstrukcji maszyn. Poradnik. Praca zbiorowa pod red. Z. Lawrowskiego, skrypt PWr., Wrocław , 1982.
6. Krawiec S.; Obliczenia konstrukcyjne przekładni pasowych i zębatych wspomagane mikrokomputerem, skrypt PWr., Wrocław, 1992.
7. Capanidis D, Krawiec S. Wieleba W.; Materiały pomocnicze do ćwiczeń projektowych z PKM wspomaganych komputerowo, IKEM PWr., 1993.
8. Roloff/Matek; Maschinenelemente - Normung, Berechnung, Gestaltung, Wiesbaden, Vieweg 1994.

LITERATURA UZUPEŁNIAJĄCA

1.Jaśkiewicz Z., Wąsiewski A.; Przekładnie walcowe. Warszawa, WKŁ 1992.
2. Niemann G., Winter H.; Maschinenelemente. Band II. Berlin, Springer- Verlag 1985.
3. Niemann G., Winter H.; maschinenelemente. Band III. Berlin, Springer- Verlag 1983.
4. Skarbiński M., Skarbiński J.; Technologiczność konstrukcji maszyn. Warszawa, WNT 1982.
5. Robert Mott, Edward Vavrek, Jyhwen Wang, Machine elements in mechanical design, Pearson, 2017
6. Norton, Robert L., Machine Design: An Integrated Approach, Pearson, 2019

OPIEKUN PRZEDMIOTU

dr inż. Tadeusz Leśniewski tel.: 71 320-40-31 email: Tadeusz.Lesniewski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Podstawy automatyki**
Nazwa przedmiotu w języku angielskim: **Fundamentals of Automatic Control**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0095**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30		30		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60		60		
Forma zaliczenia	Egzamin		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	2		2		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			2		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2		1.4		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma podstawową wiedzę z zakresu matematyki obejmującą: funkcje zespolone, równania różniczkowe, układy równań, algebrę macierzy.
2. Ma znajomość podstawowych praw i zasad fizyki.
3. Potrafi opisywać i analizować działanie podstawowych układów mechanicznych i fizycznych.

CELE PRZEDMIOTU

C1. Zapoznanie uczestników kursu ze sposobami opisu własności statycznych i dynamicznych liniowych członów automatyki w budowie maszyn i urządzeń.
C2. Zapoznanie uczestników kursu z podstawowymi układami regulacji i badania ich stabilności.
C3. Zapoznanie uczestników kursu z podstawowymi układami sterowania w mechanice i budowie maszyn.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Ma wiedzę z zakresu podstawowych metod opisu układów automatyki.
PEU_W02 - Ma wiedzę z zakresu podstawowych metod analizy układów automatyki.
PEU_W03 - Ma wiedzę z zakresu podstawowych metod syntezy układów automatyki.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi zdefiniować opis matematyczny układu automatyki.
PEU_U02 - Potrafi przeanalizować działanie układu automatyki.
PEU_U03 - Potrafi zaprojektować układ automatyki.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Potrafi pogłębić wiedzę korzystając z dodatkowych pomocy naukowych.
PEU_K02 - Potrafi myśleć i działać w sposób kreatywny.
PEU_K03 - Rozumie potrzebę przestrzegania obyczajów i zasad obowiązujących w środowisku akademickim i społeczeństwie.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie, pojęcia podstawowe, struktura układów automatyki i ich klasyfikacja.	2
Wy2	Podstawowe sygnały automatyki. Opis liniowych układów automatyki: modele matematyczne, transmitancja operatorowa, charakterystyki czasowe.	2
Wy3	Dynamiczne układy nieliniowe. Metody opisu i analizy. Punkt pracy układu dynamicznego, linearyzacja. Charakterystyki statyczne.	2
Wy4	Podstawowe człony dynamiczne i ich modele matematyczne. Przykłady układów fizycznych.	2
Wy5	Opis liniowych układów automatyki: transmitancja widmowa, charakterystyki częstotliwościowe.	2
Wy6	Systemy o strukturze złożonej. Schematy blokowe układów automatyki i metody ich przekształceń.	2
Wy7	Regulatory stosowane w automatyce, klasyfikacja. Regulacja dwupołożeniowa i trójpołożeniowa.	2
Wy8	Regulacja: P, PI, PD, PID. Metody doboru nastaw P, I, D regulatorów.	2
Wy9	Stabilność układów regulacji. Twierdzenie o stabilności, własności systemów stabilnych i niestabilnych. Kryteria stabilności.	2
Wy10	Elementy logiki. Algebra Boole'a. Analiza i synteza układów logicznych. Bramki logiczne.	2
Wy11	Układy sterownia przekaźnikowo - stycznikowe. Projektowanie schematów ideowych.	2
Wy12	Zastosowanie sterowników PLC w automatyce przemysłowej. Projektowanie i zapis algorytmów sterowania.	2

Wy13	Układy logiczne kombinacyjne w systemach sterowania.	2
Wy14	Układy logiczne sekwencyjne w automatyce przemysłowej.	2
Wy15	Podsumowanie. Sprawdzian wiadomości w formie kolokwium.	2
		Suma: 30
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Zajęcia organizacyjne. Przepisy BHP w pracowni automatyki. Wprowadzenie, podstawowe pojęcia. Klasyfikacja układów sterowania.	2
Lab2	Charakterystyki statyczne elementów automatyki.	2
Lab3	Charakterystyki dynamiczne czasowe elementów automatyki.	2
Lab4	Charakterystyki częstotliwościowe elementów automatyki.	2
Lab5	Badania symulacyjne elementów automatyki w środowisku Matlab-Simulink.	2
Lab6	Metoda regulacji dwustawnej.	2
Lab7	Metoda regulacji trójstawnej.	2
Lab8	Badanie własności układów regulacji z regulatorami: P, PI, PID w środowisku Matlab-Simulink.	2
Lab9	Zastosowanie metody regulacji PID w automatyce przemysłowej.	2
Lab10	Sterowanie w układach pneumatyki przemysłowej.	2
Lab11	Elementy i układy sterowania przekaźnikowo - stycznikowego.	2
Lab12	Synteza kombinacyjnych układów sterowania.	2
Lab13	Synteza sekwencyjnych układów sterowania.	2
Lab14	Modelowanie i programowanie procesów sekwencyjnych.	2
Lab15	Modelowanie i programowanie procesów współbieżnych i złożonych.	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. praca własna – przygotowanie do laboratorium N3. przygotowanie sprawozdania N4. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się

F1	PEU_W01-PEU_W03, PEU_K03	egzamin
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01,PEU_K02, PEU_K03	sprawozdanie, kartkówka
P = average F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

[1] Greblicki W., Podstawy automatyki. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2006.
[2] Awrejcewicz J., Wodzicki W. Podstawy automatyki, Teoria i przykłady, Łódź 2001
[3] Laboratorium podstaw automatyki i automatyzacji, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2005

LITERATURA UZUPEŁNIAJĄCA

[1] Wawrzycki J. Podstawy automatyki. Wykład dla kierunku transport, Wydawnictwo AHE, Łódź 2012

OPIEKUN PRZEDMIOTU

dr inż. Mateusz Stachowicz tel.: 713204235 email: mateusz.stachowicz@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Techniki wytwarzania - obróbka ubytkowa**
Nazwa przedmiotu w języku angielskim: **Production Technics - Machining**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0096**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	45		30		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60		60		
Forma zaliczenia	Egzamin		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	2		2		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			2		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2		1.4		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Student powinien posiadać wiedzę z zakresu rysunku technicznego, oznaczeń wymiarów i tolerancji, odchyłek kształtu i położenia, chropowatości powierzchni.
2. Student powinien posiadać podstawową wiedzę z matematyki, fizyki, materiałoznawstwa.
3. Student powinien posiadać umiejętność ogólnego planowania eksperymentu oraz rozwiązywania prostych problemów technicznych.

CELE PRZEDMIOTU

C1. Przekazanie wiadomości o podstawach, sposobach oraz możliwościach kształtowania przedmiotów metodami obróbki ubytkowej, takich jak: obróbki skrawaniem, ścierne i erozyjne.
C2. Przedstawienie narzędzi, materiałów narzędziowych, parametrów obróbki w poszczególnych rodzajach obróbek ubytkowych wraz za sposobem ich doboru.
C3. Przedstawienie możliwości technologicznych obróbek ubytkowych oraz zapoznanie studentów z metodologią rozwiązywania zagadnień technologicznych z zakresu obróbek ubytkowych oraz ekonomiką obróbki skrawaniem

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Student powinien znać podstawy fizyko-chemiczne obróbek ubytkowych. Powinien definiować i opisywać najważniejsze stosowane materiały narzędziowe oraz powłoki ochronne na narzędzia.
PEU_W02 - Student powinien znać i definiować najważniejsze obróbki skrawaniem. Powinien opisać zastosowania obróbki skrawaniem. Powinien objaśniać kinematykę, opisywać i definiować narzędzia i obrabiarki do obróbki skrawaniem, a także znać możliwe do uzyskania efekty technologiczne w wyniku zastosowania obróbki skrawaniem.
PEU_W03 - Student powinien znać i definiować najważniejsze obróbki ścierne i erozyjne. Powinien opisać zastosowania obróbek ściernych i erozyjnych. Powinien objaśniać kinematykę, opisywać i definiować narzędzia i obrabiarki do obróbek ściernych i erozyjnych, a także znać możliwe do uzyskania efekty technologiczne w wyniku zastosowania obróbek ściernych i erozyjnych.

II. Z zakresu umiejętności:
PEU_U01 - Student powinien potrafić zaplanować eksperyment laboratoryjny z zakresu obróbek ubytkowych, a także przeprowadzać pomiary (np. sił, chropowatości powierzchni, zużycia) i analizować otrzymane wyniki.
PEU_U02 - - Student powinien dobierać narzędzia, obrabiarki, parametry i warunki obróbki, zarówno w obróbce skrawaniem, jak i obróbkach ściernych i erozyjnych, ze względu na oczekiwane efekty technologiczne.
PEU_U03 - Student powinien interpretować postawione przed nim zadania z zakresu obróbek ubytkowych, a także rozwiązywać problemy technologiczne.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Student powinien mieć świadomość profesjonalnego zachowania na stanowisku badawczym oraz znać główne zasady bezpiecznej pracy z obrabiarkami.
PEU_K02 - Student powinien mieć świadomość odpowiedzialności za pracę własną oraz całego zespołu.
PEU_K03 - Student powinien rozumieć potrzebę ciągłego dokształcania i pogłębiania własnej wiedzy i umiejętności wraz ze zmieniającymi się uwarunkowaniami technicznymi i społecznymi.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Podstawy procesu skrawania. Omówienie zjawisk fizycznych występujących podczas skrawania.	3
Wy2	Materiały i powłoki stosowane na narzędzia skrawające.	3
Wy3	Mechanika tworzenia się wióra. Warstwa wierzchnia przedmiotu obrobionego. Fizykalne i geometryczne cechy warstwy wierzchniej.	3

Wy4	Budowa narzędzi skrawających. Geometria ostrzy skrawających.	3
Wy5	Zużycie ostrzy skrawających. Trwałość narzędzi. Geometryczne, technologiczne, fizykalne i ekonomiczne kryteria stępienia ostrzy.	3
Wy6	Budowa i zakres zastosowań obrabiarek	3
Wy7	Ciecze obróbkowe w procesie skrawania. Rodzaje cieczy, sposoby ich podawania. Ekonomiczne i ekologiczne aspekty stosowania cieczy obróbkowych w skrawaniu.	3
Wy8	Charakterystyka toczenia, dłutowania, wytaczania - zjawiska, parametry, efekty technologiczne, narzędzia i obrabiarki.	3
Wy9	Charakterystyka sposobów obróbki otworów na wiertarkach - zjawiska, parametry, efekty technologiczne, narzędzia i obrabiarki. Metody zwiększenia jakości wytwarzanych otworów.	3
Wy10	Charakterystyka frezowania i przeciągania - zjawiska, parametry, efekty technologiczne, narzędzia i obrabiarki.	3
Wy11	Wykonywanie gwintów metodami ubytkowymi. Nowoczesne metody wytwarzania kół zębatych	3
Wy12	Obróbka ścierna - podstawy, zjawiska fizyczne i chemiczne, materiały ścierne, budowa narzędzi ściernych. Szlifowanie powierzchni obrotowych i płaskich.	3
Wy13	Możliwości efektywnego zwiększania jakości przedmiotu metodami ściernymi – docieranie, dogładzanie oscylacyjne, gładzenie,	3
Wy14	Możliwości efektywnego zwiększania jakości przedmiotu metodami ściernymi – polerowanie, nagniatanie, wygładzanie luźnymi kształtkami.	3
Wy15	Obróbki strumieniowo-ścierne i erozyjne - zjawiska, parametry, efekty technologiczne, obrabiarki.	3
		Suma: 45
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Możliwości kształtowania powierzchni toczeniem.	2
Lab2	Możliwości kształtowania powierzchni na wiertarkach.	2
Lab3	Możliwości kształtowania powierzchni frezowaniem.	2
Lab4	Możliwości kształtowania powierzchni szlifowaniem za pomocą ściernicy.	2
Lab5	Wybrane metody obróbki ściernej.	2
Lab6	Metody wykonywania gwintów i uzębień walcowych.	2
Lab7	Pomiar sił i momentów skrawania.	2
Lab8	Kształtowanie elementów maszyn za pomocą wycinania elektroerozyjnego.	2
Lab9	Możliwości kształtowania powierzchni za pomocą dogładzania oscylacyjnego i nagniatania.	2
Lab10	Przecinanie ścierne materiałów narzędziami diamentowymi.	2
Lab11	Mechanika oddzielania materiału.	2
Lab12	Wpływ podatności układu OUPN i nierównomierności rozłożenia naddatku na błędy toczenia.	2
Lab13	Budowa i zastosowanie nowoczesnych narzędzi składanych i modułowych.	2

Lab14	Programowanie CNC Manual.	2
Lab15	Zaliczenie.	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. prezentacja multimedialna N3. eksperyment laboratoryjny N4. przygotowanie sprawozdania N5. praca własna – samodzielne studia i przygotowanie do egzaminu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01; PEU_W02; PEU_W03	Egzamin pisemny
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01; PEU_U02; PEU_U03	wejściówka, odpowiedź ustna, sprawozdanie z ćwiczeń laboratoryjnych
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA 1. Żebrowski Henryk: Techniki wytwarzania - Obróbka wiórowa, ścierna, erozyjna. Wydawnictwo: Oficyna Wyd. PWr, rok: 2004. 2. Cichosz Piotr i inni: Techniki wytwarzania - Obróbka Ubytkowa - Laboratorium. Wydawnictwo: Oficyna Wyd. PWr, rok: 2002. 3. Cichosz Piotr i inni: Techniki wytwarzania - Obróbka Ubytkowa - Laboratorium cz. II. Wydawnictwo: Oficyna Wyd. PWr, rok: 2008 LITERATURA UZUPEŁNIAJĄCA 1. JEMIELNIAK K.: Obróbka skrawaniem – podstawy, dynamika, diagnostyka, Ofic. Wyd. PW, Warszawa 2018 2. OLSZAK W.: Obróbka skrawaniem, PWN, Warszawa 2021.

OPIEKUN PRZEDMIOTU
dr inż. Marek Kołodziej tel.: 41-81 email: marek.kolodziej@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Bezpieczeństwo maszyn i procesów technologicznych**
Nazwa przedmiotu w języku angielskim: **Safety of Machines and Technological Processes**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0097**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15				15
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60				30
Forma zaliczenia	Egzamin				Zaliczenie na ocenę
Grupa kursów					
Liczba punktów ECTS	2				1
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					1
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2				0.7

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Student ma uporządkowaną wiedzę na temat podstaw projektowania, wytwarzania i użytkowania maszyn.

CELE PRZEDMIOTU

C1. Zapoznanie studenta z metodami oceny i kształtowania bezpieczeństwa maszyn na różnych etapach cyklu życia obiektu technicznego.
C2. Zapoznanie studenta z regulacjami prawnymi w zakresie odpowiedzialności za bezpieczeństwo projektowanych, wytwarzanych i użytkowanych maszyn.
C3. Zapoznanie studenta z metodami identyfikacji zagrożeń poprzez samodzielną oraz zespołową analizę przypadków.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Zna metody oceny i kształtowania bezpieczeństwa i ryzyka w różnych fazach życia obiektów technicznych.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi stosować metody oceny bezpieczeństwa maszyn i procesów oraz identyfikować środki zapobiegawcze i mitygujące rozpoznane zagrożenia.

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie. Omówienie zakresu wykładu i wymagań egzaminacyjnych. Podstawowe pojęcia i definicje. Model wypadku i zabezpieczenia.	1
Wy2	Formułowanie wymagań w zakresie bezpieczeństwa procesu. Metoda identyfikacji zagrożeń HAZOP.	2
Wy3	FMEA / FMECA jako metody wspomagające projektowanie i ocenę bezpieczeństwa obiektu technicznego i procesu technologicznego.	2
Wy4	Metody FTA, ETA.	2
Wy5	Struktura niezawodności systemu nienaprawialnego. Struktury podstawowe i mieszane. Sposoby podnoszenia niezawodności systemów.	2
Wy6	Uwarunkowania prawne w zakresie bezpieczeństwa maszyn i procesów.	2
Wy7	Analiza przypadków utraty bezpieczeństwa maszyn i procesów technologicznych oraz ocena możliwości wcześniejszej identyfikacji występujących zagrożeń.	4
		Suma: 15

Forma zajęć – Seminarium		Liczba godzin
Sem1	Wprowadzenie. Omówienie zakresu merytorycznego seminarium i zasad zaliczenia.	1
Sem2	Formułowanie wymagań w zakresie bezpieczeństwa oraz identyfikacja przyczyn utraty bezpieczeństwa dla zadanego przypadku.	2
Sem3	Zastosowanie metody HAZOP do identyfikacji zagrożeń w wybranym procesie technologicznym.	4
Sem4	Analiza przyczyn i skutków uszkodzeń wybranego podzespołu obiektu technicznego (FMEA).	4
Sem5	Analiza FTA i ETA dla wybranego podzespołu obiektu technicznego. Identyfikacja mechanizmów zabezpieczających i mitygujących zagrożenia.	4
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. prezentacja multimedialna N2. dyskusja problemowa N3. case study N4. wykład informacyjny

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01	egzamin pisemny
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Seminarium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01	udział w dyskusjach problemowych
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

[1] Ważyńska_Fiok K., Jaźwiński J.: Niezawodność systemów technicznych. PWN, Warszawa 1990.
[2] Podstawy racjonalnej eksploatacji maszyn. Red. M. Woropay. Biblioteka Problemów Eksploatacji. ITE, Radom 1996.
[3] Dwiliński L., Wstęp do teorii eksploatacji obiektu technicznego, Wyd. Politechniki Warszawskiej, Warszawa 1991.
[4] Poradnik niezawodności, tom I. Red. J. Migdalski. WEMA, Warszawa 1982.
[5] Poradnik Niezawodności, tom II. Red. J. Migdalski. WEMA, Warszawa 1992.
[6] Lorenc A.K., Szkoda M., Rezerwowanie jako metoda zwiększenia gotowości i niezawodności floty pojazdów. Instytut Logistyki i Magazynowania 2014.
[7] Kozłowski M. (red.), Budowa i eksploatacja pojazdów. Cz. 2, Obsługa, diagnostyka i naprawa zespołów i podzespołów, Wrocław: Vogel Business Media 2005.
[8] Kozłowski M. (red.), Budowa i eksploatacja pojazdów. Cz. 1, Działanie zespołów i podzespołów, Wrocław: Vogel Business Media 2005.

LITERATURA UZUPEŁNIAJĄCA

[1] Szopa T., Niezawodność i bezpieczeństwo, Wyd. Politechniki Warszawskiej, Warszawa 2009.
[2] Młynarski S., Problemy prognozowania niezawodności pojazdów eksploatowanych w transporcie drogowym. Monografie Politechniki Krakowskiej. Seria Mechanika. Kraków: Wydawnictwo PK 2018.
[3] OprzędkiewiczJ., Technologia budowy samochodów: skrypt dla studentów wyższych szkół technicznych do przedmiotów: technologia pojazdów samochodowych i technologia silników spalinowych. Cz. 11, Podstawy niezawodności maszyn i urządzeń. Kraków: Wydawnictwa Politechniki Krakowskiej 1982.

OPIEKUN PRZEDMIOTU

dr inż. Tomasz Siwulski tel.: 71 320-28-92 email: tomasz.siwulski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Maszyny technologiczne CNC i roboty**
Nazwa przedmiotu w języku angielskim: **Technological CNC machines and robots**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0098**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		15	15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30		30	30	
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę	Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	1		1	1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1	1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6		0.7	0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma podstawową wiedzę dotyczącą procesu projektowo-konstrukcyjnego, budowy i działania elementów i zespołów maszynowych oraz zasad ich doboru i konstruowania.
2. Ma ugruntowaną wiedzę z zakresu podstawowych technik wytwarzania i roli maszyn technologicznych.
3. Potrafi zaprojektować proces technologiczny w zakresie obróbki bezubytkowej i ubytkowej.

CELE PRZEDMIOTU

C1. Poznanie budowy podstawowych maszyn technologicznych CNC i robotów, a w szczególności ich układów: sterowania, napędowych i pomiarowych.
C2. Poznanie zasad programowania maszyn CNC oraz zasad budowy i wdrażania programów sterujących, a także poznanie metod wspomagających pracę programisty.
C3. Poznanie zasad i możliwości wykorzystania zautomatyzowanych systemów jedno- i wielomaszynowych do realizacji określonych zadań obróbkowych.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - W wyniku przeprowadzonych zajęć student powinien być w stanie objaśnić budowę i zasady funkcjonowania nowoczesnych maszyn technologicznych CNC, a w szczególności zasady sterowania ich pracą.
PEU_W02 - W wyniku przeprowadzonych zajęć student powinien być w stanie opisać zasady doboru maszyn technologicznych CNC do realizacji określonych zadań obróbkowych.
PEU_W03 - W wyniku przeprowadzonych zajęć student powinien być w stanie opisać podstawy programowania maszyn CNC.

II. Z zakresu umiejętności:
PEU_U01 - W wyniku zajęć student powinien umieć ocenić maszyny technologiczne CNC z uwagi na ich przydatność do realizacji określonych zadań obróbkowych.
PEU_U02 - W wyniku zajęć student powinien umieć opracować strukturę programową dla podstawowych maszyn CNC, potrafi korzystać z podprogramów i cykli standardowych.
PEU_U03 - W wyniku przeprowadzonych zajęć student powinien umieć przeanalizować sposób funkcjonowania maszyny technologicznej.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Potrafi wyszukiwać i korzystać z literatury zalecanej do kursu oraz samodzielnie zdobywać wiedzę.
PEU_K02 - Potrafi wykorzystywać nowoczesne narzędzia informatyczne.
PEU_K03 - Potrafi wykorzystywać nowoczesne narzędzia informatyczne.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Ogólna charakterystyka maszyn technologicznych i ich klasyfikacja. Struktury geometryczne, kinematyczne i energetyczne maszyn. Parametry techniczno-użytkowe. Podstawowe wymagania.	1
Wy2	Elementy, mechanizmy i komponenty maszyn technologicznych CNC: korpusy, zespoły wrzecionowe i prowadnicowe, systemy narzędziowe i przedmiotowe.	2
Wy3	Układy napędu głównego i posuwowego w nowoczesnych maszyn technologicznych. Układy pomiarowe, diagnostyki i nadzoru.	2
Wy4	Podstawy sterowania automatycznego maszyn technologicznych. Klasyfikacja układów sterowania (układy: NC, CNC, DNC, AC i PLC).	1

Wy5	Wprowadzenie do programowania obrabiarek sterowanych numerycznie - podstawy geometryczne sterowania CNC, układy współrzędnych, struktura programu sterującego, interpolacja. Sposoby wspomagania programowania - symulatory obróbki.	2
Wy6	Przegląd grup maszyn CNC: tokarki, frezarki, szlifierki (cechy techniczno-użytkowe i przeznaczenie maszyn).	2
Wy7	Maszyny CNC do obróbki erozyjnej i laserowej (cechy techniczno-użytkowe i przeznaczenie maszyn).	2
Wy8	Roboty przemysłowe i manipulatory (budowa, klasyfikacja i obszary zastosowań).	1
Wy9	Maszyny i urządzenia do wytwarzania wyrobów technikami przyrostowymi (Additive Manufacturing) oraz realizacji techniki Inżynierii Odwrotnej (Reverse Engineering) - przykłady zastosowań.	2
		Suma: 15
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Wprowadzenie, zapoznanie z maszynami technologicznymi	1
Lab2	Zastosowanie tomografii komputerowej w pomiarach geometrii i defektoskopii	2
Lab3	Technologie Rapid Prototyping oparte na metalach	2
Lab4	Technologie Rapid Prototyping oparte na tworzywach sztucznych	2
Lab5	Konstrukcja, działanie oraz obsługa i programowanie robota przemysłowego	2
Lab6	Obróbka skrawaniem z wykorzystaniem maszyn sterowanych numerycznie	2
Lab7	Manipulator w procesie natryskiwania zimnym gazem	2
Lab8	Zastosowanie robotów w procesach spawania/zgrzewania	2
		Suma: 15
Forma zajęć – Projekt		Liczba godzin
Proj1	Wybór obrabiarki, przygotowanie karty technologicznej, definicja przygotówki, dobór narzędzi i oprzyrządowania, wyznaczanie parametrów obróbki.	1
Proj2	Przygotowanie obrabiarki i środowiska programistycznego, konfiguracja symulatora. Określenie ustawienia przedmiotu obrabianego w przestrzeni roboczej obrabiarki. Tworzenie programu sterującego.	2
Proj3	Programowanie podstawowych zabiegów technologicznych z wykorzystaniem ruchów prostoliniowych.	2
Proj4	Programowanie ruchów po łuku i okręgu. Transformacje układu współrzędnych.	2
Proj5	Programowanie ruchu po konturze z wykorzystaniem korekcji wymiarów narzędzia. Łączenie segmentów ruchu poprzez zaokrąglanie i fazowanie.	2
Proj6	Technika podprogramów, programowanie przyrostowe, wykorzystanie funkcji pętli w przebiegu programu.	2
Proj7	Wykorzystanie cykli obróbkowych w programowaniu.	2
Proj8	Zaawansowane techniki programowania.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. praca własna – przygotowanie do laboratorium N3. praca własna - przygotowanie do projektu N4. praca własna – samodzielne studia i przygotowanie do kolokwium N5. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	Egzamin pisemny
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U03, PEU_U03,	Kartkówka / sprawozdanie z laboratorium
P = średnia z F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U03, PEU_U03,	Kartkówka
F2	PEU_U01, PEU_U03, PEU_U03,	Ocena przygotowanego projektu
P = 0.4*F1 + 0.6*F2		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

Honczarenko J.: Elastyczna automatyzacja wytwarzania. Obrabiarki i systemy obróbkowe. WNT, Warszawa, 2006.
Kosmol J.: Automatyzacja obrabiarek i obróbki skrawaniem. WNT, Warszawa, 2000.
Honczarenko J.: Obrabiarki sterowane numerycznie. WNT, Warszawa, 2017.
Białek M. : Maszyny technologiczne. Oficyna Wydawnicza Politechniki Warszawskiej, 1995.
Honczarenko J.: Roboty przemysłowe. WNT, Warszawa 2010
Skoczyński W.: Sensory w obrabiarkach CNC. PWN, Warszawa, 2018.

LITERATURA UZUPEŁNIAJĄCA

Paderewski K.: Vademecum obrabiarek skrawających. WNT, Warszawa, 1979.
Dmochowski J., Uzarowicz A.: Obróbka skrawaniem i obrabiarki. PWN, Warszawa, 1980.

OPIEKUN PRZEDMIOTU

dr inż. Marcin Madeja tel.: 3204185 email: marcin.madeja@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Praktyka**
Nazwa przedmiotu w języku angielskim: **Practice**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0099**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)					
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				90	
Forma zaliczenia					
Grupa kursów					
Liczba punktów ECTS				3	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				3	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				3.0	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Praktyka powinna być realizowana po zaliczonym 6 semestrze studiów, po którym student posiada już wiedzę teoretyczną ze wszystkich podstawowych obszarów działania inżyniera mechanika

CELE PRZEDMIOTU

C1. Praktyczne wykorzystanie w praktyce przemysłowej i gospodarczej wiedzy teoretycznej studenta pozyskanej w czasie studiów na uczelni technicznej
C2. Nabycie umiejętności praktycznych pogłębiających i uzupełniających wiedzę teoretyczna studenta uzyskaną w czasie zajęć dydaktycznych na uczelni
C3. Nabycie praktycznych umiejętności współdziałania inżyniera w środowisku przemysłowo-gospodarczym w stosunku do pracodawców i współpracowników

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:

PEU_U01 - Student powinien poznać struktury organizacyjne jednostek gospodarczych w aspekcie praktycznym oraz charakter pracy i zadania inżyniera w podstawowych działach przedsiębiorstwa

PEU_U02 - Student powinien zweryfikować i pogłębić swoje umiejętności rozwiązywania rzeczywistych problemów i zadań inżynierskich

PEU_U03 - Student powinien poznać zasady organizacji pracy w jednostce gospodarczej, poznać procesy technologiczne, organizację produkcji, kontrolę procesów od strony praktycznej

III. Z zakresu kompetencji społecznych:

PEU_K01 - Student powinien zweryfikować i pogłębić swoje umiejetności pracy zespołowej w rzeczywistości gospodarczej

PEU_K02 - Student powinien zweryfikować wiedzę nt. uwarunkowań prawnych obowiązujących w jednostce gospodarczej (obowiązujące regulacje prawne w zakresie Kodeksu Pracy, tajemnicy słuzbowej, wewnętrznych regulaminów, itp.)

PEU_K03 - Student powinien kształtować swoją osobowość w zakresie kreatywnego i innowacyjnego działania, odpowiedzialności i rzetelności w działaniu zawodowym, identyfikacji z pracodawcą i współpracownikami

TREŚCI PROGRAMOWE

STOSOWANE NARZĘDZIA DYDAKTYCZNE

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

LITERATURA UZUPEŁNIAJĄCA

OPIEKUN PRZEDMIOTU

dr inż. Tadeusz Lewandowski tel.: 71 320-24-65 email: tadeusz.lewandowski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Podstawy organizacji produkcji**
Nazwa przedmiotu w języku angielskim: **Production System Organisation**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0100**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	2				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Zna i rozumie istotę procesu zarządzania i podstawowych funkcji zarządzania.
2. Rozumie podstawowe podstawowe pojęcia i prawa ekonomiczne oraz zjawiska gospodarcze i ich efekty.
3. Ma podstawową wiedzę na temat procesów wytwarzania.

CELE PRZEDMIOTU

C1. Poznanie specyfiki zarządzania przedsiębiorstwem produkcyjnym oraz procesami wytwórczymi.
C2. Poznanie typów organizacji produkcji, a także metod i technik zarządzania różnymi typami procesów wytwórczych.
C3. Nabycie wiedzy z zakresu planowania, organizowania i sterowania systemami oraz procesami produkcyjnymi.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Rozróżnia i charakteryzuje rózne typy systemów produkcyjnych
PEU_W02 - Umie zdefiniować pojęcia dotyczące procesów produkcyjnych i procesów technologicznych
PEU_W03 - Ma wiedzę na temat organizacji produkcji, a także metod i technik zarządzania systemami produkcyjnym

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Charakterystyka organizacji produkcyjnych	2
Wy2	Charakterystyka systemów produkcyjnych	2
Wy3	System wytwórczy, jego organizacja i składowe	2
Wy4	lasyfikacje procesów produkcyjnych	2
Wy5	Metody sterowania produkcją - systemy ssące. Koncepcja Just In Time. Koncepcja Lean Manufacturing	4
Wy6	Metody sterowania produkcją - systemy pchające. Koncepcje MRP, MRP II, ERP.	4
Wy7	Metody sterowania produkcją - systemy wyciskające. Koncepcja OPT.	2
Wy8	Metody organizacji systemów produkcyjnych	2
Wy9	Metody zarządzania zapasami produkcyjnymi	2
Wy10	Zasady planowania i harmonogramowania procesów produkcyjnych	4
Wy11	Metody pozyskiwania/rejestracji danych produkcyjnych. Systemy traceability.	4
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01-PEU_W03	Test pisemny
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA 1. Chlebus E.: "Techniki komputerowe CAx w inżynierii produkcji", Wydawnictwa Naukowo-Techniczne, Warszawa 2000, 2. Durlik I.: "nżynieria zarządzania : Cz. 1 i Cz.2", Wydawnictwo Placet, Warszawa 2007, 3. Liwowski B.: "Podstawowe zagadnienia zarządzania produkcją", Oficyna Ekonomiczna, Kraków 2006 LITERATURA UZUPEŁNIAJĄCA 1. Rogowski A..: "Podstawy organizacji i zarządzania produkcją w przedsiębiorstwie", Wydawnictwa Fachowe CeDeWu, Warszawa 2010, 2. Burchart-Korol D.: "Zarządzanie produkcją i usługami", Wydawnictwo Politechniki Śląskiej, Gliwice 2007

OPIEKUN PRZEDMIOTU
dr inż. Jarosław Chrobot tel.: 20-66 email: jaroslaw.chrobot@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Podstawy eksploatacji remontów maszyn**

Nazwa przedmiotu w języku angielskim: **Fundamentals of exploitation of machinery repairs**

Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**

Poziom i forma studiów: **I stopień, stacjonarne**

Rodzaj przedmiotu: **obowiązkowy**

Kod przedmiotu: **W10MBM-SI0101**

Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60		30		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	2		1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2		0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma podstawową wiedzę z chemii, fizyki, grafiki inżynierskiej, materiałoznawstwa, konstruowania elementów maszyn. Zna podstawowe elementy maszyn, potrafi je dobierać z katalogu, wie na czym polega konieczność stosowania środków smarnych oraz zasad prewencyjnych w eksploatacji maszyn. Zna podstawowe procesy technologiczne typowych części maszyn. Potrafi chronić środowisko naturalne, racjonalnie wykorzystywać jego zasoby oraz ograniczać generowanie odpadów. Zdaje sobie sprawę z konsekwencji zanieczyszczania środowiska odpadami poprodukcyjnymi.
2. Potrafi rozpoznać zagrożenia związane z działalnością przemysłową eksploatacji maszyn, zna konwencje międzynarodowe i polskie akty prawne w dziedzinie ochrony środowiska. Zna ekologiczne zasady konstruowania, użytkowania i modernizacji maszyn. Ma świadomość ważności i zrozumienie pozatechnicznych aspektów i skutków działalności inżyniera i managera produkcji, w tym jej wpływu na środowisko, i związanej z tym odpowiedzialności za podejmowane decyzje.

CELE PRZEDMIOTU

C1. Nabycie podstawowej wiedzy o procesach eksploatacji maszyn. Zrozumienie systemowego podejścia do eksploatacji, opisu i oceny procesu eksploatacji. Opis technicznego stanu obiektu i jego niezawodności.
C2. Poznanie modeli niezawodności prostych obiektów naprawialnych , nienaprawialnych oraz złożonych.
C3. Zdobycie umiejętności planowania zapasów części zamiennych i materiałów eksploatacyjnych, poznanie zasad wdrażania gospodarki remontowej, metod regeneracji zużytych części maszyn, modernizacja maszyn, pozyskiwania odpadów i ich recyklingu. Poznanie zasad prewencji i diagnostyki w eksploatacji maszyn oraz ekologicznych zasad ich eksploatacji.
C4. Opracowanie wskaźników oceny oraz wyników z symulowanych badań eksploatacyjnych. Nabycie podstawowej wiedzy z zakresu diagnozowania i oceny stanu maszyn poprzez pomiary i analizę parametrów ich pracy takich jak np: zużycie energii, nagrzewanie się zespołów maszyny, poziom drgań i hałasu, dokładność ustalania położenia zespołów. Określenie technicznego stanu maszyny, stopnia jej zużycia i określenie zakresu jej remontu.
C5. Zdobycie umiejętności wyboru systemu remontowego maszyny oraz zorganizowania jego wykonania

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - rozumie systemowe podejście do procesu eksploatacji, umie opisać proces eksploatacji, techniczny stan obiektu, zna zasady oceny jego niezawodności.
PEU_W02 - posiada wiedzę z zakresu oceny technicznego stanu obiektu technicznego, opłacalności remontu maszyny, sposobu jego przygotowania i przeprowadzenia. Rozumie oddziaływanie maszyny i realizowanych procesów na człowieka i na środowisko, zna zasady ekologicznej jej eksploatacji.
PEU_W03 - zna metody oceny technicznego stanu maszyny, umie ocenić potrzebę, opłacalność i zakres przeprowadzenia jej remontu.

II. Z zakresu umiejętności:
PEU_U01 - potrafi ocenić techniczny stan prostych i złożonych obiektów technicznych oraz ich niezawodność
PEU_U02 - potrafi ocenić potrzebę przeprowadzenia remontu obiektu i niezbędny jego zakres, dobrać metodę regeneracji części, sprawować nadzór na zapasem materiałów eksploatacyjnych i części zamiennych.
PEU_U03 - potrafi minimalizować negatywne oddziaływanie maszyny i realizowanego procesu na obsługę i na środowisko

III. Z zakresu kompetencji społecznych:
PEU_K01 - wyszukiwanie informacji o eksploatacji i remontach maszyn i ich krytyczna analiza
PEU_K02 - obiektywna ocena parametrów diagnostycznych, dyskusja w gronie współpracowników i wybór optymalnej metody przywrócenia maszynie pierwotnych resursów pracy
PEU_K03 - obiektywna ocena argumentów, uzasadnianie własnych pomysłów z wykorzystaniem wiedzy z zakresu eksploatacji maszyn

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Podstawowe pojęcia z zakresu eksploatacji maszyn	1
Wy2	Prakseologiczne i systemowe podejście do eksploatacji	2
Wy3	Opis i ocena procesu eksploatacji	2

Wy4	Opis technicznego stanu obiektu	2
Wy5	Pojęcie niezawodności	2
Wy6	Niezawodność prostych obiektów naprawialnych i nienaprawialnych	2
Wy7	Niezawodność złożonych obiektów	2
Wy8	Planowanie zapasów części zamiennych i materiałów eksploatacyjnych	2
Wy9	Technicznie uzasadnione metody regeneracji części maszyn	2
Wy10	Gospodarka remontowa, systemy remontowe, modernizacja maszyn	3
Wy11	Prewencja i diagnostyka w użytkowaniu maszyn	3
Wy12	Pozyskiwanie odpadów, recykling i neutralizacja	1
Wy13	Ekologiczne aspekty konstruowania, eksploatacji i remontów maszyn	2
Wy14	Racjonalne smarowanie maszyn, techniki smarowania, smarowanie minimalne	2
Wy15	Uzdatnianie i neutralizacja środków smarowych, chłodziw i płynów technologicznych	2
		Suma: 30
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Podstawowe stany eksploatacji obiektu technicznego. Wskaźniki oceny procesu eksploatacji.	1
Lab2	Analiza stanu obiektu technicznego (samochód, maszyna robocza) na podstawie zużycia paliwa, energochłonność.	2
Lab3	Analiza nieuszkadzalności wybranego obiektu technicznego. Podstawowe wskaźniki niezawodności.	2
Lab4	Analiza naprawialności wybranego obiektu technicznego. Wyznaczenie czasów napraw i słabych ogniw	2
Lab5	Straty mocy i sprawność złożonych układów napędowych, ocena stanu napędu.	2
Lab6	Ocena energochłonności i stanu łożysk wrzecionowych obrabiarki.	2
Lab7	Akustyczna diagnostyka technicznego stanu zespołów maszyny, badanie dynamicznych własności maszyn.	2
Lab8	Eksploatacyjne własności i wyznaczanie charakterystyki układu napędu posuwu ze śrubą toczną.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. eksperyment laboratoryjny N2. praca własna – przygotowanie do laboratorium N3. przygotowanie sprawozdania N4. wykład tradycyjny z wykorzystaniem transparencji i slajdów N5. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01 ÷ PEU_W03	egzamin pisemny
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01 ÷ PEU_U03, PEU_K01 ÷ PEU_K03	kartkówka
F2	PEU_U01 ÷ PEU_U03, PEU_K01 ÷ PEU_K03	ocena ze sprawozdania
P = F2		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
1. Konspekty przekazane przez prowadzącego,
2. Ziemba S: Problemy rozwoju nauki o eksploatacji maszyn i urządzeń technicznych, PWN W-wa 1983,
3. Olearczyk E: Zarys teorii użytkowania urządzeń technicznych, WNT W-wa,
4. Gołąbek A: Elementy teorii eksploatacji - skrypt PWr,
5. Podniało A: Paliwa, oleje i smary w ekologicznej eksploatacji, WNT W-wa 2002

LITERATURA UZUPEŁNIAJĄCA
Miesięcznik: Inżynieria i Utrzymanie Ruchu Zakładów Przemysłowych

OPIEKUN PRZEDMIOTU

dr inż. Paweł Turek email: pawel.turek@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Zarządzanie w produkcji**
Nazwa przedmiotu w języku angielskim: **Management in production**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0102**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	1				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Zna i rozumie istotę procesu zarządzania i podstawowych funkcji zarządzania.
2. Rozumie podstawowe podstawowe pojęcia i prawa ekonomiczne oraz zjawiska gospodarcze i ich efekty.
3. Ma podstawową wiedzę na temat procesów wytwarzania.

CELE PRZEDMIOTU

C1. Poznanie specyfiki zarządzania przedsiębiorstwem produkcyjnym oraz procesami wytwórczymi.
C2. Poznanie metod i technik zarządzania różnymi typami procesów wytwórczych.
C3. Nabycie wiedzyi z zakresu planowania, organizowania i sterowania procesami produkcyjnymi.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ **I. Z zakresu wiedzy:** PEU_W01 - Rozróżnia i charakteryzuje rózne typy systemów produkcyjnych. PEU_W02 - Umie zdefiniować pojęcia dotyczące procesów produkcyjnych i procesów technologicznych. PEU_W03 - Ma wiedzę na temat metod i technik zarządzania systemami produkcyjnym. **II. Z zakresu umiejętności:** **III. Z zakresu kompetencji społecznych:**

TREŚCI PROGRAMOWE		
Forma zajęć – Wykład		Liczba godzin
Wy1	Charakterystyka organizacji produkcyjnych	1
Wy2	Charakterystyka systemów produkcyjnych	1
Wy3	System wytwórczy, jego organizacja i składowe	1
Wy4	Klasyfikacje procesów produkcyjnych	1
Wy5	Typy i formy produkcji	1
Wy6	Metody sterowania produkcją (systemy ssące, pchające i wyciskające)	2
Wy7	Metody organizacji systemów produkcyjnych	2
Wy8	Charakterystyka wąskich gardeł w procesach wytwórczych	2
Wy9	Metody zarządzania zapasami produkcyjnymi	2
Wy10	Zasady planowania i harmonogramowania procesów produkcyjnych	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	Kolokwium

P = F1

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

1. Chlebus E.: "Techniki komputerowe CAx w inżynierii produkcji", Wydawnictwa Naukowo-Techniczne, Warszawa 2000,
2. Durlik I.: "nżynieria zarządzania : Cz. 1 i Cz.2", Wydawnictwo Placet, Warszawa 2007,
3. Liwowski B.: "Podstawowe zagadnienia zarządzania produkcją", Oficyna Ekonomiczna, Kraków 2006

LITERATURA UZUPEŁNIAJĄCA

1. Rogowski A..: "Podstawy organizacji i zarządzania produkcją w przedsiębiorstwie", Wydawnictwa Fachowe CeDeWu, Warszawa 2010, 2. Burchart-Korol D.: "Zarządzanie produkcją i usługami", Wydawnictwo Politechniki Śląskiej, Gliwice 2007

OPIEKUN PRZEDMIOTU

dr inż. Jarosław Chrobot tel.: 20-66 email: jaroslaw.chrobot@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Technika wojskowa w konfliktach zbrojnych**
Nazwa przedmiotu w języku angielskim: **Military technology in armed conflicts**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **wybieralny**
Kod przedmiotu: **W10MBM-SI0103**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	2				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ogólna wiedza w obszarze bezpieczeństwa państwa.
2. Podstawowa wiedza z zakresu techniki wojskowej.
3. Ogólna wiedza z prawa konfliktów zbrojnych.

CELE PRZEDMIOTU

C1. Poznanie podstawowych wiadomości o poszczególnych kategoriach uzbrojenia indywidualnego i zbiorowego oraz ich funkcji bojowych na tle historycznym do współczesności.
C2. Nabycie elementarnej wiedzy z zakresu prawa wojennego, bronioznawstwa, możliwości bojowych omawianych systemów uzbrojenia i sposobów jej wykorzystania na tle rozwoju sztuki wojennej od czasów najdawniejszych po czasy współczesne.
C3. Umiejętność interpretacji podstawowych aktów prawnych, zwłaszcza ustawy o broni i amunicji oraz zdolności obronnych państwa.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Posiada wiedzę na temat potencjału obronnego państwa w strukturze bezpieczeństwa wewnętrznego i układów sojuszniczych.
PEU_W02 - Potrafi objaśnić specyfikę uzbrojenia wojska polskiego na tle armii innych krajów w historii i współczesności.
PEU_W03 - Posiada wiedzę z zakresu terminologii wojskowej w obszarze uzbrojenia, zarówno współczesnego, jak i historycznego.

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:
PEU_K01 - Rozumie potrzebę kształtowania świadomości działalności inżynierskiej w ujęciu rozwoju myśli i techniki wojskowej.
PEU_K02 - Umiejętne selekcjonowanie zdolności taktyczno-technicznych elementów uzbrojenia czołowych armii świata.
PEU_K03 - Rozumie potrzebę kształtowania wiedzy z zakresu głównych kierunków rozwoju techniki wojskowej na przykładzie konfliktów zbrojnych.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Podstawowe pojęcia związane z konfliktami zbrojnymi i sprzętem wojskowym - definicje broni i uzbrojenia, rola broni w kulturze i historii ludzkości.	2
Wy2	Broń sieczna i kolna. Dawne machiny wojenne, sprzęt taborowy, rząd koński i oporządzenie jeździeckie.	2
Wy3	Przemiany broni w czasach nowożytnych.	2
Wy4	Rozwój broni strzeleckiej.	2
Wy5	Geneza i rozwój amunicji do broni strzeleckiej i broni ręcznej.	2
Wy6	Uzbrojenie ochronne od czasów historycznych po współczesność.	2
Wy7	Artyleria w czasach nowożytnych i współczesnych. Jej znaczenie na współczesnym polu walki i w przyszłych konfliktach zbrojnych.	2

Wy8	Wozy bojowe i ich znaczenie w perspektywie robotyzacji przyszłego pola walki.	2
Wy9	Ciężkie wozy bojowe – czołgi. Geneza i taktyka ich wykorzystania na tle minionego i współczesnego wieku.	2
Wy10	Środki napadu powietrznego na tle historycznym do współczesności.	2
Wy11	Broń rakietowa i hipersoniczna.	2
Wy12	Uzbrojenie morskie w rysie historycznym, współczesnym i kierunki rozwoju.	2
Wy13	Inne rodzaje broni konwencjonalnej (ładunki wybuchowe, miny, itp.).	2
Wy14	Kastomizacja techniki i uzbrojenia wojskowego wynikająca z potrzeb obronnych zmieniającej się sytuacji konfliktów zbrojnych.	2
Wy15	Sprawdzenie wiedzy. Kolokwium.	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03.	Kolokwium
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
1. Encyklopedia wojskowa. Dowódcy i ich armie. Historia wojen i bitew. Technika wojskowa. T. 1 (A-M), Wyd. PWN, Bellona, Warszawa 2007.
2. Gwóźdź Z., Zarzycki P., Polskie konstrukcje broni strzeleckiej. SIGMA-NOT, Warszawa 1993.
3. Hogg I., Encyklopedia uzbrojenia. Rozwój uzbrojenia od prehistorii do XXI wieku. Warszawa 2009.
4. Kochański S., Małokalibrowa broń samoczynna. Wydawnictwo Politechniki Warszawskiej, Warszawa 1989.
5. Kwaśniewicz W., Encyklopedia dawnej broni i uzbrojenia ochronnego. Bellona, Warszawa 2022.
6. Weir W., 50 broni, które zmieniły sposób prowadzenia wojen. Warszawa 2005.
7. Wiśniewski A., Pancerze, budowa, projektowanie i badania. WNT, Warszawa 2001.
8. Włodarczyk E., Podstawy fizyki wybuchu. WNT, Warszawa 2012.
9. Zasieczny A., Broń Wojska Polskiego 1939-1945. Warszawa 2010.
10. Żygulski Z., Gradowski M., Słownik uzbrojenia historycznego. Warszawa 1998.

LITERATURA UZUPEŁNIAJĄCA
1. Ciepliński A., Woźniak R., Ilustrowana encyklopedia współczesnej broni palnej. Wydawnictwo Lampart, Warszawa 1997.
2. Hart R., Współczesne czołgi i pojazdy opancerzone od 1991 do dzisiaj. Wyd. 2, Alma-Press, Warszawa 2023.
3. Hazell P.J., Armour: Materials, Theory, and Design. CRC Press, Taylor & Francis Group, New York 2016.
4. Ius ad bellum versus ius in bello (Międzynarodowe Prawo Humanitarne. Tom IX). Praca zbiorowa, Wydawnictwo Marynarki Wojennej, Gdynia 2018.
5. Jamroziak K., Kędzia K., Śliwa Z., Standaryzacja amunicji strzeleckiej: budowa, znakowanie i przechowywanie. Skrypt. Wydawnictwo Wyższej Szkoły Oficerskiej Wojsk Lądowych. Wrocław 2003.
6. Puchała F., Budowa potencjału bojowego Wojska Polskiego 1945-1990. Bellona, Warszawa 2013.
7. Ustawa z dnia 21 maja 1999 r. o broni i amunicji (Dz.U. z 2022 r. poz. 2516).

OPIEKUN PRZEDMIOTU

dr hab. inż. Krzysztof Jamroziak tel.: 320 27 60 email: krzysztof.jamroziak@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Ochrona własności intelektualnej**
Nazwa przedmiotu w języku angielskim: **Intellectual Property Law**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **wybieralny**
Kod przedmiotu: **W10MBM-SI0104**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	1				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ogólna wiedza w obszarze innowacji.
2. Podstawowa wiedza z obszaru rachunkowości i finansów.
3. Ogólna wiedza z prawa gospodarczego i marketingu.

CELE PRZEDMIOTU

C1. Poznanie podstawowych wiadomości o funkcjonującym systemie prawnym ochrony własności intelektualnych i różnych postaciach dóbr: prawo autorskie, prawo własności przemysłowej, patenty, wzory użytkowe, przemysłowe, itp.
C2. Nabycie elementarnych umiejętności przygotowania opisów zgłoszeniowych wynalazków i wzorów użytkowych oraz przemysłowych itp.
C3. Umiejętność korzystania z informacji patentowej.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Posiada wiedzę na temat informacji patentowej.
PEU_W02 - Potrafi objaśnić zdolność patentową.
PEU_W03 - Posiada wiedzę dotyczącą plagiatu.

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:
PEU_K01 - Rozumie potrzebę kształtowania świadomości działalności inżynierskiej w ujęciu ochrony własności intelektualnej.
PEU_K02 - Umiejętne weryfikowanie aspektów prawnych w zakresie prawa autorskiego i praw pokrewnych oraz prawa własności przemysłowej.
PEU_K03 - Umiejętność pracy w grupie.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Podstawowe pojęcia ochrony własności intelektualnej. Badania, nauka,wiedza, odkrycie, wynalazek, innowacje i innowacyjność, zastrzeżenie patentowe, wzory użytkowe, wzory przemysłowe, topografia obwodów scalonych.	2
Wy2	Procedura badania zgłoszeń wynalazków i wzorów użytkowych.	2
Wy3	Ocena zdolności patentowej. Opis zgłoszeniowy wynalazku.	2
Wy4	Informacja patentowa: źródła i zbiory dokumentacji i literatury patentowej,dostęp do informacji i baz danych Urzędu Patentowego RP.	2
Wy5	Znaki towarowe i ich ochrona prawna. Prawo autorskie i prawa pokrewne dzieł literackich i artystycznych.	2
Wy6	Ochrona własności intelektualnej oprogramowania. Organizacje zajmujące się zbiorowym zarządzaniem praw autorskich.	2
Wy7	Ochrona własności intelektualnej baz danych oraz domen.	2
Wy8	Plagiat a praca inżynierska.	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03.	Kolokwium
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

1. Michniewicz G. Ochrona własności intelektualnej. Podręczniki akademickie,. 5. Wydanie. C.H.Beck. Warszawa 2022.
2. Czub K. Prawo własności intelektualnej. Wolters Kluwer. Warszawa 2021.
3. Kostański P., Żelechowski Ł, Prawo własności przemysłowej. Podręcznik akademicki. Warszawa 2014.
4. Barta J., Markiewicz R. Prawo autorskie i prawa pokrewne. Wydanie 5. Warszawa 2011.
5. Adamczak A., Gedłek M. Znaki towarowe w działalności małych i średnich przedsiębiorstw. Krajowa Izba Gospodarcza. Warszawa 2009.
6. Adamczak A., Dobosz E., Gedłek M. Wzory przemysłowe w działalności małych i średnich przedsiębiorstw. Krajowa Izba Gospodarcza. Warszawa 2009.
7. Kondrat M., Dreszer-Lichańska H.Własność przemysłowa w UE. Gdańsk 2007.

LITERATURA UZUPEŁNIAJĄCA

1. Pawlik K., Zenderowski R. Dyplom z internetu. Jak korzystać z internetu pisząc prace dyplomowe? CeDeWu. Warszawa 2013.
2. Jeziorow J. Wrocławski kodeks dobrych praktyk w zakresie korzystania z wyników pracy intelektualnej. Urząd Marszałkowski Województwa Dolnośląskiego. Wrocław 2010.
3. Ustawa z dnia 30 czerwca 2000 r. Prawo własności przemysłowej (tj. Dz.U. 2003 nr 119, poz. 1117 z późn. zm.).
4. Ustawa z dnia 4 lutego 1994 r. o prawie autorskim i prawach pokrewnych (tj. Dz.U. 2006 nr 90, poz. 631 z późn. zm.).
5. Konwencja o udzielaniu patentów europejskich (Konwencja o patencie europejskim), sporządzona w Monachium dnia 5 października 1973 r. (Dz. U. z 2004 r. Nr 79, poz. 737), Akt z dnia 29 listopada 2000 r. rewidujący Konwencję o udzielaniu patentów europejskich, sporządzoną w Monachium dnia 5 października 1973 r. (Dz. U. z 2007 r. Nr 236, poz. 1736).
6. Konwencja paryska o ochronie własności przemysłowej z dnia 20 marca 1883 r. zmieniona w Brukseli dnia 14 grudnia 1900 r., w Waszyngtonie dnia 2 czerwca 1911 r., w Hadze dnia 6 listopada 1925 r., w Londynie dnia 2 czerwca 1934 r., w Lizbonie dnia 31 października 1958 r. i w Sztokholmie dnia 14 lipca 1967 r. - Akt sztokholmski z dnia 14 lipca 1967 r. (Dz. U. z 1975 r. Nr 9, poz. 51).
7. Podstawowe – obowiązujące akty prawne z zakresu ochrony własności przemysłowej na stronie Urzędu Patentowego RP: https://uprp.gov.pl/pl.

OPIEKUN PRZEDMIOTU

dr hab. inż. Krzysztof Jamroziak tel.: 320 27 60 email: krzysztof.jamroziak@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Podstawy wytrzymałości materiałów**
Nazwa przedmiotu w języku angielskim: **Fundamentals of materials strength**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0105**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)			15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)			30		
Forma zaliczenia			Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS			1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)			0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Znajomość matematyki wyższej - w szczególności algebry wektorów, rachunku całkowego i równań różniczkowych.
2. Znajomość podstaw inżynierii materiałowej
3. Znajomość mechaniki ciała sztywnego w szczególności w zakresie zasad statyki układów prętowych, belek i geometrii mas.

CELE PRZEDMIOTU

C1. Poznanie podstaw i zakresu zastosowań mechaniki jednorodnych i niejednorodnych ciał odkształcalnych
C2. Nabycie umiejętności wyznaczania naprężeń i odkształceń
C3. Nabycie umiejętności doświadczalnego wyznaczania mechanicznych własności materiałów i wykorzystywania ich do określania naprężeń dopuszczalnych

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:

PEU_U01 - Potrafi stosować prawo Hooke'a do obliczeń naprężeń i odkształceń.
PEU_U02 - Potrafi przeprowadzić analizę wytrzymałościową konstrukcji prętowych i belkowych
PEU_U03 - Potrafi zaprojektować pręt ściskanym odporny na utratę stateczności

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Laboratorium		Liczba godzin
Lab1	Wprowadzenie; zasady BHP i organizacja metod pomiarowych w laboratorium	1
Lab2	Badania właściwości mechanicznych metali. Próba rozciągania	2
Lab3	Pomiary odkształceń w elementach konstrukcyjnych metodą elektrycznej tensometrii oporowej	2
Lab4	Badania zmęczeniowe metali.	2
Lab5	Wytrzymałość złożona: wytężenie, weryfikacja hipotez - skręcanie ze zginaniem. Wyznaczanie modułu Kirchhoffa - próba czystego skręcania.	2
Lab6	Utrata stateczności prętów - wyboczenie. Próba ściskania	2
Lab7	Zginanie proste i ukośne - badania modelowe	2
Lab8	Zajęcia zaliczeniowe	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. eksperyment laboratoryjny
N2. praca własna – przygotowanie do laboratorium

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się

F1	PEU_U01, PEU_U02, PEU_U03	sprawozdania z ćwiczeń laboratoryjnych, odpowiedzi ustne
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA Zielnica J., Wytrzymałość Materiałów, WPP, wyd. III, Poznań 2000, str. 554. Niezgodziński M. E., Niezgodziński T.: Wytrzymałość materiałów. PWN, Warszawa 1998. Niezgodziński M. E., Niezgodziński T.: Wzory, wykresy i tablice wytrzymałościowe. WNT, Warszawa 1996. Niezgodziński M. E., Niezgodziński T.: Zadania z wytrzymałości materiałów. WNT, Warszawa 1997. M. Ostwald: Podstawy wytrzymałości materiałów. Wydawnictwo Politechniki Poznańskiej, Poznań 1997 Jakubowicz A., Orłoś Z., Wytrzymałość materiałów, WNT, Warszawa, 1984 Magnucki K., Szyc W., Wytrzymałość materiałów w zadaniach: pręty, płyty i powłoki obrotowe, Wydawnictwo Naukowe PWN, 2000. LITERATURA UZUPEŁNIAJĄCA Broek D.: Elementary engineering - fracture mechanics. Noordhoff Int. Publishing, Leyden, 1974. Ashby M. F.: Jones D. R.: Materiały inżynierskie. Własności i zastosowania. WNT, Warszawa 1995. R. C. Hibbeler - Mechanics of Materials, Pearson Prentice Hall S. Timoshenko, Strength of Materials Part 1, Elementary Theory and Problems, D. Van Nostrand Company, Inc Willems N., Easley T. J., Rolfe S. T., Strength of Materials, Mc GrawHill Book Company, 1981. Gere M., Timoshenko S., Mechanics of Materials, PWS-Kent Publishing Company, Boston, 1984.

OPIEKUN PRZEDMIOTU
dr hab. inż. Grzegorz Lesiuk tel.: 713204216 email: grzegorz.lesiuk@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Analiza MES w zastosowaniach silnie nieliniowych w pakiecie MSC . MARC**

Nazwa przedmiotu w języku angielskim: **FEM analysis of strongly nonlinear applications in the MSC.MARC**

Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**

Poziom i forma studiów: **I stopień, stacjonarne**

Rodzaj przedmiotu: **wybieralny**

Kod przedmiotu: **W10MBM-SI0106**

Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				30	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Posiada podstawową wiedzę o procesach technologicznych.
2. Posiada podstawową wiedzę z podstaw teorii metody elementów skończonych.
3. Posiada podstawową wiedzę z wytrzymałości materiałów i mechaniki.

CELE PRZEDMIOTU

C1. Nabycie wiedzy w zakresie rozwiązywania problemów inżynierskich silnie nieliniowych tj. dużych odkształceń sprężysto-plastycznych, zagadnień kontaktowych, zagadnień cieplnych.
C2. Nabycie podstawowej wiedzy i umiejętności budowy modeli matematycznych procesów technologicznych.
C3. Zapoznanie się z wpływem parametrów modelowania na otrzymywane wyniki zachowanie się materiałów w zagadnieniach silnie nieliniowych.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Posiada umiejętność budowy modeli matematycznych procesów technologicznych.
PEU_U02 - Potrafi przeprowadzić obliczenia oraz wstępną optymalizację procesu kształtowania plastycznego.
PEU_U03 - Potrafi wskazać parametry modelowania wpływające na zachowanie się materiałów w zagadnieniach silnie nieliniowych.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Nabywa przekonania o odpowiedzialności za wykonywaną pracę.

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Wprowadzenie do komputerowej symulacji procesów kształtowania plastycznego w środowisku programu obliczeniowego.	1
Proj2	Budowa modelu obliczeniowego dla wybranego zagadnienia termomechanicznego.	2
Proj3	Przygotowanie i wykonanie obliczeń modelu matematycznego dla przyjętego modelu materiału oraz warunków kontaktu.	2
Proj4	Przygotowanie i wykonanie obliczeń modelu matematycznego dla przyjętych warunków zbieżności rozwiązania oraz warunków przebudowy siatki w trakcie obliczeń.	2
Proj5	Opracowanie założeń projektowych, budowa modelu dla wybranych zagadnień silnie nieliniowych.	2
Proj6	Wykonanie obliczeń i opracowanie wyników symulacji dla wybranych parametrów modelowania.	4
Proj7	Prezentacja wyników, wykonanie raportu.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. prezentacja multimedialna N2. ćwiczenia problemowe N3. praca własna - przygotowanie do projektu N4. prezentacja projektu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01	ocena przygotowania projektu
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA Gronostajski Z.: Badania stosowane w zaawansowanych procesach kształtowania plastycznego. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2003 Gabryszewski Z., Gronostajski J.: Mechanika procesów obróbki plastycznej, PWN, Warszawa 1991. Milenin A.: Podstawy MES. Zagadnienia termomechaniczne. AGH. 2010. LITERATURA UZUPEŁNIAJĄCA Marc and Mentat documentation Ambroziak A., Kłosowski P.: Podstawy obliczeń układów powierzchniowych w sytemie MSC.Marc/Mentat. Wydawnictwo Politechniki Gdańskiej. 2015. Zienkiewicz O.: Metoda elementów skończonych Warszawa Arkady 1972. Wiśniewski S., Wisniewski T.: Wymiana ciepła WNT. Warszawa 1997.

OPIEKUN PRZEDMIOTU
dr inż. Sławomir Polak tel.: 21-72 email: slawomir.polak@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Grafika inżynierska 3D-SolidWorks**
Nazwa przedmiotu w języku angielskim: **3D Engineering Graphics - Solid Works**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **wybieralny**
Kod przedmiotu: **W10MBM-SI0107**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				30	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Wymagana jest wiedza z zakresu kursu „Techniki wytwarzania – odlewnictwo”.
2. Wymagana jest wiedza z zakresu kursu "Grafika inżynierska - geometria wykreślna".
3. Wymagana jest wiedza z zakresu kursu "Grafika inżynierska - zapis konstrukcji".

CELE PRZEDMIOTU

C1. Nabycie wiedzy i umiejętności w zakresie modelowania przestrzennego oprzyrządowania odlewniczego.
C2. Nabycie wiedzy i umiejętności w zakresie badania i analiz modeli i form odlewniczych na modelach wirtualnych.
C3. Nabycie wiedzy i umiejętności w zakresie możliwości wykorzystania komputerowych systemów wspomagania prac inżynierskich do twórczego i innowacyjnego projektowania.
C4. Nabycie wiedzy i umiejętności projektowania odlewów oraz modeli odlewniczych. Umiejętność doboru naddatków, promieni i pochyleń odlewniczych oraz płaszczyzny podziału formy w zależności od wielkości, stopnia skomplikowania i materiału odlewu.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Student powinien umieć budować modele przestrzenne oprzyrządowania odlewniczego.
PEU_U02 - Student powinien umieć budować modele przestrzenne modeli i form odlewniczych oraz przeprowadzić analizy poprawności modeli i ich parametrów.
PEU_U03 - Student powinien umieć wykonać dokumentację rysunkową 2D na podstawie modelu przestrzennego.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Student nabywa umiejętności ponoszenia odpowiedzialności za wykonaną pracę.

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Ogólne zasady projektowania oprzyrządowania odlewniczego.	2
Proj2	Wytyczne projektowania wybranych modeli odlewniczych. Wprowadzenie naddatków na skurcz, promieni oraz pochyleń odlewniczych.	2
Proj3	Oznaczenie elementów konstrukcyjnych odlewów na rysunkach wykonawczych.	2
Proj4	Zasady projektowania rdzennic i rdzeni odlewniczych na podstawie wybranych elementów maszyn.	2
Proj5	Projektowanie naddatków na obróbkę na podstawie wybranych elementów maszyn. Bazy obróbkowe odlewu.	2
Proj6	Konstrukcja form odlewniczych. Zasady tworzenia rysunku złożeniowego form.	2
Proj7	Tworzenie dokumentacji płaskiej zespołu – rysunki złożeniowe form odlewniczych.	2
Proj8	Ocena prac studentów.	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. praca własna - przygotowanie do projektu N2. dyskusja problemowa N3. Samodzielna praca przy komputerze pod nadzorem prowadzącego N4. normy europejskie

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA SolidWorks (Podstawy); Wydawnictwo DPS LITERATURA UZUPEŁNIAJĄCA Beginner's Guide to SOLIDWORKS 2018: Level 1

OPIEKUN PRZEDMIOTU
dr inż. Patrycja Paduchowicz email: patrycja.paduchowicz@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Inspekcja wymiarowo-kształtowa 3D z wykorzystaniem programów GOM Inspect i SolidWorks**

Nazwa przedmiotu w języku angielskim: **Three-dimensional shapes inspection using GOM Inspect and Solidworks**

Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**

Poziom i forma studiów: **I stopień, stacjonarne**

Rodzaj przedmiotu: **wybieralny**

Kod przedmiotu: **W10MBM-SI0108**

Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				30	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Student posiada podstawową wiedzę w zakresie konstrukcji maszyn i technologii wytwarzania.
2. Student posiada wiedzę z metrologii wielkości geometrycznych.
3. Student posiada wiedzę w zakresie modelowania komputerowego CAD.

CELE PRZEDMIOTU

C1. Przekazanie studentom wiedzy na temat zastosowania inżynierii odwrotnej w kontroli jakości.
C2. Wykształcenie u studentów umiejętności stosowania danych ze skanowania 3D w ocenie dokładności geometrycznej produktów i projektowaniu nowych wyrobów.
C3. Zapoznanie studentów z metodami skanowania 3D i rekonstrukcji modeli CAD 3D obiektów fizycznych.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Student potrafi ocenić dane z procesu skanowania 3D i przeprowadzić podstawowe zabiegi edycyjne.
PEU_U02 - Student umie przeprowadzić proces porównania modelu ze skanowania 3D z danymi CAD.
PEU_U03 - Student potrafi zastosować dane ze skanera 3D do zaprojektowania nowego wyrobu.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Studenci powinni mieć świadomość odpowiedzialności za efekty pracy własnej i innych członków zespołu.

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Wprowadzenie do zajęć. Prezentacja skanerów 3D. Skanowanie 3D wybranego przedmiotu.	3
Proj2	Zapoznanie z interfejsem programu komputerowego. Import i podstawowe zabiegi edycyjne danych z procesu skanowania 3D.	2
Proj3	Orientacja modeli w przestrzeni, funkcja best-fit. Porównanie dwóch modeli i generowanie mapy odchyłek.	2
Proj4	Zaawansowane funkcje inspekcyjne.	2
Proj5	Rekonstrukcja modelu CAD z użyciem danych z procesu skanowania (przygotowanie danych, modelowanie CAD).	4
Proj6	Rekonstrukcja modelu CAD z użyciem danych z procesu skanowania (ocena wyniku). Zajęcia zaliczeniowe.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. case study N2. praca własna - przygotowanie do projektu N3. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03	ocena projektu
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
[1] GOM Inspect Manual - Basic
[2] GOM Inspect Manual - Advanced

LITERATURA UZUPEŁNIAJĄCA
[1] Savio E., De Chiffre L., Schmitt R. “Metrology of freeform shaped parts”. CIRP Annals – Manufacturing Technology. 56, 2 (2007): s. 810–835.
[2] Wang J., Gu D., Yu Z., Tan Ch., Zhou L. “A framework for 3D model reconstruction in reverse engineering”. Computers & Industrial Engineering. 63 (2012): s. 1189–1200
[3] Ameen W., Al-Ahmari A.M., Mian S.H. “Evaluation of handheld scanners for automotive applications”. Applied Sciences. 8 (2018), 217
[4] Gapinski B., Wieczorowski M., Marciniak-Podsadna L., Dybala B., Ziolkowski G. “Comparison of different methods of measurement geometry using CMM, optical scanner and computed tomography 3D”. Procedia Engineering. 69 (2014): s. 255–262

OPIEKUN PRZEDMIOTU

dr inż. Tomasz Będza tel.: 71 320 42 08 email: tomasz.bedza@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Komputerowo wspomagane wytwarzanie w systemie CAD-CAM-CATIA V5**

Nazwa przedmiotu w języku angielskim: **Computer-aided manufacturing in the CAD-CAM-CATIA V5 system**

Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**

Poziom i forma studiów: **I stopień, stacjonarne**

Rodzaj przedmiotu: **wybieralny**

Kod przedmiotu: **W10MBM-SI0109**

Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				30	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Posiada podstawową wiedzę o procesach technologicznych.
2. Posiada podstawową wiedzę projektowania w 3D.
3. Posiada podstawową wiedzę z wytrzymałości materiałów, mechaniki i teorii maszyn i mechanizmów.

CELE PRZEDMIOTU

C1. Nabycie wiedzy w zakresie nowoczesnych narzędzi inżynierskich do analizy i optymalizacji procesów technologicznych w systemie CATIA
C2. Nabycie podstawowej wiedzy i umiejętności budowy modeli matematycznych procesów technologicznych.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Posiada umiejętność budowy modeli matematycznych procesów technologicznych.
PEU_U02 - Potrafi przeprowadzić obliczenia oraz wstępną optymalizację procesu kształtowania plastycznego.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Nabywa przekonania o odpowiedzialności za wykonywaną pracę.

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Wprowadzenie do komputerowej symulacji procesów technologicznych w środowisku programu obliczeniowego.	2
Proj2	Modelowanie wybranych przykładowych procesów kształtowania plastycznego.	3
Proj3	Opracowanie założeń projektowych dla wybranego detalu kształtowanego przeróbką plastyczną.	3
Proj4	Opracowanie geometrii procesu.	2
Proj5	Wykonanie obliczeń dla różnych parametrów procesu i/lub geometrii procesu.	5
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. ćwiczenia problemowe
N2. praca własna - przygotowanie do projektu
N3. prezentacja projektu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_K01	ocena przygotowania projektu
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA Rusiński E., Czmochowski J., Smolnicki T.: Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000. Lisowski E., Automatyzacja i integracja zadan projektowania, Wydaw. PK, rok: 2007 Nelson D. H., Applied manufacturing process planning : with emphasis on metal forming and machining, Prentice Hall, 2001 Szabo B., Introduction to finite element analysis : formulation, verification and validation. Chichester, John Wiley and Sons, 2011. Zimmerman W. J., Multiphysics modelling with finite element methods. Singapore [etc.], World Scientific, 2008. World Scientific, LITERATURA UZUPEŁNIAJĄCA Kleiber M., Wprowadzenie do nieliniowej termomechaniki ciał odkształcalnych, Warszawa , Wydawnictwo Instytutu Podstawowych Problemów Techniki PAN, 2011. Sińczak J.: Kucie dokładne. AGH Uczelniane Wydawnictwa Naukowo-Dydaktyczne, Kraków 2007

OPIEKUN PRZEDMIOTU
dr inż. Artur Górski tel.: 71 320-28-47 email: artur.gorski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Modelowanie bryłowe i powierzchniowe w systemie CATIA**
Nazwa przedmiotu w języku angielskim: **Solid and surface modeling in CATIA**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **wybieralny**
Kod przedmiotu: **W10MBM-SI0110**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				30	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Wiedza w zakresie geometrii wykreślnej.
2. Podstawy kształtowania ustrojów maszyn
3. Umiejętność posługiwania się programami CAD/CAE

CELE PRZEDMIOTU

C1. Zapoznanie się z metodami tworzenia modeli powierzchniowych i bryłowych
C2. Opanowanie metod tworzenia złożeń i zdefiniowania animacji mechanizmów.
C3. Zapoznanie z metodami kształtowania wytrzymałościowego struktur cienkościennych i bryłowych

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Potrafi opracować model bryłowy lub powierzchniowy w programie CATIA
PEU_U02 - Potrafi wykonać model złożeniowy i przeprowadzić animację ruchu mechanizmu w programie CATIA
PEU_U03 - Potrafi przeprowadzić analizę wytrzymałościową struktury bryłowej lub cienkościennej w programie CATIA

III. Z zakresu kompetencji społecznych:
PEU_K01 - Nabywa umiejętności ponoszenia odpowiedzialności za wykonaną pracę
PEU_K02 - Myśleć i działać w sposób kreatywny
PEU_K03 - Nabywa umiejętność pracy zespołowe

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Wprowadzenie, zapoznanie się ze środowiskiem programu CATIA, praca ze szkicownikiem	2
Proj2	Podstawy modelowania bryłowego w programie CATIA	2
Proj3	Podstawy modelowania powierzchniowego w programie CATIA	2
Proj4	Tworzenie złożeń i animacji ruchu	2
Proj5	Przeprowadzenie analiz wytrzymałościowych dla struktur bryłowych	2
Proj6	Przeprowadzenie analiz wytrzymałościowych dla struktur cienkościennych	2
Proj7	Przygotowanie dokumentacji konstrukcyjnej	2
Proj8	Opracowanie sprawozdania z projektu	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. praca własna - przygotowanie do projektu
N2. prezentacja multimedialna
N3. prezentacja projektu
N4. przygotowanie sprawozdania

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01-PEU_U03, PEU_K01-PEU_K03	projekt
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

Rusinski E., Czmochowski J., Smolnicki T. Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000
Rakowski G., Kacprzak Z.: Metoda elementów skończonych w mechanice konstrukcji, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2016
Wyleżoł M. CATIA. Podstawy modelowania powierzchniowego i hybrydowego, Helion, Gliwice 2003
Wełyczko A. CATIA V5. Sztuka modelowania powierzchniowego, Helion 2008
Sokół K. CATIA. Wykorzystanie metody elementów skończonych w obliczeniach inżynierskich, Helion 2014

LITERATURA UZUPEŁNIAJĄCA

Wyleżoł M. CATIA v5 Modelowanie i analiza układów kinematycznych, Helion 2007
Skarka W., Mazurek A. CATIA. Podstawy modelowania i zapisu konstrukcji, Helion 2005
Pieczonka K.: Inżynieria maszyn roboczych. Część I. Podstawy urabiania, jazdy, podnoszenia i obrotu, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2007
Dudczak A.: Koparki. Teoria i projektowanie, PWN, Warszawa 2000
Augustyn J., Śledziewski, Technologiczność stalowych konstrukcji spawanych, Arkady, Warszawa 1981
Ferenc K., Ferenc J.: Konstrukcje spawane. Projektowanie połączeń. WNT, Warszawa 2000

OPIEKUN PRZEDMIOTU
dr hab. inż. Jerzy Czmochowski tel.: 71 320 42 84 email: jerzy.czmochowski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Modelowanie numeryczne**
Nazwa przedmiotu w języku angielskim: **Numerical modelling**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **wybieralny**
Kod przedmiotu: **W10MBM-SI0111**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				30	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Umiejętność obsługi dowolnego programu typu CAD
2. Podstawowa wiedza z zakresu fizyki, konstrukcji maszyn, teorii mechanizmów, wytrzymałości materiałów, grafiki inżynierskiej
3. Umiejętność pracy w zespole oraz kreatywne myślenie

CELE PRZEDMIOTU

C1. Poznanie nowych, użytecznych narzędzi komputerowego wspomagania prac inżynierskich.
C2. Nauczenie się zasad modelowania i prowadzenia badań symulacyjnych nowego oprogramowania i jego pakietów.
C3. Nauczenie się wykorzystania oprogramowania do modelowania i analizy wielodomenowych rozwiązań niskoemisyjnych.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Ma wiedzę z zakresu tworzenia i prowadzenia symulacji działania systemów mechatronicznych.
PEU_W02 - Ma wiedzę w zakresie badania i optymalizacji komponentów mechanicznych.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi określić odpowiednie narzędzia (pakiety) i typy symulacji umożliwiających rozwiązanie różnych problemów inżynierskich.
PEU_U02 - Potrafi tworzyć modele symulacyjne w sposób uporządkowany, świadomie wybierając opcje i parametry symulacji.
PEU_U03 - Potrafi tworzyć wysokojakościowe raporty z badań symulacyjnych.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Zna zasady porządkowania i oznaczania tworzonych modeli w sposób umożliwiający innym osobom łatwe wdrożenie w projekt.

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Wprowadzenie wraz z prezentacją przedmiotu, pierwszy kontakt z obsługą programu.	1
Proj2	Projekt i badania symulacyjne prostego układu mechanicznego – nauka obsługi programu.	3
Proj3	Projekt i badania symulacyjne wybranego systemu układu mechatronicznego pojazdu lądowego.	5
Proj4	Projekt i badania symulacyjne urządzenia łączące biblioteki mechaniczną, pneumatyczną, hydrauliczną i sygnałową.	6
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. praca własna - przygotowanie do projektu N2. case study N3. dyskusja problemowa N4. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_U01, PEU_K01, PEU_U03	obrona projektu, ocena przygotowania projektu
F2	PEU_W02, PEU_U02, PEU_K01, PEU_U03	obrona projektu, ocena przygotowania projektu
F3	PEU_U03, PEU_K01	obrona projektu, ocena przygotowania projektu
P = średnia(F1,F2,F3)		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA https://community.sw.siemens.com/s/ LITERATURA UZUPEŁNIAJĄCA J. Reimpell, J. Betzler. Podwozia samochodów. Podstawy konstrukcji. Wydawnictwa Dietrich i inni. Podstawy konstrukcji maszyn 1-3. WNT, Warszawa 2017. Zasoby i e-zasoby biblioteki PWr,

OPIEKUN PRZEDMIOTU
dr inż. Gustaw Sierzputowski email: gustaw.sierzputowski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Obliczenia inżynierskie z użyciem arkusza kalkulacyjnego**
Nazwa przedmiotu w języku angielskim: **Engineering calculations with usage of spreadsheet**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **wybieralny**
Kod przedmiotu: **W10MBM-SI0112**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				30	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Dobra umiejętność posługiwania się komputerem w zakresie zagadnień technologii informacyjnej.

CELE PRZEDMIOTU

C1. Prezentacja danych w formie graficznej.
C2. Stosowanie iteracyjnych metod rozwiązywania równań nieliniowych i obliczanie wybranymi metodami numerycznymi całek oznaczonych.
C3. Poznanie możliwości języka VBA.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Umie graficznie opracowywać dane.
PEU_U02 - Potrafi stosować iteracyjne metody rozwiązywania równań nieliniowych oraz obliczać wybranymi metodami numerycznymi całki oznaczone.
PEU_U03 - Umie używać VBA.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Potrafi zastosować zdobytą wiedzę do rozwiązywania problemów inżynierskich
PEU_K02 - Potrafi pracować w zespole i wykonywać przydzielone zadania

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Import danych do arkusza kalkulacyjnego. Formatowanie danych. Tabele.	2
Proj2	Graficzne opracowywanie danych.	2
Proj3	Rozwiązywanie równań metodą graficzną.	2
Proj4	Iteracyjne rozwiązywanie równań nieliniowych.	2
Proj5	Numeryczne obliczanie całek oznaczonych.	2
Proj6	Korelacja i regresja.	2
Proj7	Język VBA	3
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. eksperyment laboratoryjny
N2. konsultacje
N3. praca własna – przygotowanie do laboratorium
N4. przygotowanie sprawozdania

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się

F1	PEU_U01-PEU_U03	ocena sporawozdań
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA 1. Maciej Gonet "Excel w obliczeniach naukowych i inżynierskich". Helion. 2. Daniel Brzózka "Excel - szybkie przetwarzanie danych. Sztuczki i gotowe rozwiązania". Wydawnictwo: Videopoint. LITERATURA UZUPEŁNIAJĄCA 1. Jarosław Baca "Excel 2016 i programowanie VBA. Kurs video. Poziom drugi. Zaawansowane techniki tworzenia makr". Wydawnictwo: Videopoint.

OPIEKUN PRZEDMIOTU
dr inż. Maciej Panek tel.: 071 320 47 79 email: maciej.panek@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Podstawy modelowania geometrii i generowanie dokumentacji z wykorzystaniem oprogramowania PTC Creo Parametric**

Nazwa przedmiotu w języku angielskim: **Fundamentals of geometry modelling and documentation generation using PTC Creo Parametric software**

Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**

Poziom i forma studiów: **I stopień, stacjonarne**

Rodzaj przedmiotu: **wybieralny**

Kod przedmiotu: **W10MBM-SI0113**

Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				30	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Podstawowa znajomość modelowania geometrii przedmiotów z wykorzystaniem dowolnego programu CAD. Zalecana znajomość modelowania parametrycznego.
2. Znajomość rysunku technicznego maszynowego. Warunek niezbędny: zaliczony kurs "Zapis konstrukcji" lub pokrewny.

CELE PRZEDMIOTU

C1. Zapoznanie się z podstawowymi zagadnieniami parametrycznego modelowania brył oraz złożeń z wykorzystaniem oprogramowania CREO Parametric.
C2. Zapoznanie się z zasadami tworzenia dokumentacji 2D z wykorzystaniem wcześniej zdefiniowanych modeli geometrycznych. Tworzenie dokumentacji dla części oraz złożeń.
C3. Zapoznanie się z podstawowymi zasadami tworzenia dokumentacji 3D. (o ile czas pozwoli)

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Student potrafi korzystać z oprogramowania PTC Creo Parametric w zakresie tworzenia modeli bryłowych, głównie z zastosowaniem takich cech jak: wyciągnięcie, obrót, otwór, faza, promień, powielenie.
Student potrafi zbudować proste złożenie z wykorzystaniem kilku zamodelowanych przez siebie części, potrafi nadać więzy definiujące połączenia stałe oraz ruchome (mechanizmy).
W modelach bryłowych student potrafi prawidłowo zdefiniować przekroje, tolerancje wymiarów i kształtów oraz chropowatości powierzchni.
PEU_U02 - Wykorzystując wcześniej zdefiniowane modele geometryczne student potrafi utworzyć dokumentację techniczną używając dwóch sposobów definiowania wymiarów i tolerancji: definiując wymiary na rysunku płaskim oraz przywołując wymiary z modelu 3D.
Student potrafi wygenerować dokumentację zarówno dla poszczególnych części jak i dla złożenia.
Student potrafi wyeksportować dokumentację oraz modele do standardowych plików wymiany danych: step, pdf (również 3D), dwg, dxf i innych.
PEU_U03 - Student potrafi zmodyfikować model geometryczny zachowując pełne odwzorowanie zmian na wygenerowanej przez siebie dokumentacji. Student potrafi modyfikować wybrane cechy modelu bryłowego korzystając wyłącznie z wygenerowanej przez siebie dokumentacji 2D.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Studenci uczą się współpracy zarówno w zakresie bezpośrednio dotyczącym realizowanego zadania jak i w zakresie wspólnego poznawania cech użytkowych oprogramowania.

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Wprowadzenie. Opis instalacji i konfiguracji programu. Podział na grupy.	1
Proj2	Zatwierdzenie projektów. Modelowanie bryłowe - wprowadzenie. Konfiguracja programu.	2
Proj3	Modelowanie bryłowe. Parametryzacja konstrukcji.	2
Proj4	Modelowanie złożeń.	2
Proj5	Generowanie dokumentacji 2D. Definiowanie przekrojów.	2
Proj6	Wymiarowanie dokumentacji 2D.	2
Proj7	Wymiarowanie, definiowanie tolerancji kształtu. Opisywanie stanu powierzchni.	2

Proj8	Zaliczenie.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. case study N2. praca własna - przygotowanie do projektu N3. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01-PEU_U03,	ocena końcowa wykonanego zadania
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA Pomoc załączona do programu PTC Creo. LITERATURA UZUPEŁNIAJĄCA

OPIEKUN PRZEDMIOTU
mgr inż. Rafał Fenc email: rafal.fenc@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Programowanie obróbki szybkościowej w programie Inventor HSM**
Nazwa przedmiotu w języku angielskim: **Programming high-speed machining in Inventor HSM**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **wybieralny**
Kod przedmiotu: **W10MBM-SI0114**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				30	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ugruntowana wiedza dotyczącej procesu projektowo-wytwórczego z wykorzystaniem systemów CAx.
2. Potrafi zaprojektować proces technologiczny w zakresie obróbki bezubytkowej i ubytkowej.
3. Wiedza w zakresie budowy i działania obrabiarek sterowanych numerycznie.

CELE PRZEDMIOTU

C1. Opanowanie metod planowania operacji obróbkowych pod kątem technologiczności wykonania, doboru narzędzi skrawających i oprzyrządowania oraz prowadzenia i nadzorowania procesu skrawania.
C2. Zapoznanie słuchaczy z zaawansowanymi narzędziami programistycznymi, budową programów sterujących opartych na normie ISO oraz działaniem postprocesorów.
C3. Prezentacja nowoczesnych narzędzi informatycznych wspomagających wytwarzanie, omówienie problematyki doboru, wdrażania i integracji systemów CAD/CAM.
C4. Zapoznanie słuchaczy z zasadą działania, wymaganiami BHP oraz obsługą obrabiarek CNC i specyfiką opracowywania procesów technologicznych obróbki i wdrażaniem ich na tych obrabiarkach.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Przygotowanie zarówno programu sterującego jak i obrabiarki do pracy oraz weryfikację poprawności działania programu poprzez rozumienie wygenerowanego kodu sterującego oraz analizę wygenerowanych ścieżek narzędzi i symulację bryłową.
PEU_U02 - Samodzielne zaprojektowanie procesu technologicznego począwszy od analizy dokumentacji, modelowanie 3D, wybór odpowiednich operacji w systemie CAM, dobór oprzyrządowania, narzędzi skrawających oraz parametrów.
PEU_U03 - Opanowanie w podstawowym zakresie obsługiwania wybranej obrabiarki sterowanej numerycznie, zamocować przedmiot obrabiany oraz narzędzia oraz dokonać pomiarów cech charakterystycznych.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Umiejętność pracy w zespole projektowo-technologicznym.
PEU_K02 - Umiejętność krytycznej oceny uzyskanych wyników i ich wpływu na funkcjonowanie przedsiębiorstwa.
PEU_K03 - Nabywa umiejętności samodzielnego podejmowania decyzji i ponoszenia odpowiedzialności za wykonaną pracę.

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Zajęcia organizacyjne. Wprowadzenie w środowisko oprogramowania wspierającego technologie wytwarzania CAx.	1
Proj2	Konfiguracja bazy narzędzi oraz metody wprowadzania narzędzi do bazy.	2
Proj3	Omówienie podstawowych operacji obróbkowych dla 2,5D oraz 3D.	2
Proj4	Omówienie technologiczności wybranego detalu, opracowanie technologii wykonania wybranego detalu oraz dobór lub zaprojektowanie oprzyrządowania specjalnego.	2
Proj5	Omówienie podstawowych komend G-kodu dla wybranego sterowania maszyny, omówienie wygenerowanego programu obróbkowego.	2

Proj6	Przygotowanie maszyny do pracy, ustawienie wybranego systemu mocowania, uzbrojenie magazynu narzędziowego, obsługa sondy przedmiotowej oraz narzędziowej.	2
Proj7	Przygotowanie obrabianego półfabrykatu, ustawienie punktu bazowego oraz obróbka detalu i weryfikacja wygenerowanego programu.	2
Proj8	Bezpieczne uruchomienie programu NC, obróbka detalu i weryfikacja parametrów obróbki, dokonanie pomiarów ręcznymi przyrządami pomiarowymi.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. eksperyment laboratoryjny N2. ćwiczenia problemowe N3. dyskusja problemowa N4. konsultacje N5. praca własna - przygotowanie do projektu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01-PEU_U03	kartkówka, realizacja projektu
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA [1]. Autodek CAM "Fundamentals of CNC Machining A Practical Guide for Beginners" Compliments of Autodesk,Inc [2]. G. Nikiel, „Programowanie obrabiarek CNC na przykładzie układu sterowania Sinumerik 810D/ 840D”, Prace Akademi Techniczno-Humanistycznej w Bielsku-Białej, Bielsko-Biała 2004, opracowanie dostępne w Internecie [3]. J. Szadkowski, R. Stryczek, Grzegorz Nikiel, Projektowanie procesów technologicznych na obrabiarki sterowane numerycznie, skrypt Akademi Techniczno-Humanistycznej w Bielsku-Białej, Bielsko-Biała 1995, opracowanie dostępne w Internecie LITERATURA UZUPEŁNIAJĄCA [1]. B. Pytlak, R. Stryczek "Elastyczne programowanie obrabiarek" Wydawnictwo Naukowe PWN [2]. Augustyn, Krzysztof. NX CAM : programowanie ścieżek dla obrabiarek CNC / Gliwice : Helion, 2010

OPIEKUN PRZEDMIOTU
dr hab. inż. Bogdan Dybała tel.: 40 61 email: bogdan.dybala@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Projektowanie form wtryskowych i odlewniczych w programie Solid Works**

Nazwa przedmiotu w języku angielskim: **Designing injection and casting molds in Solidworks**

Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**

Poziom i forma studiów: **I stopień, stacjonarne**

Rodzaj przedmiotu: **wybieralny**

Kod przedmiotu: **W10MBM-SI0115**

Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				30	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Wiedza i umiejętności z zakresu kursów "Grafika inżynierska 3D", "Modelowanie CAD" lub podobnych.
2. Umiejętność posługiwania się programami CAD/CAE.

CELE PRZEDMIOTU

C1. Nabycie przez studentów wiedzy i umiejętności w zakresie modelowania w środowisku Solidworks formy wtryskowej.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:

PEU_U01 - Student potrafi wykonać model kompletnej formy wtryskowej.

III. Z zakresu kompetencji społecznych:

PEU_K01 - Student nabywa umiejętności ponoszenia odpowiedzialności za wykonaną pracę.

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Wprowadzenie, zapoznanie się ze środowiskiem programu Solidworks.	1
Proj2	Wstęp do modelowania narzędzi do form - różnice w podejściach modelowania bryłowego i powierzchniowego.	2
Proj3	Podstawowe aspekty modelowania form: skurcz, pochylenia, linie neutralne, powierzchnie neutralne, powierzchnie zamknięcia stykowego.	2
Proj4	Modelowanie rdzeni bocznych i wypychaczy, uwzględnienie ich roli w procesie formowania.	2
Proj5	Modelowanie form przy użyciu modelowania powierzchniowego.	2
Proj6	Alternatywne metody modelowania form wtryskowych.	2
Proj7	Wykorzystanie operacji z biblioteki do projektowania kanałów chłodzących.	2
Proj8	Praca zaliczeniowa - modelowanie kompletnej formy wtryskowej.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. dyskusja problemowa
N2. prezentacja projektu
N3. praca własna - przygotowanie do projektu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01,PEU_K01	ocena pracy zaliczeniowej

P = F1

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

[1]. Dobrzański T., Rysunek techniczny maszynowy, Wydawnictwo Naukowe PWN, 2021

[2]. Domański J., SolidWorks 2022. Projektowanie maszyn i konstrukcji, Wydawnictwo Helion, 2022

[3]. Tran P. The Complete Guide to Mold Making with SOLIDWORKS 2022

LITERATURA UZUPEŁNIAJĄCA

OPIEKUN PRZEDMIOTU

dr hab. inż. Bogdan Dybała tel.: 40 61 email: bogdan.dybala@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Projektowanie zespołów maszyn roboczych w systemach CAD(Inventor, AutoCAD)**

Nazwa przedmiotu w języku angielskim: **Design of working machines assemblies in CAD systems (Inventor, AutoCAD)**

Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**

Poziom i forma studiów: **I stopień, stacjonarne**

Rodzaj przedmiotu: **wybieralny**

Kod przedmiotu: **W10MBM-SI0116**

Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				30	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Zna zagadnienia związane z wykorzystaniem narzędzi informatycznych CAD w obszarze projektowania.
2. Potrafi prowadzić prace projektowo-konstrukcyjne prostych zespołów maszynowych; potrafi stosować w praktyce poznane programy komputerowe do wspomagania prac inżynierskich.
3. Potrafi budować modele, rozwiązywać podstawowe zagadnienia z zakresu statyki, dynamiki w maszynach, urządzeniach i pojazdach.

CELE PRZEDMIOTU

C1. Zdobycie umiejętności syntezy elementów i zespołów w układy maszynowe.
C2. Zdobycie umiejętności posługiwania się nowoczesnymi metodami i narzędziami do wirtualnego projektowania pojazdów przemysłowych i maszyn roboczych.
C3. Utrwalenie umiejętności pracy w grupie.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - potrafi sporządzać zbiory rozwiązań koncepcyjnych układów kinematycznych maszyn i urządzeń, dokonać selekcji; potrafi stosować współczesne strategie i techniki w projektowaniu elementów i zespołów maszyn i pojazdów.
PEU_U02 - potrafi przeprowadzić dobór materiału lub opracować założenia projektowe na podstawie baz danych i założeń dotyczących wymagań eksploatacyjnych elementów lub zespołów konstrukcyjnych maszyn i urządzeń
PEU_U03 - potrafi pozyskiwać i stosować informacje z literatury, baz danych i innych dostępnych źródeł do działań o charakterze inżynierskim w zakresie projektowania, eksploatacji maszyn

III. Z zakresu kompetencji społecznych:
PEU_K01 - Nabywa dbałości o estetykę wykonywanych prac, w tym projektów i raportów.
PEU_K02 - Potrafi odpowiednio określić priorytety służące realizacji określonego przez siebie lub innych zadania.
PEU_K03 - Potrafi pracować w grupie, przyjmując w niej różne role.

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Omówienie warunków zaliczenia kursu. Wybór obiektu i opracowanie jego koncepcji. Zdefiniowanie projektowanego obiektu i określenie założeń konstrukcyjnych – funkcje , gabaryty, obciążenia i prędkości ruchów.	2
Proj2	Budowa modelu geometrycznego (3D) projektowanego obiektu.	3
Proj3	Modelowanie właściwości masowych, połączeń kinematycznych i podatnych obiektu. Modelowanie układu napędowego obiektu oraz wymuszeń zewnętrznych.	2
Proj4	Badania numeryczne: optymalizacja właściwości dynamicznych obiektu, określenie obciążeń dla obliczeń wytrzymałościowych.	2
Proj5	Ocena modelu geometrycznego projektowanego obiektu. Wymagane modyfikacje i uproszczenia modelu geometrycznego. Weryfikacja proponowanych materiałów i dobór ich parametrów niezbędnych do analizy numerycznej (MES).	2

Proj6	Budowa modelu numerycznego (MES) projektowanych podzespołów. Wybór metody analizy numerycznej (MES) z uwagi na ewentualne nieliniowości geometryczne i nieliniowości materiałów. Określenie i analiza wymaganych kombinacji obciążeń. Obliczenia numeryczne. Weryfikacja i analiza otrzymanych wyników obliczeń.	3
Proj7	Prezentacja i ocena projektu	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. praca własna - przygotowanie do projektu N2. prezentacja projektu N3. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01-PEU_U03, PEU_K01-PEU_K03	zaliczenie projektu
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

Dudzinski P., Lenksysteme für Nutzfahrzeuge, Springer, 2004
Ahmed A. Shabana, Dynamic of Multibody Systems, Cambridge University Press, 1998
Rakowski G., Kacprzyk Z., Metoda elementów skonczonych w mechanice konstrukcji, Oficyna Wydawnicza Politechniki Warszawskiej, 2005
Rusiński E., Czmochowski J., Smolnicki T.: Zaawansowana metoda elementów skończonych w konstrukcjach nośnych. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000.

LITERATURA UZUPEŁNIAJĄCA

Rusiński E.: Zasady projektowania konstrukcji nośnych pojazdów samochodowych. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2002.
Pieczonka, K., Inżynieria maszyn roboczych. Część I. Podstawy urabiania, jazdy, podnoszenia i obrotu, Oficyna Wydawnicza Politechniki Wrocławskiej, 2007
Dudczak, A., Koparki: teoria i projektowanie, PWN, 2000
Piatkiewicz, A. , Sobolski R., tytuł: Dzwignice, WNT, 1978

OPIEKUN PRZEDMIOTU
dr inż. Robert Czabanowski tel.: 71 320-28-37 email: robert.czabanowski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Rozwiązywanie zagadnień mechaniki w systemie ABAQUS**
Nazwa przedmiotu w języku angielskim: **Solving problems of mechanics in the ABAQUS**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI0117**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				30	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)					

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Wiedza w zakresie mechaniki, materiałoznawstwa i wytrzymałości materiałów.
2. Umiejętność posługiwania się programami CAD/CAE.

CELE PRZEDMIOTU

C1. Zapoznanie się z metodami analiz modeli dyskretnych uwzględniających nieliniowości fizyczne i geometryczne.
C2. Opanowanie metod przeprowadzania analiz statycznych i dynamicznych z wykorzystaniem metody elementów skończonych.
C3. Zapoznanie się z metodami modelowania zjawisk kontaktowych oraz definicji interakcji między obiektami w modelu obliczeniowym.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:

PEU_U01 - Potrafi opracować model i parametry analizy dla stanów dużych odkształceń, dużych przemieszczeń i odkształceń sprężysto-plastycznych.
PEU_U02 - Potrafi wykonać model i zdefiniować parametry analizy dynamiki konstrukcji maszyn.
PEU_U03 - Potrafi opracować model i zdefiniować parametry do analizy zagadnień termosprężystych w stanach ustalonych i nieustalonych.

III. Z zakresu kompetencji społecznych:

PEU_K01 - Nabywa umiejętności ponoszenia odpowiedzialności za wykonaną pracę.
PEU_K02 - Nabywa umiejętność pracy zespołowej.

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Wprowadzenie do zajęć projektowych.	1
Proj2	Przygotowanie modelu do analizy w zakresie dużych przemieszczeń i/lub dużych odkształceń i/lub odkształceń sprężysto-plastycznych.	2
Proj3	Wykonanie analizy i opracowanie wyników obliczeń w zakresie dużych przemieszczeń i/lub dużych odkształceń i/lub odkształceń sprężysto-plastycznych.	2
Proj4	Przygotowanie modelu do analizy dynamiki metodą bezpośredniego numerycznego całkowania równań ruchu.	2
Proj5	Wykonanie analizy i opracowanie wyników z obliczeń dynamiki metodą bezpośredniego numerycznego całkowania równań ruchu.	2
Proj6	Przygotowanie modelu do analizy termosprężystej w stanie ustalonym i w stanie nieustalonym.	2
Proj7	Wykonanie analizy i opracowanie wyników z obliczeń termosprężystych w stanie ustalonym i w stanie nieustalonym.	2
Proj8	Opracowanie projektu z zaawansowanej analizy MES.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. praca własna - przygotowanie do projektu
N2. prezentacja projektu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01 PEU_U02 PEU_U03 PEU_K01 PEU_K02	ocena części obliczeniowej projektu, odpowiedzi ustne
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

Rusiński E., Czmochowski J., Smolnicki T. Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000
Rakowski G., Kacprzak Z.: Metoda elementów skończonych w mechanice konstrukcji, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2016
Zienkiewicz O.C.: Metoda elementów skończonych, Arkady Warszawa 1972

LITERATURA UZUPEŁNIAJĄCA

Skrzypek J.: Plastyczność i pełzanie. Teoria, zastosowania, zadania. PWN, Warszawa 1986
Uhl T.: Komputerowo wspomagana identyfikacja modeli konstrukcji mechanicznych, WNT Warszawa 1997
Gawroński W., Kruszewski J., Ostachowicz W., Tarnowski J., Wittbrodt E. : Metoda elementów skończonych w dynamice konstrukcji. Arkady. Warszawa, 1984
Giergiel J.: Drgania mechaniczne, Uczelniane Wydawnictwa Naukowo-Dydaktyczne, Kraków 2000
Gryboś R.: Drgania maszyn, Wydawnictwo Politechniki Śląskiej, Gliwice 1998
Kostowski E.: Przepływ ciepła, Wydawnictwo Politechniki Śląskiej, Gliwice 2000
Dobrociński S.: Modelowanie zagadnień obliczania naprężeń cieplnych. WNT, Warszawa 2000

OPIEKUN PRZEDMIOTU

dr hab. inż. Jacek Karliński tel.: 71 320-29-46 email: jacek.karlinski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Techniki projektowania - SolidWorks**
Nazwa przedmiotu w języku angielskim: **Design techniques - SoldWorks**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **wybieralny**
Kod przedmiotu: **W10MBM-SI0118**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				30	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Student powinien znać podstawowe elementy konstrukcyjne maszyn i sposoby ich działania.
2. Posiadać podstawową wiedzę z zakresu rysunku technicznego.

CELE PRZEDMIOTU

C1. Celem przedmiotu jest przedstawienie wiedzy z zakresu projektowania w środowisku SolidWorks
C2. Zapoznanie z narzędziami umożliwiającymi tworzenie szkiców, złożeń oraz dokumentacji.
C3. Nabycie umiejętności obsługi biblioteki ToolBox.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - W wyniku przeprowadzonych zajęć student powinien umieć projektować bryły i złożenia, tworzyć dokumentację, wiązania, modelować ruch i badać przemieszczenia.
PEU_U02 - Student umie korzystać z wgranych baz i bibliotek znormalizowanych części.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Student potrafi rozwiązywać w grupie zdefiniowane problemy konstrukcyjne.

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Wstęp, zapoznanie ze środowiskiem SolidWorks	2
Proj2	Rysunek 2D i rzuty	2
Proj3	Rysunek 3D	2
Proj4	Projekt typowej części maszyny	2
Proj5	Projekt typowej części maszyny	2
Proj6	Projekt typowej części maszyny	2
Proj7	Projekt typowej części maszyny	2
Proj8	Zaliczenie projektu	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. praca własna - przygotowanie do projektu
N2. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02	ocena za projekt
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA Domański J.: SolidWorks 2022. Projektowanie maszyn i konstrukcji. Wyd. Helion 2022 LITERATURA UZUPEŁNIAJĄCA Łabudek R.: Kompendium SolidWorks. Wyd. Helion 2022

OPIEKUN PRZEDMIOTU
dr inż. Kamil Waszczuk tel.: (071) 320-27-34 email: Kamil.Waszczuk@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Tworzenie dokumentacji technicznej w programie SolidWorks**
Nazwa przedmiotu w języku angielskim: **Technical drawing with Solidworks**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **wybieralny**
Kod przedmiotu: **W10MBM-SI0119**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				30	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Wiedza i umiejętności z zakresu kursów "Grafika inżynierska", "Geometria wykreślna", "Zapis konstrukcji" lub podobnych
2. Wiedza i umiejętności z zakresu kursów "Grafika inżynierska 3D", "Modelowanie CAD" lub podobnych
3. Umiejętność posługiwania się programami CAD/CAE

CELE PRZEDMIOTU

C1. Nabycie przez studentów wiedzy i umiejętności w zakresie przygotowywania dokumentacji technicznej 2D części i zespołów na podstawie modeli 3D

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Student potrafi wykonać kompletną dokumentację techniczną części i złożenia na podstawie modelu 3D

III. Z zakresu kompetencji społecznych:
PEU_K01 - Student nabywa umiejętności ponoszenia odpowiedzialności za wykonaną pracę

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Wprowadzenie, zapoznanie się ze środowiskiem programu SOLIDWORKS.	1
Proj2	Modelowanie części poznanymi metodami.	2
Proj3	Generowanie dokumentacji 2D dla zamodelowanej części.	2
Proj4	Modelowanie złożenia.	2
Proj5	Generowanie dokumentacji 2D dla zamodelowanego złożenia.	2
Proj6	Generowanie: BOM - listy komponentów, autonumerowanie części, omówienie formatów zapisu pracy.	2
Proj7	Generowanie dokumentacji 2D dla konstrukcji spawanych.	2
Proj8	Praca zaliczeniowa do wykonania na zajęciach.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. dyskusja problemowa
N2. prezentacja projektu
N3. praca własna - przygotowanie do projektu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01,PEU_K01	Ocena pracy zaliczeniowej
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
Dobrzański T., Rysunek techniczny maszynowy, Wydawnictwo Naukowe PWN, 2021
Domański J., SolidWorks 2022. Projektowanie maszyn i konstrukcji, Wydawnictwo Helion, 2022

LITERATURA UZUPEŁNIAJĄCA
E. Chlebus, "Techniki komputerowe CAx w inżynierii produkcji", WNT, Warszawa 2000

OPIEKUN PRZEDMIOTU

mgr inż. Michał Karoluk tel.: 20-44 email: michal.karoluk@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Zaawansowane funkcje i programowanie w Microsoft Excel**
Nazwa przedmiotu w języku angielskim: **Advanced functions and programming in Microsoft Excel**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **wybieralny**
Kod przedmiotu: **W10MBM-SI0120**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				30	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Student posiada wiedzę w zakresie matematyki obejmującą podstawowe zagadnienia z algebry i analizy.
2. Student potrafi wykorzystywać podstawowe narzędzia informatyczne.
3. Student posiada podstawową wiedzę w zakresie programowania komputerowego.

CELE PRZEDMIOTU

C1. Nabycie przez studentów umiejętności praktycznego zastosowania funkcji zaawansowanych oraz programowania w MS Excel.
C2. Uzyskanie wiedzy w zakresie zastosowań informatyki oraz numerycznych technik obliczeniowych w inżynierii z wykorzystaniem oprogramowania MS Excel.
C3. Zapoznanie studentów z podstawową analizą danych z wykorzystaniem dostępnych narzędzi w MS Excel.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Student posiada wiedzę do świadomego zastosowania formuł i wykonania operacji na danych w oprogramowaniu MS Excel.
PEU_U02 - Student umie posługiwać się i wykonywać działania z wykorzystaniem tabel przestawnych Excel.
PEU_U03 - Student potrafi tworzyć proste raporty na mapach w Excelu.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Student potrafi myśleć i działać w sposób kreatywny wykorzystując nowoczesne narzędzia informatyczne.
PEU_K02 - Student rozumie konieczność systematycznej i samodzielnej pracy nad opanowaniem materiału kursu.

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Wprowadzenie do formuł Excel.	2
Proj2	Operacje na danych (sortowanie i filtrowanie; znajdowanie i zamienianie; formatowanie warunkowe).	2
Proj3	Wprowadzenie do tabeli przestawnej: podstawowe kalkulacje, układ, formatowanie i sortowanie tabeli przestawnej.	2
Proj4	Grupowanie i filtrowanie tabeli przestawnej.	2
Proj5	Wykresy przestawne. Pole obliczeniowe. Projektowanie dashboardu na tabeli przestawnej.	2
Proj6	Zaawansowane kalkulacje i wykresy przestawne.	2
Proj7	Power mapa 3D. Przykłady projektów z mapami w Excelu.	2
Proj8	Ocena zdobytych umiejętności.	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. ćwiczenia problemowe N2. konsultacje N3. praca własna - przygotowanie do projektu N4. prezentacja projektu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02	Ocena przygotowania do realizacji kolejnych tematów projektu. Sprawdzenie zdobytych wiadomości na podstawie zadań i ćwiczeń.
P =		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

[1]. M. Milton, D. Suma (tłum.) Excel, wydawnictwo Helion, 2011

[2]. A. Murray Advanced Excel Formulas: Unleashing Brilliance with Excel Formulas, 2022

[3]. J. Walkenbach Excel 2010PL: programowanie w VBA, wydawnictwo Helion, 2011

[4]. W.L. Winston Microsoft Excel: analiza i modelowanie danych, w-wo Warszawa : APN PROMISE, 2005

LITERATURA UZUPEŁNIAJĄCA

Samouczek Microsoft - Excel — pomoc i informacje (www.microsoft.com)

OPIEKUN PRZEDMIOTU

dr hab. inż. Bogdan Dybała tel.: 40 61 email: bogdan.dybala@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Zaawansowane metody modelowania i analizy w systemach CAD\FEM**
Nazwa przedmiotu w języku angielskim: **Advanced modeling and analysis methods in CAD / FEM systems**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **wybieralny**
Kod przedmiotu: **W10MBM-SI0121**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				30	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Wiedza w zakresie teorii sprężystości, plastyczności, dynamiki i termosprężystości.
2. Podstawy metody elementów skończonych
3. Umiejętność posługiwania się programami CAD/CAE

CELE PRZEDMIOTU

C1. Zapoznanie się z analizami MES w zakresie dużych odkształceń, dużych przemieszczeń i odkształceń sprężysto-plastycznych konstrukcji maszyn
C2. Opanowanie metod analizy dynamiki konstrukcji maszyn
C3. Zapoznanie z metodami analiz termosprężystości w stanach ustalonych i nie ustalonych.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Potrafi opracować model i parametry analizy dla stanów dużych odkształceń, dużych przemieszczeń i odkształceń sprężysto-plastycznych
PEU_U02 - Potrafi wykonać model i zdefiniować parametry analizy dynamiki konstrukcji maszyn
PEU_U03 - Potrafi opracować model i zdefiniować parametry analizy zagadnień termosprężystych w stanach ustalonych i nieustalonych

III. Z zakresu kompetencji społecznych:
PEU_K01 - Nabywa umiejętności ponoszenia odpowiedzialności za wykonaną pracę
PEU_K02 - Myśleć i działać w sposób kreatywny
PEU_K03 - Nabywa umiejętność pracy zespołowej

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Wprowadzenie do zajęć projektowych	1
Proj2	Przygotowanie modelu do analizy w zakresie dużych przemieszczeń i/lub dużych odkształceń i/lub odkształceń sprężysto-plastycznych	2
Proj3	Wykonanie analizy i opracowanie wyników obliczeń w zakresie dużych przemieszczeń i/lub dużych odkształceń i/lub odkształceń sprężystoplastycznych	2
Proj4	Przygotowanie modelu do analizy dynamiki metodą superpozycji modalnej i/lub metodą bezpośredniego numerycznego całkowania równań ruchu	2
Proj5	Wykonanie analizy i opracowanie wyników z obliczeń dynamiki metodą superpozycji modalnej i/lub metodą bezpośredniego numerycznego całkowania równań ruchu	2
Proj6	Przygotowanie modelu do analizy termosprężystej w stanie ustalonym i w stanie nieustalonym	2
Proj7	Wykonanie analizy i opracowanie wyników z obliczeń termosprężystych w stanie ustalonym i w stanie nieustalonym	2
Proj8	Opracowanie projektu z zaawansowanej analizy MES	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. praca własna - przygotowanie do projektu N2. prezentacja projektu N3. przygotowanie sprawozdania N4. prezentacja multimedialna

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03 PEU_K01, PEU_K02, PEU_K03	Ocena przygotowania projektu
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

Rusiński E., Czmochowski J., Smolnicki T. Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000

Rakowski G., Kacprzak Z.: Metoda elementów skończonych w mechanice konstrukcji, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2016

Zienkiewicz O.C.: Metoda elementów skończonych, Arkady Warszawa 1972

LITERATURA UZUPEŁNIAJĄCA

Skrzypek J.: Plastyczność i pełzanie. Teoria, zastosowania, zadania. PWN, Warszawa 1986

Uhl T.: Komputerowo wspomagana identyfikacja modeli konstrukcji mechanicznych, WNT Warszawa 1997

Gawroński W., Kruszewski J., Ostachowicz W., Tarnowski J., Wittbrodt E. : Metoda elementów skończonych w dynamice konstrukcji. Arkady. Warszawa, 1984

Giergiel J.: Drgania mechaniczne, Uczelniane Wydawnictwa Naukowo-Dydaktyczne, Kraków 2000

Gryboś R.: Drgania maszyn, Wydawnictwo Politechniki Śląskiej, Gliwice 1998

Kostowski E.: Przepływ ciepła, Wydawnictwo Politechniki Śląskiej, Gliwice 2000

Dobrociński S.: Modelowanie zagadnień obliczania naprężeń cieplnych. WNT, Warszawa 2000

Kalinowski E.: Przekazywanie ciepła i wymienniki. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 1995

Wiśniewski S., Wiśniewski T.: Wymiana ciepła. WNT, Warszawa 1994

OPIEKUN PRZEDMIOTU
dr hab. inż. Jerzy Czmochowski tel.: 71 320 42 84 email: jerzy.czmochowski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Zarządzanie konfiguracjami i budowanie sparametryzowanych bibliotek danych CAD z wykorzystaniem programów SolidWorks i Microsoft Excel**

Nazwa przedmiotu w języku angielskim: **Configurations management and building parameterised CAD data libraries using SolidWorks and Microsoft Excel**

Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**

Poziom i forma studiów: **I stopień, stacjonarne**

Rodzaj przedmiotu: **wybieralny**

Kod przedmiotu: **W10MBM-SI0122**

Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				30	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Znajomość podstaw konstrukcji maszyn oraz zasad rysunku technicznego
2. Znajomość wiedzy z zakresu kursu „Grafika inżynierska 3D”
3. Znajomość funkcji arkuszy kalkulacyjnych oraz podstawowych funkcji modelowania 3D pakietu SolidWorks

CELE PRZEDMIOTU

C1. Zdobycie umiejętności parametrycznego modelowania części maszyn i podzespołów oraz wariantowania modeli CAD3D projektowanych części maszyn i zespołów.
C2. Zdobycie umiejętności budowania modeli CAD3D uwzgledniających matematyczne powiązania pomiędzy wartościami wybranych wymiarów geometrycznej struktury produktu oraz integracji ich z zewnętrznymi źródłami danych w postaci arkuszy kalkulacyjnych.
C3. Zdobycie umiejętności tworzenia bibliotek sparametryzowanych modeli CAD3D oraz zarządzania wybranymi cechami konstrukcyjnymi za pomocą arkuszy kalkulacyjnych MS Excel.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Potrafi wykorzystywać narzędzia informatyczne CAD do budowania sparametryzowanych modeli geometrycznych oraz tworzyć biblioteki modeli CAD3D agregujących różne warianty konstrukcyjne w postaci jednego pliku (zbioru).
PEU_U02 - Potrafi zintegrować parametryczne modele geometryczne CAD3D z arkuszem kalkulacyjnym i edytować za jego pomocą wybrane cechy struktury geometrycznej opracowywanych rozwiązań konstrukcyjnych.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Ma świadomość odpowiedzialności za pracę własną oraz za wspólnie realizowane zadania.
PEU_K02 - Prawidłowo ocenia priorytety zadań własnych i grupowych.

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Wprowadzenie to tematyki projektu. Omówienie zasad realizacji i zaliczenia. Wprowadzenie do podstawowych pojęć z zakresu parametryzacji modeli CAD3D.	2
Proj2	Opracowanie sparametryzowanego modelu CAD3D wybranej części maszyny na podstawie dokumentacji 2D. Opracowanie zmiennych lokalnych i globalnych. Edycja matematycznych powiązań wymiarów.	2
Proj3	Opracowanie sparametryzowanego modelu złożenia (podzespołu składającego się z kilku części) z zastosowaniem zmiennych lokalnych i globalnych.	4
Proj4	Integracja modeli CAD3D części maszyn z zewnętrznymi źródłami danych w postaci arkuszy kalkulacyjnych. Edycja wybranych parametrów z poziomu arkusza kalkulacyjnego.	2
Proj5	Tworzenie i udostępnianie bibliotek parametrycznych modeli CAD3D zarządzanych z poziomu arkuszy kalkulacyjnych. Opracowanie biblioteki wybranych komponentów (np. łączników)	2

Proj6	Opracowanie parametrycznego modelu wybranego podzespołu mechanicznego (np. przekładni, narzędzia formującego etc.), z zastosowaniem części z opracowanych bibliotek oraz matematycznymi powiązaniami pomiędzy wybranymi wymiarami oraz globalnymi zmiennymi powiązanymi z zewnętrznym arkuszem kalkulacyjnym.	2
Proj7	Zaliczenie kursu.	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02	Ocena przygotowania projektu
F2	PEU_K01, PEU_K02	Aktywność podczas zajęć
P = 0,75 F1 + 0,25 F2		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
[1] Tayseer Almattar Learn SOLIDWORKS - Second Edition. Packt Publishing, 2022
[2] Nathan Brown & Ibrahim Zeid Mastering SolidWorks: The Design Approach, 3rd Edition. Peachpit Press. 2021

LITERATURA UZUPEŁNIAJĄCA
[1] Almattar, T. Learn SOLIDWORKS 2020: A Hands-On Guide to Becoming an Accomplished SOLIDWORKS Associate and Professional. Birmingham: Packt Publishing, Limited. 2019
[2] Lombard, M., Mastering SolidWorks. [Online]. Newark: John Wiley & Sons, Incorporated., 2018
[3] Wang, H. Y. et al., The Parametric Design for Hydraulic Cylinder Based on SolidWorks. Applied Mechanics and Materials. [Online] 380-384132–135, 2018

OPIEKUN PRZEDMIOTU

dr inż. Mariusz Frankiewicz tel.: 713202083 email: mariusz.frankiewicz@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Zaawansowane wspomaganie wytwarzania w systemie CATIA**
Nazwa przedmiotu w języku angielskim: **Advanced computer-aided design in the CATIA system**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **wybieralny**
Kod przedmiotu: **W10MBM-SI0123**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				30	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Umiejętność posługiwania się programami CAD/CAM.
2. Wiedza z zakresu kursu „Grafika inżynierska - geometria wykreślna”.
3. Podstawy modelowania bryłowego oraz obliczeń numerycznych MES w systemie CATIA.

CELE PRZEDMIOTU

C1. Zapoznanie z bęzwięzowymi metodami tworzenia złożeń.
C2. Zapoznanie się z nowoczesnymi metodami optymalizacji konstrukcji.
C3. Opanowanie metod tworzenia wizualizacji części maszyn.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:

PEU_U01 - Potrafi posłużyć się metodą szkieletową budowania złożenia, bez wykorzystania wiązań zespołu oraz powiązań adaptacyjnych.
PEU_U02 - Potrafi planować eksperyment numeryczny, umie zautomatyzować optymalizację modelu za pomocą MES.
PEU_U03 - Potrafi wykonywać rendering i wizualizację zbudowanego modelu.

III. Z zakresu kompetencji społecznych:

PEU_K01 - Potrafi myśleć i działać w sposób kreatywny.
PEU_K02 - Docenia konieczność podnoszenia kompetencji zawodowych, osobistych i społecznych.
PEU_K03 - Docenia możliwość wykorzystania narzędzi komputerowych w procesie automatyzacji optymalizacji oraz tworzenia atrakcyjnego wizualnie projektu graficznego utworzonych modeli.

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Wykorzystanie funkcji boolean w modelowaniu objętościowym.	1
Proj2	Podstawy modelowania szkieletowego.	2
Proj3	Wykorzystanie modelowania szkieletowego do budowy złożeń zespołów maszyn.	2
Proj4	Planowanie eksperymentu numerycznego.	2
Proj5	Automatyzacja optymalizacji konstrukcji za pomocą MES.	2
Proj6	Rendering i wizualizacja modeli CAD.	2
Proj7	Podstawy rekonstrukcji powierzchni, tworzenie modelu objętościowego z chmury punktów.	2
Proj8	Prezentacja projektu i zaliczenie.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. prezentacja multimedialna
N2. prezentacja projektu
N3. przygotowanie sprawozdania
N4. System obliczeniowy CAD/MES: CATIA
N5. praca własna - przygotowanie do projektu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01; PEU_U02; PEU_U03; PEU_K01; PEU_K02; PEU_K03	raport
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

Michaud M.: Catia. Narzędzia i moduły. Podręcznik inżyniera! Wydawnictwo Helion. 2014.

Sokół K.: Catia. Wykorzystanie metody elementów skończonych w obliczeniach inżynierskich. Wydawnictwo Helion. 2014

LITERATURA UZUPEŁNIAJĄCA

Rusiński E.: Zasady projektowania konstrukcji nośnych pojazdów samochodowych. Oficyna Wydawnicza Politechniki Wrocławskiej. 2002.

OPIEKUN PRZEDMIOTU
dr inż. Paweł Kaczyński tel.: +48 71 320 3701 email: pawel.kaczynski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Komputerowa analiza danych pomiarowych**
Nazwa przedmiotu w języku angielskim: **Computer analysis of measurement data**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **wybieralny**
Kod przedmiotu: **W10MBM-SI0124**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				30	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Dobra umiejętność posługiwania się komputerem w zakresie zagadnień technologii informacyjnej.

CELE PRZEDMIOTU

C1. Prezentacja danych pomiarowych w formie graficznej.
C2. Interpolacja oraz aproksymacja danych pomiarowych.
C3. Transformata Fouriera i jej zastosowanie do analizy danych pomiarowych.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Umie graficznie przedstawić dane pomiarowe.
PEU_U02 - Umie zastosować interpolację li aproksymację danych pomiarowych.
PEU_U03 - Umie zastosować transformatę Fouriera do analizy danych pomiarowych.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Rozumie konieczność systematycznej pracy nad zadaniami; umie oszacować czas potrzebny na realizację zleconego zadania.

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Wprowadzenie. Generowanie danych „syntetycznych” o zadanych parametrach.	1
Proj2	Wizualizacja danych pomiarowych.	2
Proj3	Interpolacja wielomianowa. Interpolacja funkcjami sklejanymi.	2
Proj4	Interpolacja trygonometryczna.	2
Proj5	Szybka Transformata Fouriera (FFT).	2
Proj6	Aproksymacja danych pomiarowych.	2
Proj7	Błędy numeryczne. Dokładność obliczeń.	2
Proj8	Sztuczna inteligencja.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. praca własna - przygotowanie do projektu
N2. konsultacje
N3. przygotowanie sprawozdania
N4. eksperyment laboratoryjny

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się

F1	PEU_U01+PEU_U02+PEU_U03	sprawozdania
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA J. M. i Jankowscy, Przegląd metod i algorytmów numerycznych. Cz. 1, Wydawnictwa naukowo-techniczne, 1988. LITERATURA UZUPEŁNIAJĄCA R. P. Feynman, Feynman lectures on computation, T. Hey and R. W. Allen, Eds., Crc press, 2018.

OPIEKUN PRZEDMIOTU
dr inż. Dorota Aniszewska tel.: 320-27-90 email: dorota.aniszewska@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Modelowanie komputerowe w projektowaniu I**

Nazwa przedmiotu w języku angielskim: **Computer Aided Machine Design I**

Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**

Specjalność (jeśli dotyczy): **Konstrukcja maszyn, urządzeń i pojazdów**

Poziom i forma studiów: **I stopień, stacjonarne**

Rodzaj przedmiotu: **obowiązkowy**

Kod przedmiotu: **W10MBM-SI1011**

Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				30	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Podstawy wytrzymałości materiałów, Metody analityczne w obliczeniach wytrzymałościowych. Znajomość rodzajów materiałów inżynierskich.
2. Potrafi realizować projekt konstrukcyjny z wykorzystaniem metod komputerowych w zakresie projektowania oraz analiz numerycznych.
3. Umiejętność przeprowadzenia analizy wytrzymałościowej z wykorzystaniem metod numerycznych.

CELE PRZEDMIOTU

C1. Zdobycie umiejętności projektowania ustroju nośnego z uwzględnieniem zadanych kryteriów.
C2. Umiejętność definiowania danych wejściowych (warunków brzegowych i początkowych) niezbędnych do modelowania obciążeń oddziałujących na ustrój nośny.
C3. Zdobycie umiejętności wykorzystania systemów CAD/CAE w projektowaniu.
C4. Nabywanie i utrwalenie umiejętności pracy w grupie oraz umiejętności wyszukiwania informacji.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Potrafi zaprojektować zespół mechaniczny z uwzględnieniem zadanych kryteriów , używając do tego celu właściwych metod, technik i narzędzi wraz z obliczeniami ich elementów, przy wykorzystaniu programu do wspomagania komputerowego.
PEU_U02 - Potrafi poprawnie sformułować warunki kinetyczne i kinematyczne, jakim poddawany jest zespół maszyny lub urządzenia.
PEU_U03 - Potrafi opracować dokumentację dotyczącą realizacji zadania inżynierskiego i przygotować prezentację wyników realizacji tego zadania.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Nabywa umiejętności ponoszenia odpowiedzialności za wykonaną pracę.
PEU_K02 - Potrafi pracować w grupie, przyjmując w niej różne role.
PEU_K03 - Nabywa umiejętność pracy zespołowej.

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Omówienie programu zajęć. Przedstawienie celu i zakresu realizowanego projektu. Podanie propozycji tematów prac konstrukcyjnych (układy wieloczłonowe).	1
Proj2	Wybór tematu projektu. Omówienie źródeł: katalogi części, normy. Formaty neutralne wymiany danych projektowych stosowane w CAD.	2
Proj3	Analiza istniejących rozwiązań konstrukcyjnych (prezentacja multimedialna).	2
Proj4	Identyfikacja cech oraz struktury. Definicja założeń projektowych. Analiza spełnienia wymagań funkcjonalnych oraz parametrów.	2
Proj5	Opracowanie postaci strukturalnej (z uwzględnieniem łańcucha kinematycznego) – budowa i analiza modelu.	2
Proj6	Analiza w zakresie możliwości wykorzystania zunifikowanych podzespołów, części oraz napędów.	2
Proj7	Opracowanie projektu wstępnego z wykorzystaniem systemów CAD.	4
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. praca własna - przygotowanie do projektu N2. prezentacja multimedialna N3. prezentacja projektu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02, PEU_K03	Ocena za wykonanie projektu
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

[1] Rusiński E., Czmochowski J., Smolnicki T. Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000
[2] Rakowski G., Kacprzyk Z.: Metoda elementów skończonych w mechanice konstrukcji, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2016
[3] Zienkiewicz O.C.: Metoda elementów skończonych, Arkady 1972

LITERATURA UZUPEŁNIAJĄCA

[1] Szmelter J., Dacko M., Dobrociński S., Wieczorek M.: Metoda elementów skończonych w statyce konstrukcji, Arkady 1979
[2] Gawroński W., Kruszewski J., Ostachowicz W., Tarnowski K., Wittbrodt E.: Metoda elementów skończonych w dynamice konstrukcji, Arkady, Warszawa 1984
[3] Waszczyszyn Z., Cichoń Cz., Radwańska M.: Metoda elementów skończonych w stateczności konstrukcji, Arkady, Warszawa 1990
[4] Kleiber M.: Wprowadzenie do metody elementów skończonych, PWN, Warszawa-Poznań 1989
[5] Cichoń Cz., Cecot W., Krok J., Pluciński P.: Metody Komputerowe w liniowej mechanice konstrukcji, Wydawnictwo Politechniki Krakowskiej, Kraków, 2010
[6] Olszowski B. Wybrane metody numeryczne, Wydawnictwo Politechniki Krakowskiej, Kraków, 2007

OPIEKUN PRZEDMIOTU

dr hab. inż. Jacek Karliński tel.: 71 320-29-46 email: jacek.karlinski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Budowa pojazdów samochodowych**
Nazwa przedmiotu w języku angielskim: **Vehicle engineering**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Konstrukcja maszyn, urządzeń i pojazdów**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI1012**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	90				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	3				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.8				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Znajomość podstaw konstrukcji maszyn
2. Umiejętność kojarzenia i wykorzystania posiadanej wiedzy

CELE PRZEDMIOTU

C1. Zapoznanie się ze strukturą konstrukcyjną i funkcjonalną układów pojazdu samochodowego
C2. Poznanie podstawowych charakterystyk techniczno-eksploatacyjnych pojazdu samochodowego
C3. Zrozumienie podstawowych zasad doboru rodzajów układów pojazdu samochodowego

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Jest w stanie rozróżnić i scharakteryzować elementy i zespoły pojazdu samochodowego
PEU_W02 - Potrafi zdefiniować i wytłumaczyć ruch pojazdu samochodowego oraz dobrać źródło jego napędu
PEU_W03 - Orientuje się w obecnym stanie i wskazuje trendy rozwojowe w budowie pojazdów samochodowych

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Podstawowe informacje o składnikach systemu transportu drogowego	2
Wy2	Klasyfikacja pojazdów samochodowych. Homologacja. Elementy identyfikacji	2
Wy3	Podstawy mechaniki ruchu pojazdów. Opory ruchu	2
Wy4	Charakterystyki układów napędowych. Dobór źródła napędu pojazdu.	2
Wy5	Budowa podwozi pojazdów samochodowych. Układy: nośny i zawieszenia	3
Wy6	Koła jezdne. Opony	2
Wy7	Budowa układu kierowniczego	2
Wy8	Budowa układu hamulcowego	2
Wy9	Automatyzacja układów pojazdu	2
Wy10	Kryteria oceny bezpieczeństwa samochodowego	2
Wy11	Kompatybilność pojazdów	2
Wy12	Oświetlenie zewnętrzne pojazdu	2
Wy13	Sieci CAN/BUS	1
Wy14	Cechy pojazdów o zabudowach specjalnych	2
Wy15	Kolokwium zaliczeniowe	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. wykład problemowy
N2. prezentacja multimedialna
N3. case study
N4. praca własna – samodzielne studia i przygotowanie do egzaminu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	Aktywność na zajęciach
F2	PEU_W01, PEU_W02, PEU_W03	Kolokwium zaliczeniowe
P = F1*0,2+F2*0,8		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

1.Reimpell J., Betzler J.: Podwozia samochodów. Podstawy konstrukcji. WKŁ Warszawa 2001. Wrzecioniarz P.A., Ambroszko W., Górniak A.: Energy Efficient design of powetrain and body, PWr, 2011.
2.Merkisz, J., Pielecha I., Układy mechaniczne pojazdów hybrydowych, Polit. Poznańska, 2015.
3.Zieliński A., Konstrukcja nadwozi samochodów osobowych i pochodnych. WKiŁ Warszawa 2018
4.Wicher., J. , Bezpieczeństwo samochodów i ruchu drogowego. Pojazdy samochodowe, WKŁ, 2004.
5.Kwaśniowski S. Systemy transportowe. Skr. MWSLiTr we Wrocławiu. W-w 2012.

LITERATURA UZUPEŁNIAJĄCA

1. Leon Prochowski, Mechanika ruchu, Pojazdy samochodowe, WKŁ, 2005.
2. Informatory techniczne „Bosch".
3. Materiały konferencyjne prowadzącego dotyczące rozwiązań układów i zespołów pojazdów samochodowych.
4. Basiewicz T., Gołaszewski A., Rudziński L., Infrastruktura transportu. Of. Wyd. Pol.War. 1998.

OPIEKUN PRZEDMIOTU

dr hab. inż. Zbigniew Sroka email: zbigniew.sroka@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Podstawy tribologii**
Nazwa przedmiotu w języku angielskim: **Fundamentals of Tribology**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Konstrukcja maszyn, urządzeń i pojazdów**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI1013**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60		60		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	2		2		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			2		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2		1.4		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Wiedza:1. Ma uporządkowaną wiedzę o rodzajach materiałów inżynierskich - metalicznych, ceramicznych, polimerowych i kompozytowych.2. Ma podstawową wiedzę dotyczącą budowy, działania i eksploatacji głównych elementów i zespołów maszynowych.3. Ma podstawową wiedzę w zakresie fizyki, chemii, statystyki.
2. Umiejętności:1. Potrafi analizować przełomy makroskopowe, makrostruktury materiałów, wady pochodzenia technologicznego; potrafi określić cechy mikrostruktury materiałów metalicznych.2. Potrafi dobrać materiał na zadany element maszynowy i potrafi zbadać jego podstawowe własności.
3. Kompetencje:1. Ma świadomość ważności i zrozumienie pozatechnicznych aspektów i skutków działalności inżyniera mechanika.2. Ma świadomość ważności zachowania w sposób profesjonalny oraz ma świadomość odpowiedzialności za pracę własną.

CELE PRZEDMIOTU

C1. Zapoznanie z procesami tarcia, zuzycia i smarowania w ruchomych węzłach maszynowych oraz z metodami sterowania tymi procesami pod kątem minimalizacji ich skutków (szczególna uwaga zostanie zwrócona na konstrukcyjne i technologiczne metody podwyższenia niezawodności i trwałości węzłów ślizgowych, jak również na problem smarowania i doboru smaru jako skutecznej profilaktyki tarcia i zużycia).
C2. Poznanie wpływu wybranych parametrów wektora tarcia, tj. nacisku, prędkości poślizgu, materiału współpracujących skojarzeń i smaru na charakterystyki tribologiczne par ślizgowych. Zapoznanie z wpływem struktury materiału na zużycie ścierne oraz wpływem sztywności panwi na rozkład nacisków w łożysku ślizgowym.
C3. Pokazanie studentom, że można skutecznie przeciwdziałać negatywnym skutkom tarcia w ruchomym styku ciał stałych poprzez ilustrację na obiektach rzeczywistych wybranych zagadnień omawianych teoretycznie w ramach wykładu.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Posiada wiedzę na temat procesów tarcia, zużycia i smarowania w ruchomych węzłach maszynowych.
PEU_W02 - Zna podstawowe rodzaje środków smarnych oraz ich zastosowanie.
PEU_W03 - Zna konstrukcyjne i technologiczne metody podwyższenia niezawodności i trwałości węzłów ślizgowych.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi dobierać materiały na węzły ślizgowe i rozumie związki i zależności pomiędzy zastosowanym materiałem a jego trwałością.
PEU_U02 - Potrafi przeprowadzić podstawowe badania właściwości materiałów stosowanych w węzłach trących, interpretować je i wdrażać w gotowych węzłach maszyn.
PEU_U03 - Potrafi wykorzystać wiedzę teoretyczną z zakresu tarcia i smarowania zdobytą na wykładzie i zastosować ją w praktyce.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Potrafi wyszukiwać informacje i krytycznie je analizować.
PEU_K02 - Prawidłowo definiuje i rozstrzyga dylematy, przestrzega zasady etyki zawodowej.
PEU_K03 - Potrafi pracować samodzielnie i zespołowo oraz prawidłowo ocenia priorytety zadań własnych i grupowych.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Program i wymagania. Rys historyczny tribologii.	1
Wy2	Styk sprężysty ciał gładkich. Rzeczywisty styk ciał stałych. Zagadnienie warstwy wierzchniej.Procesy tarcia, pojęcia podstawowe i klasyfikacja. Tarcie ślizgowe i toczne. Teorie tarcia.	2
Wy3	Procesy zużywania, ich podział i charakterystyka. Wpływ nacisku i prędkości poślizgu na tarcie i zużycie.	2
Wy4	Charakterystyka materiałów (metalowych i innych) na węzły ślizgowe oraz reguły ich doboru. Prosta i odwrócona para tarcia.	2

Wy5	Podatność, sztywność i konfiguracja elementów jako czynniki zwiększające odporność na zużycie.	2
Wy6	Smar jako materiał konstrukcyjny. Cele smarowania. Sposoby uzyskiwania tarcia płynnego. Podział środków smarnych. Oleje smarne i ich własności. Klasyfikacja olejów.	2
Wy7	Smary plastyczne, ich podział i charakterystyka. Charakterystyka smarów stałych. Kryteria oceny właściwości smarnych olejów i smarów.	2
Wy8	Kolokwium zaliczeniowe.	2
		Suma: 15
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Wyznaczanie właściwości ślizgowych materiałów łożyskowych.	2
Lab2	Wyznaczanie współczynnika tarcia statycznego.	2
Lab3	Badanie smarności smarów plastycznych na aparacie czterokulowym.	2
Lab4	Wyznaczanie własności ciernych materiałów na hamulce i sprzęgła.	2
Lab5	Analiza wpływu sztywności panwi na rozkład nacisków w łożysku ślizgowym.	2
Lab6	Analiza wpływu struktury materiału na zużycie ścierne (tester T-07).	2
Lab7	Wyznaczanie charakterystyk tribologicznych olejów silnikowych.	2
Lab8	Badanie materiałów na zatarcie.	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. praca własna – przygotowanie do laboratorium N3. eksperyment laboratoryjny N4. konsultacje N5. prezentacja multimedialna

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01 - PEU_W03	kolokwium, kartkówki
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01 - PEU_U03 PEU_K01 - PEU_K03	kartkówka - wejściówka, sprawozdanie z ćwiczeń laboratoryjnych, odpowiedzi ustne
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

[1] Lawrowski Z.; Tribologia: Tarcie, zużywanie i smarowanie, Wydawnictwo Politechniki Wrocławskiej, 2008.
[2] Czarny R.; Smary plastyczne. Warszawa, WNT, 2004.
[3] Ćwiczenia laboratoryjne z podstaw konstrukcji maszyn. Praca zbiorowa pod red. F. Szymankiewicza, skrypt PWr., Wrocław , 1990 (szczegółowe instrukcje ćwiczeniowe zamieszczone na stronie internetowej).
[4] Aktualne czasopisma z zakresu tribologii: „Tribologia”, „Wear”, „Tribology letters”.
[5] Bushan B., Modern tribology handbook, 2000, Taylor & Francis Stmnetbase.

LITERATURA UZUPEŁNIAJĄCA

[1] Bartz W.; Schmierfette, Zusammensetzung, Eingeschaften, Prüfung und Anwen-dung. Renningen, Export Verlag 2000
[2] Lawrowski Z.; Technika smarowania. W-a, PWN
[3] Płaza S.; Fizykochemia procesów tribologicznych, Łódź, Wyd. Uniwersytetu Łódzkiego, 1997

OPIEKUN PRZEDMIOTU
dr inż. Tadeusz Leśniewski tel.: 71 320-40-31 email: Tadeusz.Lesniewski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Modelowanie komputerowe w projektowaniu II**
Nazwa przedmiotu w języku angielskim: **Computer Aided Machine Design II**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Konstrukcja maszyn, urządzeń i pojazdów**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI1014**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				30	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				90	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				3	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				3	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				2.1	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Podstawy wytrzymałości materiałów, Metody analityczne w obliczeniach wytrzymałościowych. Znajomość rodzajów materiałów inżynierskich.
2. Potrafi realizować projekt konstrukcyjny z wykorzystaniem metod komputerowych w zakresie projektowania oraz analiz numerycznych.
3. Umiejętność przeprowadzenia analizy wytrzymałościowej z wykorzystaniem metod numerycznych.

CELE PRZEDMIOTU

C1. Zdobycie umiejętności projektowania ustroju nośnego z uwzględnieniem zadanych kryteriów.
C2. Umiejętność definiowania danych wejściowych (warunków brzegowych i początkowych) niezbędnych do modelowania obciążeń oddziałujących na ustrój nośny.
C3. Zdobycie umiejętności wykorzystania systemów CAD/CAE w projektowaniu.
C4. Nabywanie i utrwalenie umiejętności pracy w grupie oraz umiejętności wyszukiwania informacji.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Potrafi zaprojektować zespół mechaniczny z uwzględnieniem zadanych kryteriów , używając do tego celu właściwych metod, technik i narzędzi wraz z obliczeniami ich elementów, przy wykorzystaniu programu do wspomagania komputerowego.
PEU_U02 - Potrafi poprawnie sformułować warunki kinetyczne i kinematyczne, jakim poddawany jest zespół maszyny lub urządzenia.
PEU_U03 - Potrafi opracować dokumentację dotyczącą realizacji zadania inżynierskiego i przygotować prezentację wyników realizacji tego zadania.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Nabywa umiejętności ponoszenia odpowiedzialności za wykonaną pracę.
PEU_K02 - Potrafi pracować w grupie, przyjmując w niej różne role.
PEU_K03 - Nabywa umiejętność pracy zespołowej.

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Omówienie programu zajęć. Wprowadzenie do środowiska dostosowanych narzędzi wspomagających projektowanie.	2
Proj2	Określenie obciążeń działających na zespół i poszczególne jego człony w różnych konfiguracjach z wykorzystaniem CAD.	4
Proj3	Analiza doboru materiałów na poszczególne elementy projektowanego zespołu (urządzenia, maszyny). Wyznaczenie właściwości i cech geometrycznych członów oraz elementów łączących.	2
Proj4	Opracowanie modelu geometrycznego do analiz numerycznych z wykorzystaniem systemu do komputerowego wspomagania projektowania CAD.	4
Proj5	Opracowanie modelu obliczeniowego wraz z warunkami początkowo-brzegowymi (model numeryczny) w systemach CAE.	6
Proj6	Badania numeryczne (w zależności od typu projektu i rodzaju warunków początkowo-brzegowych).	4
Proj7	Opracowanie projektu w systemie do komputerowego wspomagania projektowania CAD.	4

Proj8	Opracowanie dokumentacji konstrukcyjnej projektu (rysunek złożeniowy oraz rysunki wykonawcze wybranych części).	4
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. praca własna - przygotowanie do projektu N2. prezentacja multimedialna N3. prezentacja projektu N4. przygotowanie sprawozdania

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02, PEU_K03	Ocena za wykonanie projektu
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

[1] Rusiński E., Czmochowski J., Smolnicki T. Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000
[2] Rakowski G., Kacprzyk Z.: Metoda elementów skończonych w mechanice konstrukcji, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2016
[3] Zienkiewicz O.C.: Metoda elementów skończonych, Arkady 1972

LITERATURA UZUPEŁNIAJĄCA

[1] Szmelter J., Dacko M., Dobrociński S., Wieczorek M.: Metoda elementów skończonych w statyce konstrukcji, Arkady 1979
[2] Gawroński W., Kruszewski J., Ostachowicz W., Tarnowski K., Wittbrodt E.: Metoda elementów skończonych w dynamice konstrukcji, Arkady, Warszawa 1984
[3] Waszczyszyn Z., Cichoń Cz., Radwańska M.: Metoda elementów skończonych w stateczności konstrukcji, Arkady, Warszawa 1990
[4] Kleiber M.: Wprowadzenie do metody elementów skończonych, PWN, Warszawa-Poznań 1989
[5] Cichoń Cz., Cecot W., Krok J., Pluciński P.: Metody Komputerowe w liniowej mechanice konstrukcji, Wydawnictwo Politechniki Krakowskiej, Kraków, 2010
[6] Olszowski B. Wybrane metody numeryczne, Wydawnictwo Politechniki Krakowskiej, Kraków, 2007

OPIEKUN PRZEDMIOTU
dr hab. inż. Jacek Karliński tel.: 71 320-29-46 email: jacek.karlinski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Ustroje nośne**
Nazwa przedmiotu w języku angielskim: **Carrying Structures**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Konstrukcja maszyn, urządzeń i pojazdów**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI1015**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15			30	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30			60	
Forma zaliczenia	Zaliczenie na ocenę			Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	1			2	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				2	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6			1.4	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Podstawy wytrzymałości materiałów, analizy wytrzymałościowej układów prętowych, tarczowych i płytowych. Znajomość rodzajów materiałów inżynierskich.
2. Podstawy metody elementów skończonych
3. Potrafi przeprowadzić analizy wytrzymałościowe w zakresie sprężystym prostych elementów konstrukcyjnych

CELE PRZEDMIOTU

C1. Zapoznanie studentów z zasadami kształtowania ustrojów nośnych maszyn o strukturze prętowej, blachownicowej i grubościennej.
C2. Przedstawienie problemów związanych z prawidłowym kształtowaniem połączeń i węzłów konstrukcyjnych ustrojów nośnych poddanych obciążeniom stałym i zmiennym.
C3. Nabycie umiejętności wymiarowania ustrojów prostych struktur nośnych z wykorzystaniem metod komputerowego wspomagania projektowania, w tym szczególnie CAD/CAE.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Wiedza w zakresie projektowania ustrojów nośnych maszyn poddanych obciążeniom zmiennym, narażonych na pęknięcia zmęczeniowe (ramy, kratownice, blachownice, ustroje grubościenne).
PEU_W02 - Posiada wiedzę w zakresie zasad projektowania węzłów konstrukcyjnych i połączeń elementów ustrojów nośnych
PEU_W03 - Wiedza w zakresie wymiarowania ustrojów nośnych w oparciu o normy (dźwignice, projektowanie konstrukcji stalowych) według kryterium wytrzymałości, sztywności i trwałości

II. Z zakresu umiejętności:
PEU_U01 - Potrafi opracować model obliczeniowy prostych ustrojów nośnych maszyn do zagadnień wytrzymałości, stateczności i drgań własnych
PEU_U02 - Potrafi poprawnie sformułować warunki kinetyczne i kinematyczne, jakim poddawany jest ustrój nośny
PEU_U03 - Potrafi prawidłowo zinterpretować wyniki analiz obliczeń numerycznych

III. Z zakresu kompetencji społecznych:
PEU_K01 - Nabywa umiejętności ponoszenia odpowiedzialności za wykonaną pracę
PEU_K02 - Myśleć i działać w sposób kreatywny
PEU_K03 - Nabywa umiejętność pracy zespołowej

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Przegląd rodzajów ustrojów nośnych stosowanych w budowie maszyn	1
Wy2	Analiza awarii i katastrof ustrojów nośnych maszyn	2
Wy3	Modelowanie ustrojów nośnych maszyn	2
Wy4	Zasady łączenia ustrojów nośnych maszyn poddanych obciążeniom zmiennym	2
Wy5	Zasady projektowania ustrojów nośnych cienkościennych, zagadnienie stateczności lokalnej i globalnej	2
Wy6	Zasady projektowania węzłów konstrukcyjnych	2
Wy7	Metody obliczeniowe stosowane w wymiarowaniu ustrojów nośnych - metoda naprężeń dopuszczalnych, metoda stanów granicznych	2
Wy8	Zagadnienie zmęczenia ustrojów nośnych maszyn	2

		Suma: 15
Forma zajęć – Projekt		Liczba godzin
Proj1	Omówienie programu zajęć laboratoryjnych. Wprowadzenie do środowiska programu obliczeniowego.	2
Proj2	Projektowanie, modelowanie grubościennych ustrojów nośnych	2
Proj3	Warunki brzegowe: zasady definiowania podparć, utwierdzeń, symetrii, obciążeń kinetycznych i kinematycznych oraz analiza wytrzymałościowa	2
Proj4	Optymalizacja postaci geometrycznej grubościennego ustroju nośnego (minimalizacja masy)	2
Proj5	Projektowanie i modelowanie cienkościennych ustrojów nośnych (dźwigary dwuteowe, skrzynkowe)	2
Proj6	Optymalizacja postaci geometrycznej cienkościennego ustroju nośnego (minimalizacja masy)	4
Proj7	Projektowanie i modelowanie prętowych struktur nośnych (przestrzenna kratownica)	2
Proj8	Projektowanie i modelowanie węzłów konstrukcyjnych (sztywnych, podatnych i przegubowych)	4
Proj9	Projektowanie i modelowanie ramowych struktur nośnych maszyn i pojazdów	4
Proj10	Optymalizacja postaci konstrukcyjnej struktury nośnej ramowej	2
Proj11	Definiowanie elementarnych obciążeń i ich kojarzeń dla ustrojów nośnych dźwignic	2
Proj12	Analizy drgań własnych, stateczności sprężystej (wyboczenia) struktur nośnych	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. praca własna - przygotowanie do projektu N2. ćwiczenia problemowe N3. prezentacja multimedialna N4. prezentacja projektu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	Kolokwium i ewentualna poprawa ustnie
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03 PEU_K01, PEU_K02, PEU_K03	Ocena przygotowania projektów
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

Rusiński E., Czmochowski J., Smolnicki T. Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000

Rusiński E.: Metoda elementów skończonych, System COSMOS/M, WKiŁ, Warszawa 1994

Rusiński E.: Mikrokomputerowa analiza ram i nadwozi pojazdów i maszyn roboczych, WKiŁ, Warszawa 1990

Rusiński E.: Zasady projektowania konstrukcji nośnych pojazdów samochodowych. Oficyna Wyd. PWr Wrocław 2002

LITERATURA UZUPEŁNIAJĄCA

Augustyn J., Śledziewski, Technologiczność stalowych konstrukcji spawanych, Arkady, Warszawa 1981

Augustyn J.: Połączenia spawane i zgrzewane, Arkady, Warszawa 1987

Dudczak A.: Koparki. Teoria i projektowanie, PWN, Warszawa 2000

Ferenc K., Ferenc J.: Konstrukcje spawane. Projektowanie połączeń. WNT, Warszawa 2000

Pieczonka K.: Inżynieria maszyn roboczych. Część I. Podstawy urabiania, jazdy, podnoszenia i obrotu, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2007

Żmuda J.: Podstawy projektowania konstrukcji metalowych, Arkady, Warszawa 1997

PN-EN 1993-1 Eurokod 3 Projektowanie konstrukcji stalowych

OPIEKUN PRZEDMIOTU
dr hab. inż. Jerzy Czmochowski tel.: 71 320 42 84 email: jerzy.czmochowski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Inżynieria pojazdów przemysłowych**
Nazwa przedmiotu w języku angielskim: **Offroad Vehicles Engineering**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Konstrukcja maszyn, urządzeń i pojazdów**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI1016**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30		30	15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60		60	30	
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę	Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	2		2	1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			2	1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2		1.4	0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Posiada wiedzę z zakresu budowy układów napędowych pojazdów
2. Potrafi współpracować z grupą oraz indywidualnie rozwiązuje skomplikowane zadania
3. Posiada wiedzę z zakresu mechaniki, analizy matematycznej oraz podstaw konstrukcji maszyn układów napędowych pojazdów

CELE PRZEDMIOTU

C1. Celem zajęć jest poszerzenie wiedzy w zakresie budowy i sposobów pracy pojazdów inżynieryjnych w szczególności kołowych i gąsienicowych. Zakres obejmuje również obliczenia oporów ruchu, skrętu różnych układów podwoziowych;
C2. Celem zajęć jest zdobycie praktycznej wiedzy w zakresie obliczania typowych elementów nośnych podwozia kołowego i gąsienicowego. Zajęcia rozszerzają również wiedzę w zakresie stosowania różnych układów podwoziowych pojazdów;
C3. Celem zajęć jest zdobycie wiedzy w zakresie współpracy narzędzia z gruntem, określenie przydatności narzędzi do
różnorodnych prac;
C4. Celem zajęć jest zdobycie umiejętności pracy grupowej, opracowywania wyników.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Potrafi obliczać poszczególne podzespoły układów zawieszeń pojazdów kołowych i gąsienicowych, jak i również z zakresu przeniesienia napędu układów napędowych.
PEU_W02 - Potrafi wskazać właściwe narzędzie do zadania które należy zrealizować. Potrafi szacować siłę trakcyjną. Zna zasadę działania układów hamulcowych pojazdów przemysłowych i oblicza drogę hamowania.
PEU_W03 - Zna podstawy współpracy narzędzia z gruntem oraz zapoznał się z metodami, pozwalającymi na uzyskanie pełnego załadunku.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi posługiwać się również obcojęzyczna literaturą, analizować i dokonywać interpretacji otrzymanych wyników.
PEU_U02 - potrafi przeanalizować i opracowywać wyniki w celu uzyskania charakterystyk lub mierzonych parametrów w układach napędowych pojazdów i maszyn przy różnych nastawach układu sterowania.
PEU_U03 - potrafi zaproponować własne koncepcje układów podwoziowych.

III. Z zakresu kompetencji społecznych:
PEU_K01 - potrafi i rozumie potrzebę ciągłego doszkalania się i pozyskiwania nowych informacji.
PEU_K02 - jest odpowiedzialny za podejmowane decyzje zarówno w aspekcie ochrony środowiska naturalnego jak i działalności inżyniera mechanika.
PEU_K03 - potrafi pracować w grupie i rozwiązywać powierzone mu zadania również na różnych stanowiskach i ponosi odpowiedzialność za grupowe osiągnięcie zamierzonego celu.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie do lokomocji off-road. Lokomocja w naturze. Przegląd metod poruszania się zwierząt i pojazdów o różnych układach podwoziowych z przykładami. Efektywność ruchu. Interakcja pojazdów terenowych z podłożem gruntowym.	2

Wy2	Podział maszyn roboczych na maszyny do robót ziemnych oraz maszyny transportu bliskiego. Ich rodzaje miejsca pracy, zastosowanie z wyróżnieniem problemów związanych z lokomocją tych grup obiektów (ładowarki łyżkowe, spycharki, koparki, zagęszczarki...).	3
Wy3	Teoria ruchu koła ogumionego poruszającego się po różnych podłożach. Charakterystyki i przykłady obliczeń oporów ruchu.Charakterystyki i przykłady obliczeń oporów ruchu off-road. Sprawność koła, współczynnik przyczepności przylgowej, koło wielkogabarytowe, rodzaje bieżnika. Metody badania kół oponowych.	3
Wy4	Mechanika ruchu pojazdu niesamochodowego. Opory ruchu przyczepy, współpraca z pojazdem ciągnącym. Rozkład ciężarów działających na osie zespołu podczas ruchu. Zapotrzebowanie energetyczne podczas ruchu nieustalonego. Zużycie paliwa.	2
Wy5	Hamowanie pojazdów członowych. Wymagania stawiane układom hamulcowym pneumatycznym, hydraulicznym i mieszanym. Elementy składowe układów hamulcowych pojazdów przemysłowych. Ilość wytrącanej energii. Czujniki optymalizujące pracę układu (ciężaru osi, prędkości...). Współpraca przyczepy z ciągnikiem. Redundancja układu.	3
Wy6	Stateczność kierunkowa pojazdów kołowych. Stateczność kierunkowa podczas hamowania pojazdu członowego. Kinematyka skrętu. Zawieszenia pojazdów oraz dopasowanie się położenia kół pojazdu do znacznych krzywizn terenu. Stosowanie elementów sprężystych i tłumiących.	2
Wy7	Automatyzacja w maszynach roboczych. Zasady działania podstawowych czujników położenia i obciążenia, ciśnienia, przepływu celem określenia ich wad i zalet w sterowaniu procesem. Autonomiczne systemy prowadzące pojazd po zadanej trajektorii.	2
Wy8	Zaawansowane układy sterowania: systemy ważące oraz pozycjonujące narzędzie robocze. Roboty inspekcyjne poruszające się np wewnątrz tuneli. Praca pojazdów przemysłowych w warunkach ograniczonej widoczności.	2
Wy9	Teoria ruchu pojazdu gąsienicowego. Przykłady stosowanych gąsienic stalowych i elastomerowych. Porównanie i ich stosowanie. Obliczenia napięcia pasa gąsienicowego pod wpływem sił wewnętrznych i zewnętrznych. Kinematyka skrętu pojazdów gąsienicowych. Opory ruchu tych pojazdów.	3
Wy10	Współpraca gąsienic z gruntem. Wpływ wysokości bieżnika, siła trakcyjna, liczba rolek nośnych, wyznaczanie poślizgu gąsienicy na różnych podłożach. Nierównomierność nacisku gąsienicy a siła trakcyjna. Wyznaczanie sił trakcyjnych.	2
Wy11	Układy kierownicze i zawieszenia pojazdów roboczych. Przykłady zastosowań. Dobór sprężyn pneumatycznych. Rola poszczególnych elementów zawieszenia.	2
Wy12	Pojazdy do zastosowań specjalnych. Teoria pojazdów poduszkowych. Metody wytwarzania poduszki powietrznej, zastosowanie, wady i zalety tej grupy pojazdów. Budowa pojazdów śrubowych i kroczących. Alternatywne źródła energii.	2
Wy13	Badania przebiegowe pojazdów specjalnych. Definiowanie wymagań i metody weryfikacji. Uporządkowanie zdobytej wiedzy i wiadomości. Podsumowanie kursu.	2
		Suma: 30
Forma zajęć – Laboratorium		Liczba godzin

Lab1	Badania podstawowych parametrów wykorzystywanych w terramechanice do opisu ośrodków rozdrobnionych.	2
Lab2	Badania procesu ładowania ośrodka rozdrobnionego łyżką ładowarki.	2
Lab3	Badania oporu gruntu na ścinanie elementem jezdnym.	2
Lab4	Badania procesu urabiania skał zwięzłych nożami o różnym ukształtowaniu.	2
Lab5	Badania normowe obciążeń narzędzia roboczego i obciążeń wywracających pojazdu przemysłowego.	2
Lab6	Badania oporów ruchu pojazdu kołowego.	2
Lab7	Badania obciążeń dynamicznych mechanizmu podnoszenia suwnicy pomostowej.	2
Lab8	Badania procesu kopania ośrodka rozdrobnionego łyżką koparki.	2
Lab9	Badania oporów ruchu pojazdu gąsienicowego.	2
Lab10	Badania oporów skrętu oraz sztywności skrętnej kół oponowych.	2
Lab11	Badania zjawiska sprzężenia ciernego gąsienicy elastomerowej z liną.	2
Lab12	Badania parametrów trakcyjnych pojazdu linowego.	2
Lab13	Badania uniwersalnego pojazdu kołowego.	2
Lab14	Badania oporów skrętu kołowego pojazdu przegubowego.	2
Lab15	Właściwości jezdne pojazdów o niekonwencjonalnym sposobie lokomocji.	2
		Suma: 30
Forma zajęć – Projekt		Liczba godzin
Proj1	Celem projektu jest opracowanie układu napędowego pojazdu kołowego lub gąsienicowego. Zakres projektu obejmuje obliczenie sił uciągu, oporów ruchu, momentów napędowych oraz sporządzenie rysunków wykonawczych wybranego podzespołu. Projekt może dotyczyć również doboru geometrii wysięgnika w celu zachowania prostoliniowości ruchu narzędzia oraz układu przeniesienia napędu klasycznego lub hybrydowego. W tym przypadku określa się opory ruchu podczas nabierania urobku oraz dobiera poszczególne elementy. Dobór komponentów powinien uwzględniać osiąganą sprawność końcową pracy mechanizmu. 1. Omówienia zadania do wykonania i określenie wymagań wstępnych; 2. Analiza literaturowa Studenta; 3. Propozycja Studenta celem rozwiązania problemu; 4. Obliczenia i dobór komponentów/wykonanie dokumentacji technicznej; 5. Wniesienie poprawek i uzupełnienie projektu; 6. Złożenie gotowego projektu; 7-8. Grupowe zaprezentowanie projektu.	15
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. prezentacja multimedialna N2. eksperyment laboratoryjny N3. praca własna - przygotowanie do projektu N4. praca własna – przygotowanie do laboratorium N5. praca własna – samodzielne studia i przygotowanie do egzaminu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01-PEU_W03 PEU_K01-PEU_K03	Test pisemny
P = pozytywna ocena z egzaminu		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01-PEU_U03 PEU_K01-PEU_K03	kartkówka, odpowiedzi ustne, sprawozdanie z ćwiczeń laboratoryjnych
P = pozytywna ocena ze wszystkich ocenionych ćwiczeń laboratoryjnych		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01-PEU_U03 PEU_K01-PEU_K03	obrona projektu, ocena części obliczeniowej projektu,
P = pozytywnie ocenione wszystkie części składowe projektu		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

1. Inżynieria maszyn roboczych, K. Pieczonka, OW PWr, 2007
2. Theory of ground vehicles; J. Y. Wong, John Wiley & Sons, New York
3. Tyre and Vehicle Dynamics, H. B. Pacejka, Delft University of Technology
4. Vehicle Dynamisc, Theory and Applicaton, R. N. Jazar, Springer, 2008
5. Automotive Engineering Powertrain, Chassis System and Vehicle Body, A. Crolla, Elsevier, 2009
6. Fundamentals of Vehicle Dynamisc, T. D. Gillespie, Society of Automotive Engeeners,
7. Ciągniki, H. Dajniak, Wydawnictwa Komunikacji i Łączności, 2008
8. Kierowalność i stateczność samochodu, A. Litwinow, WKŁ, 1975
9. Teoria ruchu pojazdu gąsienicowego, Z. Burdziński, WKŁ, 1972

LITERATURA UZUPEŁNIAJĄCA

OPIEKUN PRZEDMIOTU

dr inż. Aleksander Skurjat tel.: 71 320-23-46 email: Aleksander.Skurjat@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Napęd hydrauliczny**
Nazwa przedmiotu w języku angielskim: **Hydraulic drive systems**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Konstrukcja maszyn, urządzeń i pojazdów**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI1017**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30		30	15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60		60	30	
Forma zaliczenia	Egzamin		Zaliczenie na ocenę	Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	2		2	1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			2	1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2		1.4	0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Posiada podstawową wiedzę z mechaniki płynów.
2. Posiada podstawową wiedzę z zakresu konstrukcji elementów składowych hydrostatycznych układów napędowych.
3. Posiada podstawową wiedzę z zakresu układów napędowych maszyn.

CELE PRZEDMIOTU

C1. Zapoznanie studentów z funkcjami elementów hydraulicznych w układach hydrostatycznych.
C2. Zapoznanie studentów z hydraulicznymi układami napędowymi w aspekcie sposobu działania oraz architektury.
C3. Zapoznanie studentów z metodami sterowania i regulacji określonych parametrów napędów hydraulicznych oraz bilansem energetycznym układów hydrostatycznych.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - W wyniku przeprowadzonych zajęć student ma wiedzę pozwalającą opisać podstawowe układy hydrauliczne.
PEU_W02 - W wyniku przeprowadzonych zajęć student ma wiedzę pozwalającą objaśnić zasady projektowania hydraulicznych układów napędowych.
PEU_W03 - W wyniku przeprowadzonych zajęć student ma wiedzę pozwalającą scharakteryzować elementy układów hydraulicznych sterujące odpowiednimi parametrami, bądź regulujące określone parametry.

II. Z zakresu umiejętności:
PEU_U01 - W wyniki przeprowadzonych zajęć student umie zaprojektować układ hydrauliczny wraz z układem sterującym, wykonać odpowiednie obliczenia techniczne i na ich podstawie dobrać elementy układu hydraulicznego o odpowiednich wymiarach i właściwościach.
PEU_U02 - W wyniki przeprowadzonych zajęć student umie dokonać pomiarów dotyczących elementów i układów hydraulicznych, a następnie omówić uzyskane wyniki i wyciągnąć odpowiednie wnioski.
PEU_U03 - W wyniki przeprowadzonych zajęć student umie zmontować, uruchomić dokonać nastaw i przeanalizować poprawność pracy hydraulicznych i elektrohydraulicznych układów napędowych.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Potrafi współdziałać i pracować w grupie podczas montażu układów hydraulicznych i elektrohydraulicznych oraz tworzenia sprawozdania z ćwiczenia.
PEU_K02 - Potrafi odpowiednio zaplanować wykonanie pomiarów podczas ćwiczenia laboratoryjnego oraz zaplanować wykonanie projektu.
PEU_K03 - Prawidłowo identyfikuje i rozwiązuje problemy napotkane podczas montażu układów hydraulicznych i elektrohydraulicznych oraz wykonywania projektu. Wyciąga odpowiednie wnioski z przeprowadzonego ćwiczenia.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie, omówienie treści kursu, formy zaliczenia i wymagań, podanie literatury przedmiotu. Właściwości układów hydraulicznych.	2
Wy2	Przekładnia hydrostatyczna – zasada działania, podstawowe parametry i zależności.	2
Wy3	Sposoby regulacji parametrów źródła energii hydraulicznej oraz parametrów elementów wykonawczych układów hydrostatycznych.	4
Wy4	Obliczanie układu ssącego pompy hydraulicznej.	2

Wy5	Analiza porównawcza układów wielopompowych oraz układów z pompą główną wraz z funkcją priorytetowego rodziału mocy.	2
Wy6	Synchronizacja prędkości ruchu hydraulicznych elementów wykonawczych.	2
Wy7	Funkcje i przykłady zastosowania akumulatorów hydraulicznych w układach hydrostatycznych.	2
Wy8	Sposoby równoczesnego sterowania kilkoma hydraulicznymi elementami wykonawczymi, układy sekwencyjne, logiczne oraz elektrohydrauliczne.	2
Wy9	Hydrostatyczne układy napędowe układów jazdy.	2
Wy10	Hydrostatyczne układy napędowe układów roboczych maszyn.	2
Wy11	Hydrostatyczne układy hamulcowe.	2
Wy12	Hydrostatyczne układy skrętu pojazdów.	2
Wy13	Bilans energetyczny oraz emisja energii cieplnej układów hydrostatycznych.	2
Wy14	Możliwości zwiększania sprawności układów hydrostatycznych, układy z możliwością rekuperacji energii, architektura układów hydrostatycznych w aspekcie energetycznym.	2
		Suma: 30
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Wprowadzenie – przedstawienie treści laboratoriów, formy zaliczenia, wymagań. Regulamin laboratorium i instruktaż BHP.	2
Lab2	Układy rewersyjne.	2
Lab3	Zastosowanie zaworów ciśnieniowych w układach hydraulicznych.	2
Lab4	Metody odciążania hydrulicznego układu zasilającego.	2
Lab5	Zastosowanie zaworu zwrotnego sterowanego w układach hydraulicznych maszyn roboczych. Metody zabezpieczenia pozycji obciążonego odbiornika.	2
Lab6	Sterowanie dławieniowe-szeregowe prędkością ruchu odbiornika hydraulicznego.	2
Lab7	Sterowanie dławieniowe-równoległe prędkością ruchu odbiornika hydraulicznego.	2
Lab8	Badania porównawcze układów sterowania i regulacji prędkości odbiornika hydraulicznego.	2
Lab9	Układy hydrauliczne typu Load-Sensing z pompą o stałej wydajności.	2
Lab10	Charakterystyki zasilacza z pompą o zmiennej wydajności.	2
Lab11	Układy hydrauliczne typu Load-Sensing z pompą o zmiennej wydajności.	2
Lab12	Układy z prostownikiem hydraulicznym.	2
Lab13	Funkcje akumulatora hydraulicznego.	2
Lab14	Opis stanów nieustalonych układu hydraulicznego – eksperymentalne wyznaczenie podstawowych wskaźników dynamicznych.	2
Lab15	Zaliczenie.	2
		Suma: 30

Forma zajęć – Projekt		Liczba godzin
Proj1	Wprowadzenie do projektu. Przydzielenie tematów projektowych.	2
Proj2	Określenie zakładanych parametrów układu. Generowanie struktury układu hydraulicznego.	2
Proj3	Wykonanie podstawowych obliczeń.	2
Proj4	Dobór elementów układów.	2
Proj5	Wykonanie opisu działania opracowanego układu oraz weryfikacja prawidłowości dobranych elementów w aspekcie funkcji i założoanych parametrów układu.	2
Proj6	Określenie końcowych parametrów zaprojektowanego układu. Analiza porównawcza z założeniami wstępnymi.	3
Proj7	Zaliczenie projektu.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład informacyjny N2. praca własna – przygotowanie do laboratorium N3. eksperyment laboratoryjny N4. praca własna - przygotowanie do projektu N5. praca własna – samodzielne studia i przygotowanie do egzaminu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	egzamin
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U02, PEU_U03, PEU_K01, PEU_K02	odpowiedź ustna weryfikująca wiedzę praktyczną nabytą w trakcie zajęć laboratoryjnych

F2	PEU_U02, PEU_K01, PEU_K02	sprawozdanie z ćwiczeń laboratoryjnych
F3	PEU_U03, PEU_K01, PEU_K02	ocena aktywności studenta na zajęciach
P = 50%F1+35%F2+15%F3		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_K02, PEU_K03	ocena projektu
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

Kollek W.: Podstawy projektowania napędów i sterowań hydraulicznych. Oficyna Wydawnicza PWr, Wrocław 2004
Szydelski Z.: Napęd i sterowanie hydrauliczne, WKŁ, Warszawa 1999.
Stryczek S.: Napęd hydrostatyczny - Elementy i układy. WNT 1984.
Osiecki A.: Napęd hydrostatyczny maszyn, WNT, Warszawa 1996.
Garbacik A., Szewczyk K.; Napęd i sterowane hydrauliczne. Podstawy projektowania układów. Skrypt Politechniki Krakowskiej, Kraków 1998
Akers A., Gassman M., Smith R., Hydraulic Power System Analysis (Fluid Power and Control), CRC Press, 2006
Lambeck R.: Hydraulic pumps and motors. Marcel Dekker INC. New York 1983.
Pippenger J.: Hydraulic valves and control. Marcel Dekker INC. New York 1984

LITERATURA UZUPEŁNIAJĄCA

Jędrzykiewicz Z.: Projektowanie układów hydrostatycznych. Podstawy metodyczno-obliczeniowe. Skrypt 1313. AGH Kraków 1992.
Pizoń A.: Hydrauliczne i elektrohydrauliczne układy sterowania i regulacji. WNT 1987.

OPIEKUN PRZEDMIOTU

dr inż. Tomasz Siwulski tel.: 71 320-28-92 email: tomasz.siwulski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Silniki spalinowe**
Nazwa przedmiotu w języku angielskim: **Internal Combustion Engines**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Konstrukcja maszyn, urządzeń i pojazdów**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI1018**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30		30		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	1		1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6		0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Znajomość zasady zachowania: masy, energii i pędu oraz równania stanu czynnika
2. Umiejętność wykonywania ćwiczeń laboratoryjnych w oparciu o elementarne sprawności manualne
3. Świadomość pracy samodzielnej oraz grupowej i umiejętność jej realizacji

CELE PRZEDMIOTU

C1. pozyskanie wiedzy na temat zamiany energii z postaci chemicznej na postać mechaniczną w silniku spalinowym
C2. świadomość wymagań konstrukcyjnych stawianych silnikom celem uzyskania sprawności procesu spalania
C3. zrozumienie wymagań konstrukcyjnych uzyskiwanych dzięki adekwatnym technologią wytwarzania

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - ma wiedzę z zakresu chemii, mechaniki płynów i termodynamiki umożliwiającą dobór paliwa
PEU_W02 - nabywa umiejętności umożliwiające szacowanie wymiany ładunku i ilości paliwa koniecznych do procesu spalania
PEU_W03 - zna parametry oceny sprawności rzeczywistego silnika spalinowego

II. Z zakresu umiejętności:
PEU_U01 - ma umiejętność wykonania testu hamownianego silnika spalinowego
PEU_U02 - ma umiejętność analizy wyników testu i oceny parametrów termodynamicznych
PEU_U03 - ma umiejętność wysunięcia wniosków na podstawie oceny zużycia jednostkowego oraz sprawności mechanicznej

III. Z zakresu kompetencji społecznych:
PEU_K01 - rozumie potrzebę dokształcania z zakresu napędów
PEU_K02 - ma świadomość wielkości sprawności przetwarzania energii i wpływu na środowisko naturalne
PEU_K03 - ma świadomość na temat emisji do środowiska z obecnie stosowanych układów napędowych

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Historia epoki przemysłowej z szczegółowym opisem rozwoju silników spalinowych	2
Wy2	Klasyfikacja silników spalinowych z opisem zastosowań w branżach przemysłu	2
Wy3	Paliwa silnikowe	2
Wy4	Obiegi termodynamiczne, sprawności i dodatkowe parametry oceny sprawności	2
Wy5	Proces spalania w silniku o zapłonie iskrowym	2
Wy6	Proces spalania w silniku o zapłonie samoczynnym	2
Wy7	Pętla wymiany ładunku	2
Wy8	Charakterystyki silników	1
		Suma: 15

Forma zajęć – Laboratorium		Liczba godzin
Lab1	Budowa układu tłokowo-korbowego	2
Lab2	Rozrząd	2
Lab3	Historyczna aparatura wtryskowa	2
Lab4	Układy zasilania typu Common Rail	2
Lab5	Stanowisko hamowniane ISO8178 - opis i wzory	2
Lab6	Stanowisko hamowniane - pomiar	2
Lab7	Obliczenia zużycia jednostkowego paliwa i jednostkowej emisji	2

Lab8	Napęd z ogniwem paliwowym	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład problemowy N2. prezentacja multimedialna N3. eksperyment laboratoryjny N4. ćwiczenia rachunkowe N5. dyskusja problemowa

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01	kolokwium
F2	PEU_W02	kolokwium
F3	PEU_W03	kolokwium
P = F1+F2+F3		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_K01	sprawozdanie
F2	PEU_U02, PEU_K02	sprawozdanie
F3	PEU_U03, PEU_K03	sprawozdanie
P = F1+F2+F3		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA Kowalewicz A., Wybrane zagadnienia samochodowych silników spalinowych, wydawnictwo: WSI Radom, rok: 20003. Drozd Cz., Sroka Z.J. Silniki spalinowe laboratorium. Oficyna wydawnicza PWr, skrypt PWr. Wrocław 1996 LITERATURA UZUPEŁNIAJĄCA ISO8178

OPIEKUN PRZEDMIOTU
dr inż. Marcin Tkaczyk tel.: 71 347-79-18 email: Marcin.Tkaczyk@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Modelowanie obciążeń pojazdów samochodowych**
Nazwa przedmiotu w języku angielskim: **Vehicles Loading Modelling**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Konstrukcja maszyn, urządzeń i pojazdów**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI1020**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15			15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60			60	
Forma zaliczenia	Zaliczenie na ocenę			Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	2			2	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				2	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2			1.4	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. znajomość zasad zachowania: masy, energii i pędu
2. umiejętność samodzielnej pracy z komputerem
3. świadomość konieczności samodzielnej pracy i umiejętność jej realizacji

CELE PRZEDMIOTU

C1. Pojęcie możliwości obliczenia pól: prędkości, ciśnienia i temperatury w oparciu o prawa zasad zachowania (masy energii i pędu) aplikowane z użyciem Metody Objętości Skończonych do zagadnień inżynierskich.
C2. Poznanie obciążeń oddziałujących na pojazd samochodowy wynikających z poruszania się pojazdu w ośrodku płynnym (powietrzu) oraz obciążeń cieplnych wynikających z obecności źródeł ciepła i ich oddziaływania na elementy pojazdu.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Ma wiedzę na temat Metody Objętości Skończonych w stopniu umożliwiającym wytłumaczenie aplikacji postaci całkowej równań zasad zachowania (masy, energii i pędu) do wybranego przepływu.
PEU_W02 - Umie zdefiniować wytyczne na temat kształtowania karoserii pojazdów i wybranych elementów pojazdów w zależności od obciążeń którymi są poddane.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi prowadzić symulację wybranego przepływu dla pojazdu samochodowego lub jego elementów.
PEU_U02 - Analizuje wyniki symulacji celem określenia miejsc o maksymalnym obciążeniu.
PEU_U03 - Na podstawie własnej analizy jest w stanie zaprojektować wybrane elementy pojazdów samochodowych.

III. Z zakresu kompetencji społecznych:
PEU_K01 - rozumie potrzebę i ma możliwość ciągłego dokształcania się szczególnie z zakresu oprogramowania komputerowego
PEU_K02 - docenia koniecznośc podnoszenia kompetencji zawodowych, osobistych i społecznych

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie do systemów obliczeniowych typu CFD - definicja pojęć	2
Wy2	Uogólnione równanie transportu - przedstawienie zasad zachowania: masy, energii i pędu (postać całkowa).	2
Wy3	Metoda Objętości Skończonych - Stosowane modele turbulencji.	2
Wy4	Metoda Objętości Skończonych - przedstawienie schematów obliczeniowych (jawny, niejawny, Cranka-Nicolson).	2
Wy5	Metoda Objętości Skończonych - stosowane rozwiązania rachunku macierzowego.	2
Wy6	Typy warunków brzegowych - podstawy matematyczno-fizyczne	2
Wy7	Post-processing - Analiza pola prędkości i cisnienia	2
Wy8	Post-processing - Analiza pola temperatury	1
		Suma: 15

Forma zajęć – Projekt		Liczba godzin
Proj1	Pomiar wartości wejściowych	2
Proj2	Budowa geometrii	1
Proj3	Dyskretyzacja przestrzeni obliczeniowej	1
Proj4	Zdefiniowanie modelu numerycznego	1
Proj5	Zdefiniowanie warunków brzegowych i warunku początkowego	1
Proj6	Przeprowadzenie obliczeń	2
Proj7	Wizualizacja wyników	2
Proj8	Analiza wyników	1
Proj9	Modernizacja obiektu modelowanego - zmiany geometrii	1
Proj10	Przeprowadzenie obliczeń, wizualizacja wyników	1
Proj11	Analiza wyników i redakcja raportu z projektu	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. praca własna - przygotowanie do projektu N3. system obliczeniowy ANSYS Fluent N4. przygotowanie sprawozdania N5. prezentacja projektu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01,PEU_W02	kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się

F1	PEU_U01-PEU_U03	raport
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA Janina Jankowska, Michał Jankowski, Metody numeryczne, tom 1, Wydawnictwo Naukowo Techniczne (WNT), Warszawa, 1981. Kwasniowski S., Sroka Z., Zabłocki W, tytuł: Modelowanie obcia¿en cieplnychw elementach silników spalinowych , wydawnictwo: Oficyna Wyd. PWr, rok: 1999 Szargut J , tytuł: Modelowanie numeryczne pól temperatury, wydawnictwo: WNT Warszawa, rok: 1992 LITERATURA UZUPEŁNIAJĄCA O. Węgrzyn, Validation of CFD predictions for flow over a full-scale formula student vehicle using PIV in real conditions J.P. Merkel, Development of Multi-element active aerodynamics for the formula student car J. Tu, G-H Yeoh, Ch. Li., Computational Fluid Dynamics A Practical Approach

OPIEKUN PRZEDMIOTU
dr inż. Marcin Tkaczyk tel.: 71 347-79-18 email: Marcin.Tkaczyk@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Uwarunkowania prawne działalności inżyniera**
Nazwa przedmiotu w języku angielskim: **Legal aspects of engineering activities**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Konstrukcja maszyn, urządzeń i pojazdów**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI1021**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15			15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30			30	
Forma zaliczenia	Zaliczenie na ocenę			Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	1			1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6			0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma ugruntowaną wiedzę z zakresu podstaw konstrukcji maszyn, materiałoznawstwa, wytrzymałości materiałów, mechaniki, metod przetwarzania i obróbki materiałów konstrukcyjnych.
2. Potrafi samodzielnie poszukiwać informacji w tekstach źródłowych, kartach katalogowych i Internecie.
3. Umie czytać i tworzyć mechaniczną dokumentację techniczną.

CELE PRZEDMIOTU

C1. Zdobycie podstawowej wiedzy w zakresie wymagań prawnych stawianych wytwórcom maszyn.
C2. Zdobycie podstawowej wiedzy w zakresie bezpieczeństwa eksploatacji maszyn.
C3. Zdobycie praktycznej umiejętności analizy i redukcji ryzyka stwarzanego przez maszyny.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Ma wiedzę odnośnie podstawowych wymagań prawnych stawianych konstruktorom maszyn.
PEU_W02 - Ma podstawową wiedzę dotyczącą procesu redukcji ryzyka przy projektowaniu maszyn.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi zidentyfikować ryzyko stwarzane przez maszynę i zaproponować sposób redukcji tego ryzyka.
PEU_U02 - Potrafi określić normy zharmonizowane adekwatne do danego zagadnienia.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Ma świadomość zagrożeń stwarzanych przez różne rodzaje maszyn.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie do problematyki odpowiedzialności wytwórców maszyn. Dyrektywa maszynowa. Rola konstruktora w procesie redukcji ryzyka.	2
Wy2	Normy zharmonizowane typu A, B i C.	2
Wy3	Zagrożenia stwarzane przez maszyny – rodzaje i identyfikacja.	2
Wy4	Metody oceny ryzyka.	2
Wy5	Środki ochronne stosowane przez konstruktora – konstruowanie maszyn bezpiecznych samych w sobie.	2
Wy6	Środki ochronne stosowane przez konstruktora – stosowanie technicznych środków ochronnych i uzupełniających środków ochronnych.	2
Wy7	Środki ochronne stosowne przez konstruktora – informacje dla użytkownika. Ryzyko resztkowe.	2
Wy8	Instrukcja obsługi maszyny – wymagania prawne.	1
		Suma: 15

Forma zajęć – Projekt		Liczba godzin
Proj1	Przedstawienie maszyny do analizy ryzyka. Określenie wymagań dla analizowanej maszyny.	1
Proj2	Opracowanie wstępnej koncepcji maszyny spełniającej założone wymagania. Próba opracowania maszyny o konstrukcji bezpiecznej samej w sobie.	4

Proj3	Ocena ryzyka maszyny koncepcyjnej.	4
Proj4	Propozycja technicznych środków ochronnych ograniczających ryzyko.	4
Proj5	Ocena ryzyka resztkowego.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. konsultacje N3. prezentacja projektu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02	kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01- PEU_U02 PEU_K01	obrona projektu
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA Dyrektywa 2006/42/EC LITERATURA UZUPEŁNIAJĄCA

OPIEKUN PRZEDMIOTU
dr inż. Damian Stefanow tel.: 320-27-18 email: damian.stefanow@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Projektowanie elementów z tworzyw sztucznych**
Nazwa przedmiotu w języku angielskim: **Polymers in Engineering**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Konstrukcja maszyn, urządzeń i pojazdów**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI1022**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	90				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	3				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.8				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Podstawowa wiedza dotycząca własności materiałów polimerowych
2. Podstawowa wiedza dotycząca technologii wytwarzania elementów z tworzyw sztucznych
3. Podstawowa wiedza dotycząca projektowania elementów maszyn

CELE PRZEDMIOTU

C1. Nabycie umiejętności zastosowania materiałów polimerowych na elementy maszyn z uwzględnieniem założeń dotyczących warunków pracy, technologii wytwarzania, kosztów produkcji itp.
C2. Poznanie zagadnień związanych z zasadami projektowania elementów maszyn z tworzyw sztucznych
C3. Poznanie zagadnień związanych z projektowaniem połączeń elementów z tworzyw sztucznych

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Student zna charakterystyczne właściwości tworzyw sztucznych i jest w stanie zaproponować materiał polimerowy dla określonego zastosowania technicznego.
PEU_W02 - Student zna zasady projektowania oraz metody obliczeń elementów maszyn z tworzyw sztucznych
PEU_W03 - Student zna metody łączenia elementów maszyn z tworzyw sztucznych

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie. Właściwości materiałów polimerowych stosowanych w budowie maszyn. Charakterystyka własności mechanicznych i eksploatacyjnych materiałów polimerowych - wpływ temperatury i czasu.	2
Wy2	Przegląd polimerowych materiałów konstrukcyjnych - właściwości i zastosowania techniczne. Polimerowe materiały kompozytowe.	4
Wy3	Modelowanie własności mechanicznych materiałów polimerowych. Zastosowanie modeli w obliczeniach uwzględniających lepkosprężystość polimerów.	2
Wy4	Zasady projektowania elementów obudów i korpusów z tworzyw sztucznych - technologiczność, kształtowanie, metody obliczeniowe.	2
Wy5	Metody łączenia elementów z tworzyw sztucznych - połączenia rozłączne i nierozłączne. Projektowanie połączeń, metody obliczeń wytrzymałościowych.	4
Wy6	Tarcie i zużywanie elementów maszyn z tworzyw sztucznych. Łożyska ślizgowe z tworzyw sztucznych - obliczenia i rozwiązania konstrukcyjne.	2
Wy7	Przekładnie zębate z kołami polimerowymi - projektowanie, obliczenia.	2
Wy8	Wykorzystanie metod numerycznych w obliczeniach wytrzymałościowych elementów z tworzyw sztucznych	2
Wy9	Materiały polimerowe w zastosowaniach bioinżynierskich.	2
Wy10	Elementy z tworzyw sztucznych wytwarzane technologią druku 3D. Zagadnienia projektowe.	2

Wy11	Elementy urządzeń hydraulicznych z tworzyw sztucznych - dobór materiałów, projektowanie.	2
Wy12	Kolokwium zaliczające.	2
Wy13	Recykling wyrobów z tworzyw sztucznych. Podsumowanie kursu. Zaliczenie.	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. dyskusja problemowa

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	kartkówki (quizy) po wykładach
F2	PEU_W01, PEU_W02, PEU_W03	kolokwium
P = 0,1*F1+0,9*F2		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

[1] Gruin I. Materiały polimerowe. Wydawnictwo Naukowe PWN. Warszawa, 2003
[2] Wieleba W. Bezobsługowe łożyska ślizgowe z polimerów termoplastycznych, Oficyna Wydawnicza PWr, Wrocław, 2014.
[3] Materiały pomocnicze do wykładu - ePortal PWr

LITERATURA UZUPEŁNIAJĄCA

[1] Łączyński B. Niemetalowe elementy maszyn, WNT, Warszawa 1988.
[2] Poradniki i materiały ofertowe firm produkujących tworzywa sztuczne znajdujące się na stronach internetowych (odnośniki do stron internetowych są podawane na pierwszym wykładzie)
[3] Erhard G.: Designing with Plastics. Hanser Gardner Publications, 2006

OPIEKUN PRZEDMIOTU
Prof. dr hab. inż. Wojciech Wieleba tel.: +4871 320-27-74 email: wojciech.wieleba@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Seminarium dyplomowe**
Nazwa przedmiotu w języku angielskim: **Diploma seminar**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI1023, W10MBM-SI2027**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)					15
Liczba godzin całkowitego nakładu pracy studenta (CNPS)					30
Forma zaliczenia					Zaliczenie na ocenę
Grupa kursów					
Liczba punktów ECTS					1
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					1
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)					0.7

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Znajomość zagadnień objętych programem studiów
2. Deficyt punktów ECTS nie większy niż to wynika z uchwały Rady Wydziału

CELE PRZEDMIOTU

C1. Przekazanie wiedzy na temat wymogów pisania pracy dyplomowej inżynierskiej
C2. Nabycie umiejętności prezentacji pracy własnej oraz obrony zawartych tez
C3. Nabycie umiejętności prowadzenia dyskusji na tematy inżynierskie oraz formułowania własnego stanowiska

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Potrafi przygotować prezentację, omówić cel i zakres pracy inżynierskiej oraz postępy w jej realizacji
PEU_U02 - Potrafi prowadzić dyskusje na tematy inżynierskie, w tym prezentować własne stanowisko
PEU_U03 - Potrafi sformułować cel pracy inżynierskiej oraz dobrać metody do jego realizacji

III. Z zakresu kompetencji społecznych:
PEU_K01 - Rozumie konieczność ciągłego zdobywania wiedzy i kompetencji zawodowych
PEU_K02 - Rozumie potrzebę prowadzenia dyskusji nad sposobem rozwiazywania problemów inżynierskich
PEU_K03 - Ma świadomość wpływu swoich decyzji na sposób funkcjonowania przedsiębiorstw

TREŚCI PROGRAMOWE

Forma zajęć – Seminarium		Liczba godzin
Sem1	Omówienie planu i sposobu prowadzenia seminarium oraz harmonogramu wystąpień	1
Sem2	Przekazanie wiedzy na temat zasad przygotowania prezentacji oraz sposobu jej prowadzenia	1
Sem3	Przekazanie wiedzy na temat pisania pracy dyplomowej inżynierskiej oraz przebiegu egzaminu dyplomowego	2
Sem4	Prezentacja własnych tematów prac inżynierskich (dyskusja merytoryczna)	11
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. prezentacja multimedialna
N2. konsultacje
N3. dyskusja problemowa

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Seminarium)

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01,PEU_U03	Ocena sposobu przygotowania, zaprezentowania prezentacji

F2	PEU_K01, PEU_K02, PEU_U02, PEU_K03	Udział w dyskusji
P = F1*0.8+F2*0.2		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA 1. Kowalkowska, A. (2022). Esej naukowy jako trening przed pisaniem pracy dyplomowej. Tutoring Gedanensis, 7 (3) 2. Majchrzak J.:Metodyka pisania prac magisterskich i dyplomowych, Wydawnictwo Uniwersytetu Ekonomicznego, Poznań 2009 2. Brycz B.: Przewodnik dla piszących prace magisterskie w zakresie zarządzania, Polskie Wydawnictwo Ekonomiczne, Warszawa 2011 LITERATURA UZUPEŁNIAJĄCA 1. Wiszniewski A.: Sztuka pisania. Videograf II, Katowice 2003 2. Wiszniewski A.: Sztuka mówienia. Videograf II, Katowice 2003

OPIEKUN PRZEDMIOTU
dr hab. inż. Mirosław Bocian tel.: 320-27-54 email: miroslaw.bocian@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Biomechanika inżynierska**
Nazwa przedmiotu w języku angielskim: **Biomedical Engineering**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Konstrukcja maszyn, urządzeń i pojazdów**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **wybieralny**
Kod przedmiotu: **W10MBM-SI1025**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	2				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Posiada wiedzę z zakresu podstaw mechaniki i wytrzymałości materiałów.
2. Posiada wiedzę z zakresu podstaw materiałoznawstwa.

CELE PRZEDMIOTU

C1. Opanowanie wiedzy na temat nowoczesnych technik stosowanych we wspomaganiu wybranych funkcji życiowych człowieka.
C2. Nabycie wiedzy z zakresu stosowanych biomateriałów i istniejących rozwiązań konstrukcyjnych implantów i sztucznych narządów.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Posiada wiedzę o mechanicznych i fizycznych właściwościach podstawowych elementów anatomicznych człowieka w aspekcie możliwości aplikacji sztucznych elementów zastępczych.
PEU_W02 - Ma uporządkowaną wiedzę z zakresu istniejących konstrukcji endoprotez stawowych i stabilizatorów oraz zasad ich projektowania z uwzględnieniem szczególnych wymagań materiałowych i wytrzymałościowych.

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Stan obecny i kierunki rozwoju inżynierii medycznej. Rola i funkcja inżyniera w medycynie.	2
Wy2	Ciało człowieka jako złożony układ mechaniczny. Biomechanika narządu ruchu człowieka. Modele obciążeń układu kostno-mięśniowego człowieka.	2
Wy3	Podstawy wytrzymałości materiałów tkankowych – biomechaniczne aspekty przeciążenia struktur tkankowych.	2
Wy4	Biomateriały, wymagania, ich własności mechaniczne i biofizyczne, modyfikacja powierzchni implantów. Zjawiska na granicy implant- tkanka.	2
Wy5	Endoprotezy stawowe kończyn dolnych (staw biodrowy, kolanowy, skokowy) i górnych (staw nadgarstka, łokciowy, barkowy). Biotribologia.	2
Wy6	Implanty i systemy stabilizujące uszkodzenia kręgosłupa. Protezy krążków międzykręgowych.	2
Wy7	Stabilizatory zewnętrzne i wewnętrzne kości długich. Skafoldy jako rusztowanie tkanki kostnej.	2
Wy8	Kolokwium	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. wykład informacyjny
N2. prezentacja multimedialna

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02	Kolokwium
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA 1. Biomechanika i Inżynieria Rehabilitacyjna T.V pod red. M. Nałęcza, Biocybernetyka i Inżynierii Biomedycznej, Warszawa 2003. 2. Bober T., Zawadzki J., Biomechanika układu ruchu człowieka, Wyd. BK, Wrocław 2001. 3. Tejszerska D., Świtoński E., Gzik M., Biomechanika narządu ruchu człowieka, Wydawnictwo Instytutu Technologii Eksploatacji – PIB, 2011. LITERATURA UZUPEŁNIAJĄCA

OPIEKUN PRZEDMIOTU
Prof. dr hab. inż. Celina Pezowicz tel.: 71 320-27-13 email: Celina.Pezowicz@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Technika w medycynie**
Nazwa przedmiotu w języku angielskim: **Technique in Medicine**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Konstrukcja maszyn, urządzeń i pojazdów**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **wybieralny**
Kod przedmiotu: **W10MBM-SI1026**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	2				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Wiedza z zakresu mechaniki i wytrzymałości materiałów.
2. Wiedza z zakresu podstaw konstrukcji maszyn.
3. Wiedza z zakresu układów napędowych.

CELE PRZEDMIOTU

C1. Omówienie budowy i zasady działania urządzeń i systemów wspomagających zabiegi i operacje chirurgiczne.
C2. Omówienie budowy i zasady działania wybranych sztucznych narządów oraz sterowania ich pracą.
C3. Omówienie technicznych środków wspomagających lokomocję człowieka.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Formułuje i objaśnia wymagania stawiane urządzeniom wspomagającym funkcjonowanie człowieka oraz robotom i manipulatorom przeznaczonym do zastosowań medycznych.
PEU_W02 - Zana zasady doboru rozwiązań technicznych wspomagających funkcjonowanie narządów i układów człowieka.

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:
PEU_K01 - Ma świadomość ważności i rozumie pozatechniczne aspekty i skutki działalności inżyniera i rozumie związaną z tym odpowiedzialność za podejmowane decyzje.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wspomaganie lokomocji osób niepełnosprawnych (ON): wózki inwalidzkie, wózki z funkcją pionizacji, egzoszkielety. Normy dotyczące projektowania środków transportu dla ON, układy napędowe i sposoby sterowania, kierunki rozwoju konstrukcji wspomagających lokomocję ON.	2
Wy2	Protezy kończyn górnych i dolnych; funkcje, klasyfikacja, omówienie rozwiązań konstrukcyjnych stosowanych protez, układy napędowe w protezach, protezy bioniczne.	2
Wy3	Środki techniczne stosowane w rehabilitacji układu kostno-stawowego i mięśniowego, urządzenia do rehabilitacji czynnej i biernej kończyn, pionizatory i parapodia, egzoszkielety i systemy rehabilitacyjne wykorzystujące biologiczne sprzężenie zwrotne (biofeedback).	2
Wy4	Manipulatory i roboty medyczne, rozwiązania konstrukcyjne stosowane w manipulatorach medycznych, narzędzia do operacji laparoskopowych, kierunki rozwoju telemedycyny.	2
Wy5	Systemy nawigacji na sali operacyjnej, przeznaczenie, klasyfikacja, zasada funkcjonowania nawigacji optycznej i magnetycznej, przykłady rozwiązań konstrukcyjnych elementów mechanicznych systemów nawigacji, przykłady aplikacji w praktyce klinicznej.	2
Wy6	Obrazowanie w medycynie, budowa i zasada działania tomografów komputerowych, rodzaje konstrukcji, zakres stosowania, rezonans magnetyczny, ultrasonografia wewnątrznaczyniowa, algorytmy rekonstrukcji obrazów trójwymiarowych narządów wewnętrznych.	2
Wy7	Techniczne wspomaganie układu krążenia: sztuczne serce, idea budowy, stosowane rozwiązania, materiały, sterowanie, rozruszniki serca, układy krążenia pozaustrojowego, technika małoinwazyjnej angioplastyki naczyniowej; stenty naczyniowe, stengrafty, budowa, zasada działania, stosowane rozwiązania konstrukcyjne.	2
Wy8	Kolokwium zaliczeniowe.	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_K01	Kolokwium
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA 1) Inżynieria Biomedyczna - podstawy i zastosowania (tomy: I - X); red. Władysław Torbicz, Akademicka Oficyna Wydawnicza EXIT, Warszawa 2013 LITERATURA UZUPEŁNIAJĄCA e-zasoby Biblioteki PWr.

OPIEKUN PRZEDMIOTU
dr hab. inż. Jarosław Filipiak tel.: 71 320-21-50 email: jaroslaw.filipiak@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Projektowanie procesów wytwarzania - obróbka bezubytkowa I**
Nazwa przedmiotu w języku angielskim: **Design of manufacturing techniques 1 - chipless forming**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Technologie i systemy wytwórcze**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI2013**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				30	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Umiejętność czytania i opracowywania rysunku technicznego
2. Znajomość Technik wytwarzania z zakresu kształtowania plastycznego
3. Znajomość budowy i możliwości podstawowych maszyn technologicznych z obszaru obróbki bezubytkowej

CELE PRZEDMIOTU

C1. Zdobycie wiedzy dotyczącej postępowania podczas projektowania procesów technologicznych w zakresie kształtowania plastycznego
C2. Zdobycie wiedzy z zakresu projektowania oprzyrządowania technologicznego w procesach obróbki bezubytkowej
C3. Zdobycie umiejętności analizy ekonomicznej wyboru materiału i metod technologicznych

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Potrafi wykorzystać wiedzę teoretyczną z zakresu obróbki plastycznej i zastosować ją w praktyce
PEU_U02 - Potrafi wyszukiwać informacje dotyczące plastycznego kształtowania oraz przeprowadzać ich krytyczną analizę
PEU_U03 - Potrafi odpowiednio dobrać dane do opracowania proces technologicznego

III. Z zakresu kompetencji społecznych:
PEU_K01 - Nabywa umiejętność pracy zespołowej
PEU_K02 - Potrafi myśleć i działać w sposób kreatywny
PEU_K03 - Rozumie odpowiedzialność związaną z zawodem inżyniera

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Wprowadzenie do zajęć. Omówienie zadania projektowego dotyczącego obróbki plastycznej	1
Proj2	Wykonanie rysunku gotowego wyrobu. Analiza technologiczności konstrukcji przedmiotu pod względem obróbki plastycznej	2
Proj3	Ustalenie kształtu oraz wymiarów materiału wyjściowego (półfabrykatu). Opracowanie koncepcji procesu technologicznego	2
Proj4	Dobór oprzyrządowania, maszyn oraz sposobu podawania i usuwania materiału	2
Proj5	Określenie technicznego normowania czasu pracy w poszczególnych etapach obróbki plastycznej	2
Proj6	Obliczenia i rysunki. Opracowanie dokumentacji technologicznej	2
Proj7	Organizacja przebiegu procesu technologicznego. Organizacja kontroli technicznej	2
Proj8	Sprawdzenie, dyskusja i odbiór projektu. Końcowa ocena projektu	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. praca własna - przygotowanie do projektu N2. konsultacje N3. prezentacja projektu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02, PEU_K03	Prezentacja projektu. Obrona projektu
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA [1] Gronostajski J., Obróbka plastyczna metali, Wrocław 1974 [2] Dobrzański L., Podstawy kształtowania struktury i własności materiałów metalowych, Wydawnictwo Politechniki Śląskiej, Gliwice 2007. [3] Romanowski P., Poradnik obróbki plastycznej na zimno, Wydawnictwo Naukowo- Techniczne, Warszawa 1976 LITERATURA UZUPEŁNIAJĄCA [4] Dobrzański T., Rysunek techniczny maszynowy, Wydawnictwa Naukowo-Techniczne, Warszawa 2008

OPIEKUN PRZEDMIOTU
dr inż. Karol Jaśkiewicz tel.: 21-72 email: karol.jaskiewicz@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Komputerowa symulacja procesów odlewania**
Nazwa przedmiotu w języku angielskim: **Computer simulation of casting processes**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Technologie i systemy wytwórcze**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI2014**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15			15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60			30	
Forma zaliczenia	Zaliczenie na ocenę			Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	2			1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2			0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma podstawową wiedzę z zakresu modelowania geometrycznego i systemów CAD. Wykazuje się podstawową znajomością technik wytwarzania w zakresie przygotowania i wytopu ciekłego metalu oraz w obszarze oprzyrządowania odlewniczego i technologii formy odlewniczej.
2. Potrafi sporządzić model 3D w środowisku CAD oraz zna podstawy projektowania procesów technologicznych. Posiada umiejętności doboru oraz krytycznej analizy dobranej technologii odlewania i podstawowych parametrów procesu
3. Potrafi czytać i interpretować rysunki i schematy stosowane w dokumentacji technicznej.

CELE PRZEDMIOTU

C1. Nabycie podstawowej wiedzy z zakresu projektowana procesów odlewania w oparciu o środowisko komputerowego wspomagania 3D
C2. Umiejętność zaprojektowania procesu odlewania prostego elementu. Umiejętność modyfikacji konstrukcji formy i odlewu z uwagi na technologiczność konstrukcji.
C3. Zdobycie umiejętności wyszukiwania i posługiwania się informacją - efektywne rozwiązywanie problemów i odnajdowanie środków zaradczych

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Zna zasady konstruowania formy piaskowej i odlewu. Zna zasady budowy geometrii i dyskretyzacji modelu oraz podziału
na grupy w programie Flow-3D
PEU_W02 - Ma wiedzę z zakresu modelowania procesu przepływu ciekłego metalu w formie i krzepnięcia odlewu w programie Flow-3D
PEU_W03 - Zna przyczyny powstawania wad w odlewach, ich rodzaje oraz metody ich eliminacji. Zna zasady projektowania nadlewów, przelewów i układów odpowietrzających

II. Z zakresu umiejętności:
PEU_U01 - Nabył umiejętność projektowania form odlewniczych, przeprowadzenia symulacji procesu zalewania formy i symulacji krzepnięcia odlewu w środowisku komputerowego wspomagania 3D
PEU_U02 - Nabył umiejętność w zakresie analizy wyników symulacji odlewania oraz doboru parametrów procesu i modyfikacji konstrukcji formy mających na celu eliminację wad w odlewach
PEU_U03 - Nabył w zakresie podstawowym umiejętność posługiwania się programem Flow-3D

III. Z zakresu kompetencji społecznych:
PEU_K01 - Potrafi wyszukiwać informacje oraz je krytycznie analizować, obiektywnie oceniać argumenty, racjonalnie tłumaczyć i uzasadniać własny punkt widzenia z wykorzystaniem wiedzy z zakresu odlewnictwa.
PEU_K02 - Ma świadomość znaczenia zespołowej współpracy dotyczącej doskonalenia metod wyboru strategii mającej na celu optymalne rozwiązywanie powierzonych grupie studentów problemów.
PEU_K03 - Rozumie potrzebę przestrzegania obyczajów i zasad obowiązujących w środowisku akademickim i społeczeństwie.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Sprawy organizacyjne. Wprowadzenie, pojęcia podstawowe. Omówienie programów do symulacji procesów odlewniczych.	1
Wy2	Omówienie zasad projektowania form odlewniczych w środowisku Flow-3D. Obliczenia układów wlewowych. Technologiczność konstrukcji odlewów - wybór koncepcji.	2
Wy3	Omówienie zasad budowy geometrii formy w programie Flow-3D. Zarządzanie geometrią i omówienie metod jej dyskretyzacji.	2

Wy4	Omówienie warunków brzegowych ustalanych podczas modelowania procesów odlewniczych. Charakterystyka współczynników.	2
Wy5	Metody modelowania przepływu ciekłego metalu i procesu wypełniania formy ciekłym metalem.	2
Wy6	Modelowanie procesu krzepnięcia ciekłego metalu w formie odlewniczej.	2
Wy7	Interpretacja wyników symulacji krzepnięcia odlewu. Analiza przebiegu procesu krzepnięcia, kinetyka transferu ciepła w układzie odlew-forma. Wyznaczenie kierunku krzepnięcia i ustalenie węzłów cieplnych.	2
Wy8	Zasady modyfikacji konstrukcji formy odlewniczej: projektowanie nadlewów, przelewów, układów odpowietrzających w oparciu o wyniki symulacji. Opracowanie dokumentacji. Kolokwium zaliczeniowe.	2
		Suma: 15

Forma zajęć – Projekt		Liczba godzin
Proj1	Sprawy organizacyjne. Omówienie struktury programu Flow-3D. Rozdanie projektów	1
Proj2	Budowa geometrii formy odlewniczej w środowisku CAD i import do Flow3D	2
Proj3	Określenie warunków brzegowych. Dyskretyzacja modelu formy odlewniczej.	2
Proj4	Symulacja, wizualizacja i analiza procesu wypełniania formy ciekłym metalem	2
Proj5	Symulacja, wizualizacja i analiza procesu krzepnięcia i stygnięcia odlewu	2
Proj6	Identyfikacja węzłów cieplnych, porowatości, defektów powierzchni odlewów. Analiza przyczyn powstawania wad w odlewach na podstawie wyników symulacji.	2
Proj7	Eliminacja wad w odlewach poprzez modyfikację konstrukcji formy odlewniczej: projektowanie nadlewów, przelewów, układów odpowietrzających.	2
Proj8	Analiza wyników, przygotowanie dokumentacji. Prezentacja i zdanie projektów	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. praca własna - przygotowanie do projektu N3. prezentacja projektu N4. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się

F1	PEU_W01-PEU_W03, PEU_K01-PEU_K03	kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01-PEU_U03, PEU_K01-PEU_K03	odpowiedzi ustne
F2	PEU_U01-PEU_U03, PEU_K01-PEU_K03	raport, prezentacja projektu
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

1. Perzyk M., Waszkiewicz St., Kaczorowski M.i: Odlewnictwo, WNT, 2009;
2. Perzyk M.: Materiały do projektowania procesów odlewniczych, Warszawa 1981;
3. Longa W.: Krzepnięcie odlewów w formach piaskowych. Katowice, 1973;
4. Tabor A., Rączka J., S.: Projektowanie odlewów i technologii form, Wydawnictwo Fotobit, Kraków 1998;

LITERATURA UZUPEŁNIAJĄCA

1. Poradnik inżyniera - Odlewnictwo, Warszawa, 1986;
2. www.flow3d.com

OPIEKUN PRZEDMIOTU

dr inż. Adam Kurzawa tel.: 42-35 email: adam.kurzawa@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Technologie spajania**
Nazwa przedmiotu w języku angielskim: **Joining technology**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Technologie i systemy wytwórcze**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI2015**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60		60		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	2		2		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			2		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2		1.4		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Student zna rodzaje spoin, pozycje spawania, potrafi oznaczać spoiny na rysunku technicznym, zna podstawowe metody spawania i parametry procesów oraz posiada wiedzę z podstaw i zastosowań metod lutowania, zgrzewania i cięcia termicznego.
2. Student potrafi dobrać odpowiednią technologię spajania i cięcia termicznego oraz określić podstawowe parametry procesu technologicznego.
3. Student ma wiedzę na temat struktur i własności metalicznych materiałów inżynierskich, zna zasady ich klasyfikacji i oznaczania oraz ma podstawową wiedzę na temat obróbki cieplnej i cieplno-mechanicznej.

CELE PRZEDMIOTU

C1. Nabycie wiedzy o sposobach projektowania i spajania konstrukcji wytworzonych z różnych materiałów
C2. Zdobycie umiejętności opracowania technologii spajania
C3. Wyszukiwanie informacji oraz umiejętność poddania ich krytycznej analizie

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Student posiada wiedzę dotyczącą wykonawstwa różnych konstrukcji spawanych
PEU_W02 - Student zna technologie spawania, zgrzewania lutowania i klejenia stopów żelaza, metali nieżelaznych i ich stopów oraz tworzyw sztucznych i ceramiki
PEU_W03 - Student posiada wiedzę dotyczącą zastosowania spawania, zgrzewania, lutowania i klejenia w odniesieniu do stopów żelaza, metali nieżelaznych i ich stopów oraz tworzyw sztucznych i ceramiki

II. Z zakresu umiejętności:
PEU_U01 - Student potrafi dobrać właściwą technologię spajania
PEU_U02 - Student potrafi dobrać właściwe parametry spawania, lutowania, zgrzewania i klejenia
PEU_U03 - Student potrafi zaprojektować proces spajania różnego typu konstrukcji

III. Z zakresu kompetencji społecznych:
PEU_K01 - Student przestrzega reguł zespołowej współpracy dotyczącej doskonalenia metod wyboru strategii mającej na celu optymalne rozwiązywanie powierzonych grupie problemów
PEU_K02 - Student potrafi obiektywnie oceniać argumenty, racjonalnie tłumaczyć i uzasadniać własny punkt widzenia z wykorzystaniem wiedzy z zakresu inżynierii spajania
PEU_K03 - Student przestrzega obyczajów i zasad obowiązujących w środowisku akademickim

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie do zagadnień inżynierii spajania oraz przypomnienie podstawowych wiadomości z zakresu spawalnictwa.	2
Wy2	Podstawy materiałoznawstwa spawalniczego	2
Wy3	Obróbka cieplna złączy spawanych	2
Wy4	Nanoszenie warstw metodami spawalniczymi	2
Wy5	Podstawy elektrotechniki i dobór zasilaczy łuku spawalniczego	2
Wy6	Technologia spawania stali niskowęglowych i niskostopowych	2
Wy7	Technologia spawania stali wysokostopowych	2
Wy8	Technologia spawania staliw	2
Wy9	Technologia spawania żeliw	2
Wy10	Metody badań niszczących złączy spawanych	2

Wy11	Technologia spawania metali nieżelaznych i ich stopów, cz. 1: aluminium i miedź	2
Wy12	Technologia spawania metali nieżelaznych i ich stopów, cz. 2: tytan, nikiel i magnez	2
Wy13	Technologia spajania tworzyw sztucznych i ceramicznych	2
Wy14	Projektowanie konstrukcji spawanych, cz. 1	2
Wy15	Projektowanie konstrukcji spawanych, cz. 2 oraz podsumowanie treści przekazanych podczas wykładów	2
		Suma: 30
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Organizacja zajęć, warunki zaliczenia oraz przepisy BHP prac spawalniczych	1
Lab2	Dobór parametrów spawania metodą elektrodą otuloną	2
Lab3	Dobór parametrów spawania metodami łukowymi w osłonach gazów	2
Lab4	Wyznaczenie temperatury podgrzewania wstępnego przy spawaniu stali	2
Lab5	Dobór materiałów dodatkowych do spawania stali wysokostopowych	2
Lab6	Dobór parametrów zgrzewania oraz ocena połączeń zgrzewanych	2
Lab7	Zaawansowane technologie lutowania	2
Lab8	Klejenie podstawowych materiałów inżynierskich	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. praca własna – przygotowanie do laboratorium N3. przygotowanie sprawozdania N4. praca własna – samodzielne studia i przygotowanie do egzaminu N5. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03,	kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02	kartkówka, sprawozdanie
P = średnia z F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA 1. Pilarczyk J., Pilarczyk J.: Spawanie i napawanie elektryczne metali, Wyd. Śląsk, Katowice 1996 2. Ferenc K., Spawalnictwo, WNT, Warszawa, 2007 3. Tasak E., Metalurgia spawania, Wydawnictwo JAK, Kraków, 2008 4. Klimpel A., Spawanie, zgrzewanie i cięcie metali. Technologie, WNT, Warszawa, 2009 LITERATURA UZUPEŁNIAJĄCA 1. Pilarczyk J. (red.), Poradnik inżyniera. Spawalnictwo. T1, WNT, Warszawa, 2017 2. Pilarczyk J. (red.), Poradnik inżyniera. Spawalnictwo. T2, WNT, Warszawa, 2017 3. Normatywy spawalnicze 4. Przedmiotowe normy spawalnicze

OPIEKUN PRZEDMIOTU
dr hab. inż. Leszek Łatka tel.: 071-320-21-38 email: leszek.latka@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Projektowanie procesów wytwarzania - obróbka bezubytkowa II**
Nazwa przedmiotu w języku angielskim: **Design of manufacturing techniques - chipless forming 2**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Technologie i systemy wytwórcze**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI2016**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				30	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				90	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				3	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				3	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				2.1	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Student posiada umiejętność czytania i opracowywania rysunku technicznego
2. Student posiada znajomość technik wytwarzania z zakresu odlewnictwa i spawalnictwa
3. Student posiada znajomość budowy i możliwości podstawowych maszyn technologicznych z obszaru obróbki bezubytkowej

CELE PRZEDMIOTU

C1. Zdobycie wiedzy dotyczącej postępowania podczas projektowania procesów technologicznych w zakresie odlewnictwa i spawalnictwa
C2. Zdobycie wiedzy z zakresu projektowania oprzyrządowania technologicznego w procesach obróbki bezubytkowej
C3. Zdobycie wiedzy na temat oceny technologiczności konstrukcji oraz analizy ekonomicznej wyboru materiału i metod technologicznych

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Student potrafi pozyskiwać informacje z literatury, baz danych, norm technicznych i innych źródeł oraz integrować uzyskane informacje, dokonywać ich interpretacji, a także wyciągać wnioski.
PEU_U02 - Student potrafi wyszukiwać informacje dotyczące odlewnictwa i spawalnictwa oraz przeprowadzać ich krytyczną analizę. Również potrafi czytać i interpretować rysunki i schematy stosowane w dokumentacji technicznej oraz wykonać dokumentację techniczną.
PEU_U03 - Student potrafi zastosować oprogramowanie inżynierskie oraz odpowiednio dobrać i zaprojektować technologie wytwarzania dla określonych grup wyrobów.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Student nabywa umiejętność pracy zespołowej
PEU_K02 - Student potrafi myśleć i działać w sposób kreatywny
PEU_K03 - Student rozumie odpowiedzialność związaną z zawodem inżyniera

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Wprowadzenie do zajęć. Omówienie zadania projektowego dotyczącego odlewnictwa.	2
Proj2	Zasady poprawnego technologicznie konstruowania odlewów. Wybór koncepcji. Wyznaczenie płaszczyzny podziałowej.	2
Proj3	Wielkości uwzględniane przy wytwarzaniu oprzyrządowania odlewniczego.	2
Proj4	Projektowanie i obliczenie układu wlewowego. Opracowanie rysunku surowego odlewu.	2
Proj5	Projektowanie modeli odlewniczych. Opracowanie rysunku modelu i rdzennicy.	2
Proj6	Dobór masy formierskiej, rdzeniowej, płyty podmodelowej i skrzynek formierskich.	2
Proj7	Opracowanie rysunku złożeniowego formy odlewniczej. Zestawienie dokumentacji – obliczenia i rysunki. Opracowanie karty technologicznej.	2
Proj8	Sprawdzenie, dyskusja i odbiór projektu.	2

Proj9	Omówienie zadania projektowego dotyczącego spawalnictwa. Analiza technologiczności konstrukcji pod względem spawalniczym.	2
Proj10	Określenie spawalności zastosowanych na konstrukcję materiałów. Podział konstrukcji na podzespoły technologiczne.	2
Proj11	Dobór metod spawania, materiałów dodatkowych oraz urządzeń spawalniczych. Określenie wymagań jakości spoin i dobór metody ich kontroli.	2
Proj12	Przygotowanie koncepcji oprzyrządowania technologicznego	2
Proj13	Określenie wymagań względem personelu spawalniczego wykonującego i nadzorującego prace spawalnicze oraz dobór oprzyrządowania prac spawalniczych.	2
Proj14	Przygotowanie dokumentacji rysunkowej oraz instrukcji technologicznych spawania pWPS.	2
Proj15	Sprawdzenie, dyskusja i odbiór projektu	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. praca własna - przygotowanie do projektu N2. konsultacje N3. prezentacja projektu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02, PEU_K03	Prezentacja projektu z odlewnictwa. Obrona projektu z odlewnictwa.
F2	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02, PEU_K03	Prezentacja projektu ze spawalnictwa. Obrona projektu ze spawalnictwa.
P = (F1+F2/2		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
1. Chorzępa St., Projektowanie procesów technologicznych, cz. I Odlewnictwo, Oficyna Wydawnicza Politechniki Wrocławskiej, 1982
2. Błaszkowski K., Technologia formy i rdzenia, Państwowe Wydawnictwa Szkolnictwa Zawodowego, Warszawa, 1990
3. Perzyk M. i inni, Materiały do projektowania procesów odlewniczych, PWN, Warszawa, 1990
4. Pilarczyk J. (red.), Poradnik inżyniera. Spawalnictwo. T1, WNT, Warszawa, 2017
5. Pilarczyk J. (red.), Poradnik inżyniera. Spawalnictwo. T2, WNT, Warszawa, 2017
6. Ferenc K., Ferenc J., Konstrukcje spawane: połączenia, WNT, Warszawa, 2006
7. Słania J., Plany spawania – teoria i praktyka, Wydawnictwo SIMP, Warszawa, 2013

LITERATURA UZUPEŁNIAJĄCA
1. Perzyk M i inni, Odlewnictwo, WNT, Warszawa, 2012
2. Holtzer M., Procesy metalurgiczne i odlewnicze stopów żelaza, PWN, Warszawa, 2013
3. Klimpel A., Spawanie, zgrzewanie i cięcie metali, WNT Warszawa, 2009

OPIEKUN PRZEDMIOTU

dr hab. inż. Leszek Łatka tel.: 071-320-21-38 email: leszek.latka@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Komputerowa symulacja procesów kształtowania plastycznego**
Nazwa przedmiotu w języku angielskim: **Computer simulation of plastic forming processes**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Technologie i systemy wytwórcze**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI2017**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15			15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60			30	
Forma zaliczenia	Zaliczenie na ocenę			Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	2			1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2			0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Posiada podstawową wiedzę o procesach i maszynach do kształtowania plastycznego.
2. Posiada podstawową wiedzę z podstaw teorii metody elementów skończonych.
3. Posiada podstawową wiedzę z wytrzymałości materiałów, mechaniki i teorii maszyn i mechanizmów.

CELE PRZEDMIOTU

C1. Nabycie wiedzy w zakresie nowoczesnych narzędzi inżynierskich do analizy i optymalizacji procesów kształtowania plastycznego.
C2. Nabycie podstawowej wiedzy i umiejętności budowy modeli matematycznych procesów kształtowania.
C3. Zapoznanie się z wpływem parametrów procesu na wielkość sił kształtowania.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Zna podstawy budowy modeli matematycznych procesów kształtowania plastycznego.
PEU_W02 - Posiada podstawową wiedzę o możliwościach zastosowania metody elementów skończonych do analizy i optymalizacji procesów kształtowania plastycznego.
PEU_W03 - Zna podstawowe relacje pomiędzy właściwościami materiału i parametrami procesu kształtowania.

II. Z zakresu umiejętności:
PEU_U01 - Posiada umiejętność budowy modeli matematycznych procesów kształtowania plastycznego.
PEU_U02 - Potrafi przeprowadzić obliczenia oraz wstępną optymalizację procesu kształtowania plastycznego.
PEU_U03 - Potrafi wskazać parametry procesu istotnie wpływające na wielkość sił kształtowania.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Nabywa przekonania o odpowiedzialności za wykonywaną pracę.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Kształtowanie plastyczne –rodzaje procesów, podstawowe parametry procesów.	3
Wy2	Podstawy odkształceń plastycznych.	2
Wy3	Modele materiałów, krzywe umocnienia, warunki plastyczności.	2
Wy4	Modelowanie procesów objętościowych przeróbki plastycznej- walcowanie, kucie.	2
Wy5	Modelowanie procesów objętościowych przeróbki plastycznej- wyciskanie, ciągnienie.	2
Wy6	Modelowanie procesów kształtowania blach.	4
		Suma: 15

Forma zajęć – Projekt		Liczba godzin
Proj1	Wprowadzenie do komputerowej symulacji procesów kształtowania plastycznego w środowisku programu obliczeniowego.	3
Proj2	Modelowanie wybranych przykładowych procesów kształtowania plastycznego.	2
Proj3	Analiza i określenie wpływu parametrów procesu kształtowania na wielkość sił kształtowania (tarcie, temperatura, prędkość prasy).	2

Proj4	Opracowanie założeń projektowych dla wybranego detalu kształtowanego przeróbką plastyczną	2
Proj5	Opracowanie modeli obliczeniowych w programie MES dla wybranego procesu.	2
Proj6	Wykonanie obliczeń dla różnych parametrów procesu i/lub geometrii procesu	4
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. prezentacja multimedialna N2. ćwiczenia problemowe N3. praca własna - przygotowanie do projektu N4. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01	ocena przygotowania projektu
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA Pater Z., Samołyk G.: „Podstawy technologii obróbki plastycznej metali” Politechnika Lubelska Lublin 2013 Gronostajski Z.: Badania stosowane w zaawansowanych procesach kształtowania plastycznego. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2003 Morawiecki M., Sadok L., Wosiek E.: Przeróbka plastyczna- podstawy teoretyczne. Wydawnictwo Śląsk 1986 Gabryszewski Z., Gronostajski J.: Mechanika procesów obróbki plastycznej, PWN, Warszawa 1991 LITERATURA UZUPEŁNIAJĄCA Sińczak J.: Kucie dokładne. AGH Uczelniane Wydawnictwa Naukowo-Dydaktyczne, Kraków 2007

OPIEKUN PRZEDMIOTU
dr inż. Sławomir Polak tel.: 21-72 email: slawomir.polak@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Narzędzia skrawające**
Nazwa przedmiotu w języku angielskim: **Cutting tools**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Technologie i systemy wytwórcze**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI2018**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30		30		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	1		1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6		0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma podstawową wiedzę z technik wytwarzania w zakresie obróbki skrawaniem.
2. Posiada umiejętności w zakresie metod pomiaru, technik mierzenia i oceny wyników pomiaru.
3. Potrafi pozyskiwać informacje z literatury, baz danych i innych źródeł, a także wyciągać wnioski oraz formułować i uzasadniać opinie.

CELE PRZEDMIOTU

C1. Poszerzenie wiedzy z zakresu budowy nowoczesnych narzędzi skrawających, geometrii ostrza, materiałów narzędziowych oraz powłok stosowanych na ostrza skrawające.
C2. Poznanie zasad prawidłowego doboru narzędzi skrawających z uwagi na warunki pracy, wydajność obróbki oraz koszty wytwarzania.
C3. Zdobycie wiedzy z zakresu zużycia, trwałości, stępienia oraz regeneracji narzędzi skrawających.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Student potrafi poprawnie sklasyfikować narzędzia skrawające, zna ich budowę i geometrię.
PEU_W02 - Student wie jak dobierać dla procesów technologicznych nowoczesne narzędzia skrawające z uwagi na wydajność oraz koszty wytwarzania.
PEU_W03 - Student potrafi objaśnić zjawiska fizyko-chemiczne zachodzące na ostrzu skrawającym podczas obróbki skrawaniem.

II. Z zakresu umiejętności:
PEU_U01 - Student wie jaki dobierać materiały narzędziowe z uwagi na optymalne parametry skrawania.
PEU_U02 - Student umie określić jaki jest wpływ geometrii ostrza skrawającego na efekty technologiczne obróbki skrawaniem.
PEU_U03 - Student zna programy komputerowe służące do doboru narzędzi w ustalonych warunkach obróbkowych.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Ma świadomość ważności zachowania w sposób profesjonalny, prawidłowo definiuje i rozstrzyga dylematy.
PEU_K02 - Poznaje skutki wpływu działalności technicznej na środowisko i związaną z tym odpowiedzialnością społeczną nauki i techniki.
PEU_K03 - Ma świadomość niezbędności aktywności indywidualnych i zespołowych wykraczających poza działalność inżynierską.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Rola narzędzi skrawających oraz oprzyrządowania technologicznego w wytwarzaniu części maszyn	2
Wy2	Materiały narzędziowe, powłoki przeciwzużyciowe oraz sposoby ich doboru w zależności od warunków obróbki skrawaniem	2
Wy3	Geometria ostrza skrawającego. Układy odniesienia i wymiarowania ostrza. Rola i znaczenie kątów ostrza w procesie skrawania.	2
Wy4	Części składowe narzędzi – budowa i pełnione funkcje. Możliwości stosowania tłumików drgań w narzędziach skrawających.	2
Wy5	Charakterystyka i zastosowanie narzędzi składanych i jednolitych.	2
Wy6	Frezy i głowice frezowe. Narzędzia do gwintów i kół zębatych	2

Wy7	Narzędzia modułowe i wielozadaniowe.	2
Wy8	Kolokwium zaliczeniowe	1
		Suma: 15
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Pomiar i ustawienie narzędzi w elastycznych systemach produkcyjnych.	2
Lab2	Regeneracja narzędzi skrawających	2
Lab3	Możliwości toczenia ostrzami typu WIPER.	2
Lab4	Narzędzia mechatroniczne z kompensacją odkształceń sprężystych układu OUPN	2
Lab5	Dobór narzędzi skrawających z wykorzystaniem programów komputerowych	2
Lab6	Analiza i ocena topografii nasypowych narzędzi diamentowych	2
Lab7	Wyznaczanie skrawności wybranych narzędzi	2
Lab8	Zaliczenie	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. praca własna – przygotowanie do laboratorium N3. przygotowanie sprawozdania N4. praca własna – samodzielne studia i przygotowanie do egzaminu N5. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się

F1	PEU_U01, PEU_U02, PEU_U03 PEU_K01, PEU_K02, PEU_K03	sprawozdanie z ćwiczeń laboratoryjnych
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA Piotr Cichosz: Narzędzia skrawające, WNT , 2006 Piotr Cichosz: Sterowane i mechatroniczne narzędzia skrawające, PWN , 2016 LITERATURA UZUPEŁNIAJĄCA Piotr Cichosz: Nowoczesne procesy obróbki skrawaniem, PWN , 2022

OPIEKUN PRZEDMIOTU
dr inż. Marek Kołodziej tel.: 41-81 email: marek.kolodziej@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Planowanie wytwarzania CAD/CAM**
Nazwa przedmiotu w języku angielskim: **Manufacturing planning CAD/CAM**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Technologie i systemy wytwórcze**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI2019**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15			30	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60			60	
Forma zaliczenia	Zaliczenie na ocenę			Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	2			2	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				2	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6			1.4	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Podstawy z zakresu modelowania geometrycznego w systemach CAD 3D.
2. Podstawy z zakresu projektowania technologicznego.
3. Wiedza podstawowa odnośnie obrabiarek sterowanych numerycznie.

CELE PRZEDMIOTU

C1. Nabycie wiedzy z zakresu projektowania technologii dla maszyn CNC z wykorzystaniem systemów CAD/CAM.
C2. Prezentacja nowoczesnych narzędzi informatycznych wspomagających wytwarzanie. Integracja systemów CAD/CAM.
C3. Omówienie zagadnień związanych z zarządzaniem projektem w obszarze projektowania konstrukcji i technologii.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Student potrafi scharakteryzować nowoczesne rozwiązania informatyczne wspomagające projektowanie konstrukcyjne i technologiczne.
PEU_W02 - Student potrafi opisać przebieg projektowania procesów technologicznych obróbki w systemie CAD/CAM.
PEU_W03 - Student posiada wiedzę odnośnie doboru, integracji i wdrażania systemów CAD/CAM w przedsiębiorstwach.

II. Z zakresu umiejętności:
PEU_U01 - Student powinien umieć dokonać analizy części biorąc pod uwagę to, że będą wytwarzane na maszynach CNC. Analiza technologiczności konstrukcji.
PEU_U02 - Student powinien umieć przygotować dane geometryczne niezbędne do realizacji prac projektowych.
PEU_U03 - Student powinien umieć opracować proces technologiczny dla obrabiarki CNC z wykorzystaniem wybranych systemów CAD/CAM.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Umiejętność pracy w zespole projektowym.
PEU_K02 - Umiejętność krytycznej oceny uzyskanych wyników i ich wpływu na funkcjonowanie przedsiębiorstwa.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie do zagadnień CAD/CAM. Przegląd dostępnych rozwiązań.	3
Wy2	Integracja systemów CAD/CAM.	2
Wy3	Zarządzanie projektem w środowisku systemu CAD/CAM. Powiązania między dokumentami. Wymiana danych między systemami CAD/CAM.	2
Wy4	Metody programowania OSN. Projektowanie technologiczne w systemach CAM. Etapy oraz realizowane zadania.	2
Wy5	Weryfikacja procesów poprzez symulację komputerową. Obróbka wirtualna.	2
Wy6	Omówienie wybranych funkcji systemów CAM.	2
Wy7	Kolokwium zaliczeniowe.	2
		Suma: 15
Forma zajęć – Projekt		Liczba godzin

Proj1	Wprowadzenie. Prezentacja wybranego środowiska CAD/CAM.	2
Proj2	Modelowanie bryłowe w systemie CAD. Przygotowanie przykładowych modeli geometrycznych potrzebnych do zaplanowania obróbki w systemie CAM.	6
Proj3	Projektowanie technologiczne w systemie CAM - moduł frezarski. Obróbka 2.5D.	8
Proj4	Zarządzanie projektem. Weryfikacja obróbki. Generowanie G-kodu.	4
Proj5	Projektowanie technologiczne w systemie CAM - moduł frezarski. Obróbka 3D w 3 osiach.	4
Proj6	Projektowanie technologiczne w systemie CAM - moduł frezarski. Obróbka wieloosiowa. Projektowanie technologiczne w module tokarskim.	4
Proj7	Zaliczenie.	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. prezentacja multimedialna N2. praca własna - przygotowanie do projektu N3. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03, PEU_K01, PEU_K02	kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02	ocena za projekt
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
<u>LITERATURA PODSTAWOWA</u> Grzesik, Wit. Programowanie obrabiarek NC/CNC / Warszawa: Wydawnictwa Naukowo-Techniczne, 2010. Honczarenko, Jerzy. Obrabiarki sterowane numerycznie / Warszawa : Wydawnictwa Naukowo-Techniczne, 2008. <u>LITERATURA UZUPEŁNIAJĄCA</u> Augustyn, Krzysztof., NX CAM : programowanie ścieżek dla obrabiarek CNC / Gliwice : Helion, 2010. Kacprzyk, Zbigniew., Komputerowe wspomaganie projektowania : podstawy i przykłady / Warszawa: Oficyna Wydawnicza Politechniki Warszawskiej, 2012.

OPIEKUN PRZEDMIOTU
dr inż. Jacek Czajka tel.: 31-37 email: jacek.czajka@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Projektowanie procesów technologicznych**
Nazwa przedmiotu w języku angielskim: **Technological designe processes**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Technologie i systemy wytwórcze**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI2020**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15			30	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60			60	
Forma zaliczenia	Zaliczenie na ocenę			Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	2			2	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				2	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2			1.4	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Umiejętność czytania i opracowania rysunku technicznego na podstawowym poziomie.
2. Podstawowa wiedza na temat możliwości wytwarzania różnych części maszyn (odlewanie, przeróbka plastyczna, spajanie, obróbka skrawaniem).
3. Znajomość budowy i możliwości podstawowych maszyn technologicznych.

CELE PRZEDMIOTU

C1. Zdobycie wiedzy na temat dokumentacji technologicznej oraz czynników jakie wpływają na jej rozmiar oraz zdobycie umiejętności poprawiania technologiczności konstrukcji.
C2. Zdobycie umiejętności analizowania technologiczności konstrukcji.
C3. Zdobycie wiedzy na temat dobierania odpowiedniej technologii wytwarzania do rodzaju produkcji i kształtu przedmiotu.
C4. Zdobycie wiedzy na temat ustalania kolejności operacji w procesie technologicznym.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Dobiera odpowiedni rodzaj półfabrykatu (odlew, odkuwka, spawany, tworzywa sztuczne lub profil walcowany) ze względu na rodzaj materiału, rozmiar produkcji, złożoność gotowego wyrobu, itd.
PEU_W02 - Posiada wiedzę z podstaw projektowania procesów technologicznych elementów typu korpus oraz elementów osiowo-symetrycznych. Zna podstawowe zasady ustalania i mocowania przedmiotu obrabianego na obrabiarce.
PEU_W03 - Posiada wiedzę z zakresu możliwości i ograniczeń stosowania poszczególnych technologii obróbki.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi dobrać odpowiedni proces wykonania półfabrykatu (odlewanie, kucie, obróbka plastyczna) w zależności od rodzaju materiału, rozmiaru produkcji itp.
PEU_U02 - Potrafi poprawić technologiczność konstrukcji, aby umożliwić lub uprościć obróbkę.
PEU_U03 - Potrafi dobrać odpowiednie narzędzie skrawające oraz obliczyć parametry skrawania na podstawie danych katalogowych i wymiarów obrabianego elementu.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Student wyszukuje informacje handlowe o materiałach, które mogą ułatwić opracowanie procesu technologicznego.
PEU_K02 - Prezentacja propozycji procesu technologicznego, umiejętność przekazywania informacji.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Sprawy organizacyjne. Informacje o procesie wytwarzania. Fazy rozwoju i życia produktu. Ogólna struktura wytwarzania, operacje i zabiegi. Metody wytwarzania.	2
Wy2	Opracowanie procesu technologicznego, technologiczność i seryjność produkcji.	2
Wy3	Dobór materiałów i półwyrobów, technologiczność produkcji.	2
Wy4	Bazowanie w obróbce i uzyskiwane dokładności.	2
Wy5	Obróbka cieplna w procesie technologicznym.	2
Wy6	Przykłady obróbki wybranych kształtów powierzchni.	2
Wy7	Normowanie czasu pracy.	2

Wy8	Kolokwium zaliczeniowe.	1
		Suma: 15
Forma zajęć – Projekt		Liczba godzin
Proj1	Omówienie przebiegu i warunków zaliczenia zajęć, wydanie tematów.	2
Proj2	Aktualizacja rysunków przedmiotów zgodnie z obowiązującymi normami, określenie seryjności produkcji.	2
Proj3	Obliczenie wymiarów półfabrykatów ze względu na ograniczenia technologiczne.	2
Proj4	Dobór rodzaju oraz wykonanie projektów półfabrykatów.	2
Proj5	Wykonanie dokumentacji półfabrykatu.	2
Proj6	Opracowanie ramowego procesu technologicznego dla wskazanych części.	2
Proj7	Opracowanie kart technologicznych.	2
Proj8	Opracowanie Kart Instrukcyjnych Obróbki Skrawaniem.	2
Proj9	Dobór narzędzi i parametrów skrawania.	2
Proj10	Dobór i charakterystyka obrabiarek.	2
Proj11	Obliczenie czasu wykonania wskazanych zabiegów.	2
Proj12	Obliczenie normy czasów.	2
Proj13	Organizacja przebiegu procesu technologicznego.	2
Proj14	Podsumowanie i weryfikacja projektu.	2
Proj15	Prezentacja i oddanie prac.	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. praca własna - przygotowanie do projektu N3. konsultacje N4. prezentacja projektu N5. praca własna – samodzielne studia i przygotowanie do egzaminu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	Kolokwium zaliczeniowe
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03	Ocena przygotowania projektu.
F2	PEU_U01, PEU_U02, PEU_U03,	Obrona projektu.
P = (F1+F2)/2		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA 1. Feld M.: Podstawy projektowania procesów technologicznych typowych części maszyn, WNT Warszawa 2003. 2. Choroszy B.: Technologia maszyn, Oficyna Wydawnicza PWr, Wrocław 2000. LITERATURA UZUPEŁNIAJĄCA 1. Helmi A. Youssef, Hassan El-Hofy: Machining technology Machine Tools and Operations, 2008 by Taylor & Francis Group.

OPIEKUN PRZEDMIOTU
dr inż. Andrzej Roszkowski tel.: (71) 320 2781 email: andrzej.roszkowski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Technologia i materiały stosowane w wytwarzaniu konstrukcji lekkich**
Nazwa przedmiotu w języku angielskim: **Technology and materials used in the manufacturing of lightweight structures**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Technologie i systemy wytwórcze**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI2021**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		15	15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30		30	30	
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę	Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	1		1	1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1	1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6		0.7	0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Podstawy materiałoznawstwa
2. Podstawy mechaniki
3. Podstawy z technologii wytwarzania

CELE PRZEDMIOTU

C1. Poznanie właściwości materiałów lekkich
C2. Poznanie technologii przetwarzania materiałów lekkich
C3. Zaprojektowanie technologii wytwarzania wybranego elementu konstrukcji lekkiej

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Rozróżniać materiały lekkie
PEU_W02 - Dobierać technologię dla danego wyrobu
PEU_W03 - Opisać technologię wytwarzania danego wyrobu

II. Z zakresu umiejętności:
PEU_U01 - Zaprezentować metody otrzymywania materiałów lekkich
PEU_U02 - Przeprowadzać badania właściwości materiałów lekkich
PEU_U03 - Opracować proces technologiczny

III. Z zakresu kompetencji społecznych:
PEU_K01 - Przestrzegać zasad ochrony środowiska

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Konstrukcje lekkie - istota, rodzaje	2
Wy2	Właściwości metali lekkich i ich stopów	2
Wy3	Otrzymywanie materiałów lekkich	2
Wy4	Wytwarzanie i kształtowanie magnezu i jego stopów	2
Wy5	Wytwarzanie i kształtowanie aluminium i jego stopów	2
Wy6	Wytwarzanie i kształtowanie tytanu i jego stopów	2
Wy7	Kompozyty	3
		Suma: 15
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Zajęcia organizacyjne - wprowadzenie i omówienie zasad dotyczących zajęć laboratoryjnych	1
Lab2	Określenie właściwości mechanicznych i technologicznych stopów lekkich. Wpływ obróbki cieplnej na ich właściwości	2
Lab3	Odlewanie pianoaluminium cz.1	2
Lab4	Odlewanie pianoaluminium cz.2	2
Lab5	Mikroformowanie stopów tytanu	2

Lab6	Wytwarzanie elementów konstrukcji lekkich w procesach kształtowania plastycznego	2
Lab7	Wytwarzanie konstrukcji lekkich metodami odlewniczymi	2
Lab8	Badanie energochłonności konstrukcji ze stopów lekkich	2
		Suma: 15

Forma zajęć – Projekt		Liczba godzin
Proj1	Wprowadzenie do zajęć. Omówienie zadania projektowego	1
Proj2	Wykonanie rysunku wybranego elementu konstrukcyjnego. Analiza technologiczności i konstrukcji przedmiotu. Określenie właściwości wytrzymałościowych analizowanego elementu wykonanego z konwencjonalnych stali HSS	2
Proj3	Przegląd i porównanie materiałów konstrukcyjnych - właściwości i zastosowania. Materiały konstrukcyjne z grupy lekkich. Wysoko wytrzymała materiały konstrukcyjne z grupy AHSS	2
Proj4	Przeprojektowanie wybranego elementu konstrukcyjnego z uwzględnieniem: redukcji masy, własności użytkowych, własności mechanicznych oraz fizycznych	2
Proj5	Obliczenia wytrzymałościowe	2
Proj6	Wybór metody wytwarzania z zakresu obróbki plastycznej umożliwiającej wytworzenie wybranego elementu	2
Proj7	Analiza i weryfikacja projektu	2
Proj8	Sprawdzenie, dyskusja i odbiór projektu. Końcowe zaliczenie przedmiotu	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. praca własna – samodzielne studia i przygotowanie do egzaminu N2. wykład tradycyjny z wykorzystaniem transparencji i slajdów N3. konsultacje N4. prezentacja projektu N5. przygotowanie sprawozdania

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	kolokwium
P = P		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01-PEU_U03	raport, kartkówka
P = P		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01-PEU_U03	Obrona projektu
P = P		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

Technologia metali, Franciszek Grosman, Wydawnictwo Politechniki Ślaskiej, 2010
Kształtowanie metali lekkich, Kazimierz E. Oczoś, 2012, PWN

LITERATURA UZUPEŁNIAJĄCA

OPIEKUN PRZEDMIOTU

Prof. dr hab. inż. Zbigniew Gronostajski tel.: 21-73 email: zbigniew.gronostajski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Utrzymanie ruchu maszyn i urządzeń wytwórczych**
Nazwa przedmiotu w języku angielskim: **Maintenance of machinery and manufacturing equipment**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Technologie i systemy wytwórcze**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI2023**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	1				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma podstawową wiedzę dotyczącą budowy i działania elementów i zespołów maszynowych oraz zasad ich doboru i konstruowania.
2. Ma podstawową wiedzę w zakresie eksploatacji, niezawodności i bezpieczeństwa maszyn.
3. Ma ugruntowaną wiedzę z zakresu podstawowych technik wytwarzania i roli maszyn technologicznych.

CELE PRZEDMIOTU

C1. Poznanie podstawowych zasad koncepcji Totalnego produktywnego utrzymania ruchu (TPM).
C2. Poznanie podstawowych narzędzi TPM oraz metod pozwalających zwiększyć efektywność utrzymania parku maszynowego. Poznanie zasad wyznaczania wskaźników określających postęp we wdrażaniu metodyki TPM.
C3. Poznanie możliwości systemów komputerowych klasy CMMS wspomagających planowanie zadań obsługowonaprawczych,
gospodarkę magazynową oraz zarządzanie personelem obsługowo-naprawczym.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Zna zakres działań i zasady wyboru strategii utrzymania ruchu maszyn i urządzeń wytwórczych.
PEU_W02 - Zna podstawowe narzędzia i wskaźniki TPM.
PEU_W03 - Zna rolę organizacji i jej strukturę w aspekcie utrzymania ruchu.

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Maszyny i urządzenia wytwórcze – aktualne tendencje rozwojowe. Podstawowe wymagania eksploatacyjne (elastyczność, produktywność, wydajność, dokładność i inne). Analiza przyczynowo-skutkowa awarii maszyn	4
Wy2	Podstawowe zagadnienia eksploatacji maszyn (eksploatacja, eksploatyka, wymagania eksploatacyjne). Definicje i określenia niezawodności	2
Wy3	Modele eksploatacyjne i zasady sterowania eksploatacją. Strategie eksploatacji. Zbiór zasad rządzących eksploatacją maszyn	2
Wy4	Rola i znaczenie organizacji w planowaniu utrzymania ruchu.	4
Wy5	Istota systemu Total Productive Maintenance (TPM) – zakres, filary, wskaźniki.	3
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów
N2. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	Kolokwium
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

Szymaniec S., Kacperak M.. "Utrzymanie ruchu w przemyśle", Wydawnictwo Naukowe PWN, 2021
Legutko S.: Podstawy eksploatacji maszyn i urządzeń. Wyd. WSiP. Warszawa, 2007.
Słowiński B.: Inżynieria eksploatacji maszyn. Wyd. Pol. Koszalińskiej. Koszalin, 2011.

LITERATURA UZUPEŁNIAJĄCA

Żółtowski B.: Podstawy diagnostyki maszyn. Wyd. ATR Bydgoszcz, 1996.

OPIEKUN PRZEDMIOTU
dr hab. inż. Tomasz Kurzynowski tel.: 713202190 email: tomasz.kurzynowski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Technologie przyrostowe w budowie maszyn**
Nazwa przedmiotu w języku angielskim: **Additive manufacturing in machine building**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Technologie i systemy wytwórcze**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI2024**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30		30		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	1		1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6		0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Wiedza i umiejętności z zakresu modelowania 3D w systemach CAD – znajomość zasad wspomaganego komputerowo projektowania konstrukcyjnego i technologicznego
2. Podstawowa wiedza z zakresu materiałów inżynierskich, w tym zdolność określenia związku pomiędzy rodzajem materiału i jego właściwościami

CELE PRZEDMIOTU

C1. Przekazanie słuchaczom wiedzy z zakresu przyrostowych technologii wytwarzania, szczególnie w budowie maszyn
C2. Przekazanie wiedzy i umiejętności niezbędnych do rozwiązywania zagadnień budowy maszyn z zakresu modelowania materiałów i elementów i ich wytwarzania z zastosowaniem technologii przyrostowych

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Student powinien rozróżniać różne urządzenia z zakresu technologii przyrostowych i scharakteryzować ich najważniejsze cechy użytkowe
PEU_W02 - Student powinien optymalnie dobrać i zaproponować odpowiednie urządzenie bazujące na technologii przyrostowej do wytwarzania części i zespołów z uwzględnieniem wymagań stawianych nowym produktom pod kątem weryfikacji fizycznej i użytkowej

II. Z zakresu umiejętności:
PEU_U01 - Student powinien umieć prawidłowo prowadzić proces rozwoju produktu w zakresie jego weryfikacji fizycznej, oceny użytkowej i jakościowej
PEU_U02 - Student powinien umieć zaproponować założenia konstrukcyjne nowego produktu, zaprojektować i zastosować odpowiednie narzędzia inżynierskie pod kątem technologii wytwarzania

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wstęp do przyrostowych technologii wytwarzania. Podstawowe zasady i terminologia.	1
Wy2	Przygotowanie danych geometrycznych dla procesu przyrostowego: modele CAD, Inżynieria odwrotna, przetwarzanie danych 3D, formaty STL i AMF	2
Wy3	Możliwości technologii przyrostowych i projektowanie wyrobów	2
Wy4	Procesy wytwarzania przyrostowego – polimery. Stosowane materiały, charakterystyka procesów wytwarzania, obróbka poprocesowa, przykłady zastosowań.	2
Wy5	Procesy wytwarzania przyrostowego – metale. Stosowane materiały, charakterystyka procesów wytwarzania, obróbka poprocesowa, przykłady zastosowań.	2
Wy6	Procesy wytwarzania przyrostowego – kompozyty i ceramika. Stosowane materiały, charakterystyka procesów wytwarzania, przykłady zastosowań.	2
Wy7	Procesy wytwarzania przyrostowego – wytwarzanie narzędzi, przyrządów i małych serii produktów. Stosowane materiały, charakterystyka procesów wytwarzania, przykłady zastosowań.	2

Wy8	Kolokwium zaliczeniowe	2
		Suma: 15
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Wprowadzenie, omówienie metody zaliczenia zajęć. Zasady bezpieczeństwa w laboratorium.	1
Lab2	Technologie przyrostowe dla polimerów (SLA, SLS) – modele funkcjonalne i wyroby gotowe	2
Lab3	Technologie przyrostowe dla polimerów (3DP, DoD, FDM, PolyJet) – modele funkcjonalne, wzorce i wyroby gotowe	2
Lab4	Technologie przyrostowe dla metali (SLM, EBM) – prototypy i wyroby gotowe	2
Lab5	Wytwarzanie hybrydowe - Laser cladding + CNC - prototypy, regeneracja i wytarzanie gotowych wyrobów	2
Lab6	Technologie wytwarzania narzędzi, przyrządów i małych serii produkcyjnych (Rapid Tooling)	2
Lab7	Charakteryzacja materiałów i części – badania mechaniczne, mikroskopia optyczna i elektronowa, tomografia komputerowa	2
Lab8	Praca w zespołach – projektowanie konstrukcyjne i technologiczne wybranego wyrobu	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład informacyjny N2. prezentacja multimedialna N3. case study N4. praca własna – przygotowanie do laboratorium

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01 PEU_W02	Pisemne sprawdziany
F2	PEU_W01 PEU_W02	Kolokwium zaliczeniowe
P = 0,25*F1 + 0,75*F2		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02	Średnia ocen z kartkówek z laboratorium
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA E. Chlebus, „Techniki komputerowe CAx w inżynierii produkcji”, WNT, Warszawa 2000 LITERATURA UZUPEŁNIAJĄCA E. Chlebus, T. Boratyński, B. Dybała, M. Frankiewicz, P. Kolinka, „Innowacyjne technologie Rapid Prototyping - Rapid Tooling w rozwoju produktu”, Oficyna Wydawnicza PWr, Wrocław 2003

OPIEKUN PRZEDMIOTU
dr inż. Tomasz Boratyński tel.: 28-40 email: tomasz.boratynski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Technologie laserowe w wytwarzaniu**
Nazwa przedmiotu w języku angielskim: **Laser Technologies in Manufacturing**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Technologie i systemy wytwórcze**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI2025**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30		60		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	1		2		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			2		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6		1.4		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Podstawowa wiedza z zakresu fizyki optyki i wpływu układów optycznych na bieg wiązki świetlnej
2. Podstawowa wiedza z zakresu termodynamiki - metody transferu energii cieplnej
3. Znajomość zagadnień obróbki cieplnej i jej wpływu na przemiany zachodzące w materiale

CELE PRZEDMIOTU

C1. Nabycie wiedzy z zakresu budowy i działania systemów do obróbki laserowej oraz wpływu parametrów na proces.
C2. Nabycie umiejętności doboru odpowiedniego systemu laserowego do wyznaczonego zadania.
C3. Samodzielne zdobywanie informacji i jej wykorzystanie do rozwiązywania problemów inżynierskich.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Zna zasadę działania i budowę laserów wysokiej mocy
PEU_W02 - Posiada wiedzę z zakresu układów formowania wiązki laserowej i interakcji promieniowania z materią
PEU_W03 - Zna zakres stosowania laserów w wytwarzaniu

II. Z zakresu umiejętności:
PEU_U01 - Potrafi dobrać odpowiedni system laserowy do zadanego procesu obróbki
PEU_U02 - Postępuje w sposób właściwy ze specjalistycznym sprzętem laserowym
PEU_U03 - W zależności od potrzebnego procesu potrafi dobrać odpowiedni układ formowania wiązki

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Bezpieczeństwo laserowe, Działanie laserów dużej mocy, różne typy generatorów laserowych.	3
Wy2	Absorpcja promieniowania, Kształtowanie, prowadzenie i pomiary wiązki laserowej	3
Wy3	Hartowanie laserowe. Spawanie laserowe.	3
Wy4	Laserowe Technologie Generatywne (LC, SLM, SLS). Cięcie laserowe.	3
Wy5	Inne technologie laserowe (kulowanie, oczyszczanie powierzchni, grawerowanie, drążenie). Mikroobróbka laserowa	2
Wy6	Zaliczenie	1
		Suma: 15
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Bezpieczeństwo laserowe; Generatory laserowe	3
Lab2	Kształtowanie i prowadzenie wiązki laserowej (optyka)	3
Lab3	Interakcja wiązki laserowej; Hartowanie laserowe ; Spawanie laserowe	3
Lab4	Napawanie powierzchni funkcjonalnych; Cięcie laserowe	3
Lab5	Grawerowanie laserowe; Badanie wiązki laserowej	3

	Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. prezentacja multimedialna N2. praca własna – przygotowanie do laboratorium N3. demonstracje procesów laserowych N4. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01 - PEU_W03	kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01 - PEU_U03,	Kartkówki
P = średnia(F1)		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA J. Kusiński: ”Lasery i ich zastosowanie w inżynierii materiałowej”, Wydawnictwo Naukowe Akapit, 2000; A. Klimpel: "Technologie laserowe w spawalnictwie" Wydawnictwo Politechniki Śląskiej, 2011. LITERATURA UZUPEŁNIAJĄCA Reinhart Poprawe, Tailored Light 2. Laser Application Technology, Springer 2010 Elijah Kannatey-Asibu, Jr. Principles of laser materials processing, Wiley, 2008 Jyotirmoy Mazumder, Laser Material Processing, Springer 2010 E. Kannatey-Asibu: “Principles of Laser Materials Processing”, Wiley, 2009 J.C. Ion: „Laser Processing of Engineering Materials”, Elsevier, 2005

OPIEKUN PRZEDMIOTU
dr hab. inż. Jacek Reiner tel.: 29-81 email: jacek.reiner@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Technologie wytwarzania wyrobów z tworzyw sztucznych**
Nazwa przedmiotu w języku angielskim: **Technologies of plastics parts manufacturing**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Technologie i systemy wytwórcze**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI2026**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60		30		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	2		1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2		0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Student posiada wiedzę na temat: budowy tworzyw polimerowych, własności mechanicznych tworzyw, zmiany ich struktury i własności pod wpływem temperatury i odkształcenia
2. Student potrafi: czytać rysunek techniczny, analizować zmiany zachodzące w tworzywie poddanym grzaniu i odkształcaniu
3. Student umie współpracować z grupą dla rozwiązania zadania

CELE PRZEDMIOTU

C1. Zapoznać z przemysłowymi metodami wytwarzania wyrobów z tworzyw sztucznych
C2. Dać umiejętność wiązania parametrów technologicznych z jakością wyrobu
C3. Dać umiejętność rozwiązywania problemów technologicznych i narzędziowych w technologiach przetwórstwa tworzyw

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Po wykładzie student powinien: znać najważniejsze technologie wytwarzania wyrobów z tworzyw sztucznych, znać konieczne do tego maszyny i narzędzia
PEU_W02 - Student zna budowę: wtryskarki, wytłaczarki, termoformierki, narzędzi do podstawowych technologii przetwórstwa tworzyw
PEU_W03 - Zna zachowanie się tworzywa podczas przetwarzania i wpływ parametrów technologicznych na to zachowanie
II. Z zakresu umiejętności:
PEU_U01 - Student umie: dobrać odpowiednią technologię wytwarzania do rodzaju wyrobu
PEU_U02 - Student potrafi ustawić podstawowe parametry technologii przetwarzania tworzyw i wykonać proste operacje przygotowawcze
PEU_U03 - Student potrafi rozpoznać wady wyrobów i powiązać je z parametrami przetwórstwa
III. Z zakresu kompetencji społecznych:
PEU_K01 - Uzyskuje możliwość obiektywnego oceniania argumentów, racjonalnego tłumaczenia i uzasadniania własnego punktu widzenia
PEU_K02 - Potrafi współdziałać z innymi w dążeniu do celu

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Technologia wtryskiwania oraz optymalizacja procesu wtrysku	3
Wy2	Wady wyrobów wtryskiwanych	2
Wy3	Technologia wytłaczania i rozdmuchu oraz optymalizacja procesu wytłaczania	2
Wy4	Wady wyrobów wytłaczanych	2
Wy5	Technologia formowania próżniowego	2
Wy6	Technologie przetwórstwa duroplastów oraz technologie niszowe	3
Wy7	Kolokiwum	1
		Suma: 15
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Wpływ parametrów nagrzewania na temperaturę materiału w procesie termoformowania oraz na rozkład grubości wyrobu po termoformowaniu	2

Lab2	Wpływ parametrów formowania i kształtu wzornika na rozkład grubości wyrobu po termoformowaniu	2
Lab3	Optymalizacja procesu wtryskiwania	4
Lab4	Optymalizacja procesu wytłaczania	4
Lab5	Wytwarzanie powłok polimerowych	3
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład problemowy N2. prezentacja multimedialna N3. eksperyment laboratoryjny N4. praca własna – przygotowanie do laboratorium

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02	sprawozdania z zajęć laboratoryjnych
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
- Henryk Zawistowski, Daniel Frenkler; Konstrukcja form wtryskowych do tworzyw termoplastycznych; PLASTECH 2003;
- Izabela Hyla; Tworzywa sztuczne: własności, przetwórstwo, zastosowanie; Wyd. Politechniki Śląskiej 2004

LITERATURA UZUPEŁNIAJĄCA
- H. Saechtling; Tworzywa sztuczne: Poradnik; WNT 2007;
- Peter Eyerer, Thomas Hirth, Peter Elsner; Polymer Engineering. Technologien und Praxis; SPRINGER 2008

OPIEKUN PRZEDMIOTU

dr inż. Oliwia Trzaska tel.: 4642 email: oliwia.trzaska@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Metrologia w procesach wytwarzania**
Nazwa przedmiotu w języku angielskim: **Metrology in manufacturing techniques**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Technologie i systemy wytwórcze**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **wybieralny**
Kod przedmiotu: **W10MBM-SI2029**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	2				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Posiada podstawową wiedzę w zakresie konstrukcji elementów maszyn. Posiada podstawową wiedzę w zakresie technik wytwarzania elementów maszyn.
2. Posiada umiejętność odczytywania rysunków i schematów zawartych w dokumentacji technicznej.

CELE PRZEDMIOTU

C1. Nabycie wiedzy na temat właściwości sprzętu pomiarowego do pomiaru wielkości geometrycznych stosowanego do pomiaru elementów maszyn wytwarzanych w różnego rodzaju procesach wytwarzania.
C2. Zdobycie wiedzy na temat analizy wyników pomiarów, błędów pomiarów i wyrażania niepewności pomiarowej w zależności od wielkości serii produkcyjnej wytwarzanych elementów.
C3. Wyszukiwanie informacji oraz jej krytycznej analizy

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Potrafi zidentyfikować i zdefiniować wielkości związane z pomiarem części maszyn. Zna i potrafi określić warunki zapewnienia spójności pomiarowej.
PEU_W02 - Potrafi wymienić elementy systemu pomiarowego i zdefiniować jego cechy użytkowe. Zna charakterystyczne wielkości podlegające pomiarom w różnych rodzajach elementów maszyn.
PEU_W03 - Zna zasady obowiązujące przy tworzeniu elementów narzędzi i systemów pomiarowych w zależności od ich zastosowania w jednostkowym, seryjnym lub masowym procesie wytwarzania.

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:
PEU_K01 - Wyszukiwanie informacji oraz jej krytycznej analizy
PEU_K02 - Zespołowa współpraca dotycząca doskonalenia metod wyboru strategii mająca na celu optymalne rozwiązanie powierzonej grupie problemów.
PEU_K03 - Obiektywne ocenianie argumentów, racjonalne tłumaczenie i uzasadnianie własnego punktu widzenia z wykorzystaniem wiedzy z zakresu metrologii

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Elementy systemów pomiarowych i ich właściwości.	2
Wy2	Rozkład zmienności wymiarów dla typowych procesów technologicznych.	2
Wy3	Tolerowanie elementów maszyn w różnych procesach technologicznych.	2
Wy4	Projektowanie głowic urządzeń pomiarowych. Projektowanie i kontrola sprawdzianów dla sprawdzania geometrii wyrobów.	2
Wy5	Integracja stanowisk pomiarowych.	2
Wy6	Mechanizacja i automatyzacja procesów pomiarowych.	2
Wy7	Metody analizy systemów pomiarowych.	2
Wy8	Zaliczenie	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. praca własna – samodzielne studia i przygotowanie do egzaminu N3. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01; PEU_W02; PEU_W03; PEU_K01; PEU_K02; PEU_K03;	kolokwium
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

[1] Jakubiec W., Malinowski J.: "Metrologia wielkości geometrycznych". WNT, Warszawa 2018.

LITERATURA UZUPEŁNIAJĄCA

[1] Adamczak S., Makieła W.: " Metrologia w budowie maszyn. Zadania z rozwiązaniami. Wydanie II, zmienione". WNT, Warszawa 2022.
[2] Adamczak S., Makieła W.: "Pomiary geometryczne powierzchni". WNT, Warszawa 2009.
[3] Ratajczyk E., Woźniak A.: "Współrzędnościowe Systemy Pomiarowe". Oficyna Wydawnicza PW, Warszawa 2016

OPIEKUN PRZEDMIOTU
dr inż. Marek Kuran tel.: 27-28 email: marek.kuran@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Badanie jakości wyrobów**
Nazwa przedmiotu w języku angielskim: **Research of qualities of products**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Technologie i systemy wytwórcze**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **wybieralny**
Kod przedmiotu: **W10MBM-SI2030**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	2				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Student ma uporządkowaną wiedzę o rodzajach materiałów inżynierskich oraz ich podstawowych własności mechanicznych.
2. Student ma szczegółową wiedzę o metalicznych materiałach inżynierskich (budowa, własności, zastosowania oraz zasady doboru), jak również potrafi klasyfikować i oznaczać stale, staliwa i żeliwa oraz podstawowe metale nieżelazne i ich stopy. Ma podstawową wiedzę na temat obróbki cieplnej i cieplno-chemicznej.
3. Student ma podstawową wiedzę na temat procesów wytwarzania wyrobów metalowych technologiami odlewniczymi, przeróbki plastycznej, spawalniczymi oraz obróbką ubytkową. Ma podstawową wiedzę z zakresu metrologii wielkości geometrycznych.

CELE PRZEDMIOTU

C1. Zapoznanie studentów z metodami oceny jakości wyrobów metalowych wytwarzanych technologiami odlewniczymi, przeróbki plastycznej, spawalniczymi oraz obróbką ubytkową.
C2. Nabycie wiedzy o podstawowych metodach badań jakości odlewów, odkuwek, wytłoczek, wyrobów walcowanych, ciągnionych, wyrobów spawanych, zgrzewanych i lutowanych, klejonych, skręcanych, wyrobów spiekanych z proszków metali, wyrobów wytwarzanych obróbką skrawaniem, wyrobów obrabianych cieplnie i wyrobów z tworzyw sztucznych.
C3. Nabywanie i utrwalanie kompetencji społecznych obejmujących inteligencję emocjonalną polegającą na umiejętności współpracy w grupie studenckiej mającej na celu efektywne rozwiązywanie problemów. Odpowiedzialność, uczciwość i rzetelność w postępowaniu; przestrzeganie obyczajów obowiązujących w środowisku akademickim i społeczeństwie.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Student zna podstawowe metody badań jakości odlewów i wyrobów wytwarzanych metodami przeróbki plastycznej.
PEU_W02 - Student zna podstawowe metody badań jakości wyrobów wytwarzanych w procesach spawalniczych, klejonych, skręcanych i wyrobów spiekanych z proszków metali.
PEU_W03 - Student zna podstawowe metody badań jakości wyrobów wytwarzanych obróbką skrawaniem, obrabianych cieplnie i wyrobów z tworzyw sztucznych.

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:
PEU_K01 - Student potrafi wyszukać informacje oraz poddać je krytycznej analizie
PEU_K02 - Student potrafi obiektywnie ocenić argumenty, racjonalnie wytłumaczyć i uzasadnić własny punkt widzenia z wykorzystaniem wiedzy z zakresu odlewnictwa, przeróbki plastycznej, spawalnictwa, obróbki skrawaniem i tworzyw sztucznych.
PEU_K03 - Student przestrzega dobrych obyczajów i zasad obowiązujących w środowisku akademickim.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Sprawy organizacyjne. Podstawowe pojęcia i terminologia w systemach zapewnienia jakości wyrobów. Stosowane techniki w kontroli jakości wyrobów. Współrzędnościowa technika pomiarowa w ocenie jakości wyrobów. Pomiary geometryczne wyrobów.	3
Wy2	Metody i zasady oceny jakości odlewów, wyrobów klejonych i skręcanych oraz wyrobów z tworzyw sztucznych.	3
Wy3	Metody oceny jakości wyrobów walcowanych, ciągnionych i tłoczonych oraz wyrobów kutych, wyrobów spiekanych i wyrobów po obróbce cieplno-chemicznej.	3
Wy4	Metody badań i kontroli jakości wyrobów spawanych oraz i wyrobów zgrzewanych i lutowanych.	3

Wy5	Metody oceny jakości wyrobów wytwarzanych obróbką skrawaniem. Aspekty certyfikacji i akredytacji. Podsumowanie treści przekazanych w ramach wykładów.	3
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. praca własna – samodzielne studia i przygotowanie do egzaminu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03,	kolokwium
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

1. Łabanowski, J., Ocena jakości wyrobów hutniczych, Wydawnictwo PWSZ w Elblągu, 2012
2. Krajewski, A., Hudycz, M., Zapewnienie jakości i kontrola złączy spajanych, Oficyna Wydawnicza Politechniki Warszawskiej, 2015
3. Kubiński, W., Wybrane metody badań materiałów, PWN, Warszawa, 2016
4. Sobczak J.J. (red.), Poradnik Odlewnika, Wyd. STOP, Kraków, 2013
5. Pater Z., Samołyk G., Podstawy technologii obróbki plastycznej metali, Wydawnictwo Politechniki Lubelskiej, Lublin, 2013

LITERATURA UZUPEŁNIAJĄCA

1. Zymonik J., Zymonik Z., Systemy jakości w wytwarzaniu maszyn. SIMPRESS, Wrocław, 1997
2. Hamrol A., Zarządzanie jakością z przykładami, PWN, Warszawa, 2010
3. Łunarski J., Zarządzanie jakością, standardy i zasady, WNT, Warszawa, 2008

OPIEKUN PRZEDMIOTU

dr hab. inż. Leszek Łatka tel.: 071-320-21-38 email: leszek.latka@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Essential of Management (Podstawy zarządzania)**
Nazwa przedmiotu w języku angielskim: **Essential of Management**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3071**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	1				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Brak wymagań wstępnych.

CELE PRZEDMIOTU

C1. Przyswojenie wiedzy z zakresu procesu zarządzania i jego elementów.
C2. Przyswojenie wiedzy na temat istoty i mechanizmów budowania i funkcjonowania organizacji.
C3. Przyswojenie wiedzy dotyczącej podstawowych instrumentów i narzędzi zarządzania, wykorzystania ich w organizacji oraz analizy problemów zarządzania.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Student potrafi scharakteryzować podstawowe mechanizmy funkcjonowania organizacji, rozróżniać typy organizacji, ich elementy składowe oraz rozpoznawać elementy otoczenia, które wpływają na funkcjonowanie poszczególnych podsystemów w organizacjach.
PEU_W02 - Student potrafi definiować proces zarządzania i jego elementy oraz zna podstawowe metody i techniki zarządzania w ramach poszczególnych funkcji zarządzania: planowania, organizowania, przewodzenia i kontrolowania.
PEU_W03 - Student potrafi formułować zakres i obszary wpływu organizacji na otoczenie w zależności od zidentyfikowanych decyzji podejmowanych przez menedżerów w organizacjach.

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:
PEU_K01 - Student ma świadomość wpływu otoczenia na decyzje podejmowane w organizacji i decyzji podejmowanych w organizacji na otoczenie.
PEU_K02 - Student ma świadomość roli planowania, organizowania, przewodzenia i kontrolowania oraz technik stosowanych i narzędzi stosowanych w każdej z tych funkcji zarządzania na sprawne i skuteczne funkcjonowanie organizacji jako całości.
PEU_K03 - Student ma świadomość istoty innowacji i przedsiębiorczości dla otoczenia.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Organizacja i jej zasoby. Pojęcie zarządzania. Proces zarządzania i jego elementy. Menedżer i jego praca.	2
Wy2	Otoczenie organizacji i jego elementy. Wpływ otoczenia na organizację. Wybrane metody analizy otoczenia.	2
Wy3	Funkcja planowania w organizacji. Wyznaczanie celów. Hierarcha celów. Rodzaje planów w organizacjach. Proces podejmowania decyzji. Strategia i zarządzanie strategiczne. Marketing i planowanie marketingowe.	2
Wy4	Funkcja organizowania. Struktury organizacyjne. Zarządzanie zasobami ludzkimi i jego elementy. Narzędzia i techniki zarządzania zasobami ludzkimi.	2
Wy5	Funkcja przewodzenia. Podstawy zachowań jednostek w organizacjach. Przywództwo i władza. Style kierowania. Motywowanie. Wybrane techniki motywacyjne.	2
Wy6	Funkcja kontrolowania. Etapy i dziedziny kontroli. Kreatywność, innowacyjność i wiedza. Pojęcie i rodzaje innowacji.	2
Wy7	Pojęcie przedsiębiorczości. Rola przedsiębiorczości w gospodarce. Gospodarka oparta na wiedzy.	2
Wy8	Kolokwium zaliczeniowe / Kolokwium zaliczeniowe on-line	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01-W03	kolokwium
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA 1. Griffin R.W., Podstawy zarządzania organizacjami, PWN, Warszawa 2022. 2. Koźmiński A.K., Piotrowski W.Zarządzanie. Teoria i praktyka, PWN, Warszawa, 2019. 3. Krzakiewicz K., Cyfert S., Podstawy zarządzania organizacjami, Wydawnictwo UE w Poznaniu, 2020. 4. DeCenzo D.A., Robbins S.P., Podstawy zarządzania, PWE, Warszawa, 2019. LITERATURA UZUPEŁNIAJĄCA 1. Masłyk-Musiał E., Rakowska A., Krajewska-Bińczyk E., Zarządzanie dla inżynierów, PWE, Warszawa, 2012. 2. Hatch M.J., Teoria organizacji, PWN, Warszawa, 2002. 3. Glinka B., Gudkova S., Przedsiębiorczość, Wolters Kluwer Business, 2011. 4. Aulet B., Przedsiębiorczość zdyscyplinowana. Od startupu do sukcesu w 24 krokach, 2015. 5. Prasa i portale o tematyce zarządzania i przedsiębiorczości.

OPIEKUN PRZEDMIOTU
dr inż. Mateusz Molasy tel.: 713202662 email: mateusz.molasy@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Ergonomy and Safety (Ergonomia i BHP)**
Nazwa przedmiotu w języku angielskim: **Ergonomy and Safety**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3072**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	1				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)					

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. ma podstawową wiedzę z zakresu charakterystyki i właściwości czynników fizycznych (energia el., drgania mechaniczne, oświetlenie, pole EM, pyły), chemicznych i biologicznych
2. ma uporządkowaną wiedzę z zakresu matematyki rachunkowej, fizyki, chemii i informatyki

CELE PRZEDMIOTU

C1. Nabycie podstawowej wiedzy z obszaru prawa pracy oraz z zakresu wypadków przy pracy i chorób zawodowych
C2. Nabycie podstawowej wiedzy z zakresu ergonomii oraz biomechaniki pracy
C3. Nabycie podstawowej wiedzy z dziedziny analizy i ochrony przed czynnikami niebezpiecznymi, szkodliwymi i uciążliwymi w środowisku pracy

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - zna podstawowe przepisy i zasady bezpieczeństwa i higieny pracy
PEU_W02 - posiada wiedzę z podstaw ergonomii oraz jest świadomy możliwości praktycznego jej zastosowania w projektowaniu i wytwarzaniu wyrobów
PEU_W03 - zna podstawowe zagrożenia występujące na stanowiskach pracy oraz metody ochrony przed nimi

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:
PEU_K01 - rozumie prawne i środowiskowe aspekty i skutki działalności inżynierskiej, ma świadomość ekologiczną lokalną i globalną
PEU_K02 - potrafi odpowiedzialnie podejmować decyzje jako inżynier uwzględniając ich wpływ na pozatechniczne aspekty działalności inzynierskiej, potrafi pracować samodzielnie i zespołowo oraz prawidłowo ocenia priorytety zadań

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Ochrona pracy, przepisy i zasady BHP	2
Wy2	Wypadki przy pracy i choroby zawodowe	2
Wy3	Ergonomia jako nauka interdyscyplinarna	2
Wy4	Biomechanika pracy - nauka o wykrywaniu zagrożeń dla zdrowia pracownika, będących skutkiem wykonywanej pracy	2
Wy5	Czynniki niebezpieczne i szkodliwe w środowisku pracy - czynniki mechaniczne i energia elektryczna	3
Wy6	Czynniki niebezpieczne i szkodliwe w środowisku pracy - hałas, drgania mechaniczne, oświetlenie	3
Wy7	Podsumowanie zajęć, zaliczenie	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. dyskusja problemowa N3. konsultacje N4. praca własna – samodzielne studia i przygotowanie do egzaminu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01 - PEU_W03	kolokwium zaliczeniowe
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA Monika Blaszczok - Ergonomia bezpiecznej i higienicznej pracy, Politechnika Śląska, Gliwice 2018 LITERATURA UZUPEŁNIAJĄCA B. Rączkowski - BHP w praktyce, ODDK, Gdańsk 2022

OPIEKUN PRZEDMIOTU
dr inż. Jacek Iwko tel.: 42-54 email: jacek.iwko@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Fundamentals of metrology (Podstawy metrologii)**
Nazwa przedmiotu w języku angielskim: **Fundamentals of metrology**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3073**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	1				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma podstawową wiedzę w zakresie matematyki i fizyki na poziomie szkoły średniej.

CELE PRZEDMIOTU

C1. Zrozumienie istoty pomiarów dla poznania stanu rzeczywistego i współzależności wielkości fizycznych.
C2. Poznanie podstawowych pojęć metrologicznych, systemu jednostek miar SI i zasad wykonywania pomiarów podstawowych wielkości fizycznych oraz właściwości podstawowych czujników i przyrządów pomiarowych.
C3. Zapoznanie się ze sposobami przetwarzania sygnałów pomiarowych, systemami pomiarowymi i zasadami właściwego zaplanowania procesu pomiarowego.
C4. Nabycie podstawowej wiedzy o czynnikach zakłócających pomiary.
C5. Nabycie podstawowej wiedzy o planowaniu eksperymentu i opracowywaniu wyników pomiarów wraz z ich niepewnością.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Ma podstawową wiedzę w zakresie metrologii, rozumie istotę pomiarów i zna metody pomiarów.
PEU_W02 - Zna podstawowe właściwości przyrządów i systemów pomiarowych.
PEU_W03 - Ma podstawową wiedzę o dokładności i niepewności pomiarów.

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:
PEU_K01 - Wyszukiwanie informacji oraz jej krytycznej analizy
PEU_K02 - Obiektywne ocenianie argumentów, racjonalne tłumaczenie i uzasadnianie własnego punktu widzenia z wykorzystaniem wiedzy z zakresu podstaw metrologii.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Sprawy organizacyjne. Podstawowe pojęcia metrologii.	1
Wy2	Wielkości i jednostki miar. Układy jednostek miar. Układ SI, wzorce jednostek miar, układ hierarchiczny wzorców jednostek miar.	2
Wy3	Metody pomiarowe, rodzaje i klasyfikacja. Przykłady zastosowań.	2
Wy4	Przyrządy pomiarowe analogowe i cyfrowe: rodzaje; elementy składowe; układy wejściowe i wyjściowe; przetworniki analogowo-cyfrowe; rola mikroprocesorów i komputera zewnętrznego; właściwości metrologiczne i użytkowe; wpływ wielkości zakłócających.	4
Wy5	Niepewność pomiarów i opracowywanie wyników: źródła niepewności pomiarów; podział i zasady szacowania, obliczanie niepewności standardowej typu A.	2
Wy6	Obliczanie niepewności standardowej typu B oraz rozszerzonej na odpowiednim poziomie ufności. Sposoby opracowywania wyników i ich prezentacji.	2
Wy7	Kolokwium	2

	Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01 - PEU_W02, PEU_K01-PEU_K02	kolokwium
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

[1] M. Lisowski: Podstawy metrologii. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2011.
[2] J. Ciepłucha: Podstawy metrologii. Wyd. II. Wydawnictwo Politechniki Łódzkiej. Łódź 2008
[3] J. Arendarski: Niepewność pomiarów. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2006.

LITERATURA UZUPEŁNIAJĄCA

[1] J. Piotrowski: Podstawy miernictwa. WNT, Warszawa 2002.
[2] J. Jaworski, R. Morawski, J. Olędzki: Wstęp do metrologii i techniki eksperymentu. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 1992.
[3] J. Piotrowski, K. Kostyro: Wzorcowanie aparatury pomiarowej. WNT, Warszawa 2000.
[4] T. Skubis: Postawy metrologicznej interpretacji wyników pomiarów. Wydawnictwo Politechniki Śląskiej. Gliwice 2004.
[5] S. Białas: Metrologia techniczna z podstawami tolerowania wielkości geometrycznych dla mechaników. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2006.
[6] P.H. Sydenham: Podręcznik metrologii. Tom II. WKiŁ, Warszawa 1990.
[7] Międzynarodowy słownik podstawowych i ogólnych terminów metrologii. Wyd. Główny Urząd Miar, Warszawa 1996.
[8] Wyrażanie niepewności pomiaru – przewodnik. Wyd. Główny Urząd Miar, Warszawa 1996.
[9] Wyrażanie niepewności pomiaru przy wzorcowaniu. Dokument EA-4/02, Europejska Współpraca w Dziedzinie Akredytacji. Wyd. Główny Urząd Miar, Warszawa 1999.

OPIEKUN PRZEDMIOTU
dr inż. Marek Kuran tel.: 27-28 email: marek.kuran@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Engineering Graphics: Descriptive Geometry (Grafika inżynierska - geometria wykreślna)**

Nazwa przedmiotu w języku angielskim: **Engineering Graphics: Descriptive Geometry**

Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**

Specjalność (jeśli dotyczy): **Mechanical engineering design**

Poziom i forma studiów: **I stopień, stacjonarne**

Rodzaj przedmiotu: **obowiązkowy**

Kod przedmiotu: **W10MBM-SI3074**

Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15	30			
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30	60			
Forma zaliczenia	Zaliczenie na ocenę	Zaliczenie na ocenę			
Grupa kursów					
Liczba punktów ECTS	1	2			
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		2			
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6	1.4			

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Znajomość podstawowych twierdzeń geometrii euklidesowej.
2. Umiejętność posługiwania się przyborami kreślarskimi.
3. Umiejętność kreślenia podstawowych konstrukcji geometrycznych (np. podział odcinak na n równych części, kreślenie sześciokąta foremnego).

CELE PRZEDMIOTU

C1. Opanowanie teoretycznych i praktycznych podstaw metody Monge'a wykreślnego odwzorowania tworów geometrycznych na płaszczyźnie rysunku, stanowiącej podstawę zapisu konstrukcji (rysunku technicznego).
C2. Opanowanie podstaw restytucji tworów geometrycznych na podstawie rzutów Monge'a.
C3. Nabycie umiejętności rozwiązywania zadań miarowych (wykreślne wyznaczanie odległości, kątów, wielkości rzeczywistej).

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Ma uporządkowaną wiedzę dotyczącą odwzorowania na płaszczyźnie rysunku tworu geometrycznego metodą Monge'a oraz elementarną wiedzę z zakresu aksonometrii.
PEU_W02 - Potrafi wskazać odpowiedni algorytm rozwiązania zadania z zakresu odwzorowania położenia i wzajemnych relacji w przestrzeni tworów geometrycznych, a także określania związków miarowych.
PEU_W03 - Potrafi zinterpretować rysunek, wykonany wg metody Monge'a, przedstawiający usytuowanie elementu lub tworu geometrycznego w przestrzeni.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi praktycznie zastosować zasady rzutowania metodą Monge'a w celu odwzorowania elementów i tworów geometrycznych (w tym brył) na płaszczyźnie rysunku.
PEU_U02 - Umie wyznaczyć wielkości rzeczywiste charakteryzujące zagadnienie miarowe geometrii wykreślnej.
PEU_U03 - Potrafi na podstawie rzutów Monge'a przeprowadzić restytucję tworu geometrycznego i przedstawić jej rezultat za pomocą rzutu aksonometrycznego.

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Podstawowe definicje i zasady rzutowania równoległego, prostokątnego wg Monge'a; odwzorowania podstawowych elementów geometrycznych (punktu, prostej, płaszczyzny); relacja przynależności.	1
Wy2	Wyznaczanie elementów wspólnych - krawędzi i punktów przebicia; elementy równoległe i prostopadłe.	2
Wy3	Transformacja położenia (obrót, kład, podniesienie z kładu) i transformacja układu odniesienia (zastosowanie dodatkowej rzutni).	2
Wy4	Bryły - definicje; przekrój bryły jako zbiór elementów wspólnych bryły i płaszczyzny tnącej, punkty przebicia bryły przez prostą	2
Wy5	Wykrawanie brył zespołem płaszczyzn rzutujących - modyfikacja wyjściowej postaci bryły; rozwinięcia brył.	2
Wy6	Przenikanie brył - definicja linii przenikania, zastosowanie pomocniczych płaszczyzn tnących oraz transformacji układu odniesienia.	2

Wy7	Rzutowanie na trzy wzajemnie prostopadłe płaszczyzny; podstawy aksonometrii; uzupełnianie brakującego rzutu bryły - wykorzystanie rzutu aksonometrycznego.	2
Wy8	Kolokwium zaliczeniowe.	2
		Suma: 15
Forma zajęć – Ćwiczenia		Liczba godzin
Ćw1	Informacje dotyczące przyborów kreślarskich i zasad kreślenia konstrukcji geometrycznych. Rzuty punktu i prostej, odwzorowanie płaszczyzny za pomocą jej śladów; identyfikacja położenia podstawowych elementów geometrycznych w przestrzeni w układzie dwóch prostopadłych rzutni.	2
Ćw2	Identyfikacja przynaleznośći podstawowych elementów geometrycznych, uzupełnianie brakującego rzutu; szczególne położenia elementów geometrycznych.	2
Ćw3	Krawędź jako element wspólny dwóch płaszczyzn. Punkt przebicia jako element wspólny prostej i płaszczyzny. Przypadki szczególne wyznaczania elementów wspólnych.	2
Ćw4	Krawędź między figurami płaskimi (zastosowanie pomocniczych płaszczyzn rzutujących); punkt przebicia prostą figury płaskiej. Identyfikacja i konstruowanie relacji równoległości i prostopadłości podstawowych elementów geometrycznych	2
Ćw5	Obrót i kład podstawowych elementów geometrycznych (obrót odcinka, płaszczyzny); zastosowanie transformacji położenia w zagadnieniach miarowych (wyznaczanie wielkości rzeczywistej odcinka, kąta, figury płaskiej).	2
Ćw6	Wyznaczanie rzutów płaskich tworów geometrycznych o zadanych parametrach i zadanym położeniu w przestrzeni (podniesienie z kładu figury płaskiej). Zastosowanie transformacji układu odniesienia w zagadnieniach miarowych oraz identyfikacji relacji położenia (kąt nachylenia płaszczyzny względem rzutni, odległość punktu od płaszczyzny, wyznaczanie rzutów punktu o zadanej odległości od płaszczyzny).	2
Ćw7	Kolokwium K1 (obejmuje materiał ćwiczeń 1 - 6)	2
Ćw8	Odwzorowanie brył elementarnych w rzutach Monge'a, identyfikacja punktów i odcinków prostych należących do ścian brył; wyznaczanie przekrojów wielościanów płaszczyznami rzutującymi.	2
Ćw9	Wyznaczanie przekrojów wielościanów płaszczyznami dowolnymi. Wyznaczanie przekrojów brył zawierających powierzchnie. Wyznaczanie punktów przebicia brył przez proste (zastosowanie pomocniczych płaszczyzn tnących zawierających prostą przebijającą).	2
Ćw10	Rozwinięcie wielościanu oraz bryły zawierającej powierzchnię prostokreślną. Wykrawanie brył płaszczyznami rzutującymi jako modyfikacja wyjściowej postaci bryły - wykrawanie wielościanu.	2
Ćw11	Wykrawanie bryły obrotowej. Wyznaczanie linii przenikania wielościanów.	2
Ćw12	Wyznaczanie linii przenikania brył zawierających powierzchnie.	2
Ćw13	Odwzorowanie bryły na trzech wzajemnie prostopadłych rzutniach. Modyfikacja bryły za pomocą płaszczyzny rzutującej względem jednej z rzutni.	2

Ćw14	Odwzorowanie bryły za pomocą rzutu aksonometrycznego. Wyznaczanie brakującego rzutu bryły zmodyfikowanej za pomocą płaszczyzn tnących. Relacja: rzuty Monge'a - rzut aksonometryczny.	2
Ćw15	Kolokwium nr 2 (obejmuje materiał ćwiczeń 8 - 14).	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład problemowy N2. ćwiczenia problemowe N3. konsultacje N4. praca własna - przygotowanie do projektu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W03	kolokwium zaliczeniowe
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Ćwiczenia)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02	kolokwium nr 1, ocena co najmniej dostateczna
F2	PEU_U01, PEU_U02, PEU_U03	kolokwium nr 2, ocena co najmniej dostateczna
P = F3		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA [1] Lewandowski Z., Geometria wykreślna, PWN, Warszawa 1980 (i późniejsze wydania), [2] Otto F., Otto E., Podręcznik geometrii wykreślnej, PWN, Warszawa 1998, [3] Zbiór zadań z geometrii wykreślnej, red. Nowakowski T., Oficyna Wyd. Politechniki Wrocławskiej, Wrocław 2001, [4] Bieliński A., Geometria wykreślna, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2005. LITERATURA UZUPEŁNIAJĄCA [1] Szerszeń S., Nauka o rzutach, PWN, Warszawa 1974 (i późniejsze wydania), [2] Przewłocki S., Geometria wykreślna w budownictwie, Wyd. Arkady, Warszawa 1997, [3] Bogaczyk T., Romaszkiewicz-Białas T., 13 wykładów z geometrii wykreślnej, Oficyna Wyd. Politechniki Wrocławskiej, Wrocław 1997, [4] Błach A., Geometria. Przegląd wybranych zagadnień dla uczniów i studentów. Arkady, Warszawa 1998.

OPIEKUN PRZEDMIOTU
dr inż. Marta Kozuń tel.: 320-27-13 email: marta.kozun@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Information Technologies (Technologie informacyjne)**
Nazwa przedmiotu w języku angielskim: **Information Technologies**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3075**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	2				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Podstawowa wiedza na temat funkcjonowania komputerów wyniesiona ze szkoły średniej

CELE PRZEDMIOTU

C1. Przedstawienie w przystępny sposób historii liczenia i komputerów.
C2. Opis wewnętrznej struktury komputerów i podstawowych algorytmów wykonywania obliczeń na liczbach całkowitych i zmiennoprzecinkowych; omówienie przyczyn i natury powstających błędów podczas operacji arytmetycznych
C3. Przedstawienie istoty algorytmu, sposobów zapisu algorytmów, prezentacja podstawowych metod tworzenia algorytmów. Omówienie istoty błędów oprogramowania i podstaw złożoności obliczeniowej algorytmów.
C4. Przedstawienie podstawowych pojęć z zakresu ochrony własności intelektualnej, prawa autorskiego, prawa patentowego i znaków towarowych

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - W wyniku przeprowadzonych zajęć student powinien być w stanie zdefiniować podstawowe pojęcia związane z informacją i jej przetwarzaniem
PEU_W02 - Po zakończeniu kursu student powinien być w stanie opisać i wytłumaczyć algorytmy oraz podstawowe sposoby ich konstruowania, a także zdefiniować różne przyczyny powstawania błędów oraz sposoby ich usuwania.
PEU_W03 - Ma elementarną wiedzę w zakresie ochrony własności intelektualnej oraz prawa patentowego.

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Program kursu. Wymagania. Sposób zaliczenia. Informacja.	2
Wy2	Krótka historia matematyki i historia rozwoju systemów komputerowych.	2
Wy3	Arytmetyka komputerów	2
Wy4	Arytmetyka liczb niecałkowitych; błędy absolutne	2
Wy5	Architektura komputerów	2
Wy6	Wprowadzenie do algorytmów	2
Wy7	Algorytmy (część I)	2
Wy8	Sposób zapisu algorytmów (Algorytmy część II)	2
Wy9	Maszyna Turinga (Algorytmy part III)	2
Wy10	Metody algorytmiczne (Algorytmy część IV)	2
Wy11	Czy komputery mogą się mylić?	1
Wy12	Złożoność obliczeniowa	1
Wy13	Zarys prawa Autorskiego	2

Wy14	Zarys prawa patentowego	2
Wy15	Znaki towarowe	2
Wy16	Kolokwium zaliczeniowe	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01-PEU_W03, PEU_K01	kolokwium zaliczeniow
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

1. Harel D., Feldman Y.A.: Rzecz O Istocie Informatyki: Algorytmika Wydawnictwa Naukowo-Techniczne
2. Gleick J.: Informacja. Bit, wszechświat, rewolucja, Znak

LITERATURA UZUPEŁNIAJĄCA

1. Michniewicz, G.,Ochrona własności intelektualnej, PWN
2. Żelazowska W., Prawo własności przemysłowej, C.H. Beck

OPIEKUN PRZEDMIOTU

dr inż. Wojciech Myszka tel.: +48(71)3203269 email: Wojciech.Myszka@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Chemistry (Chemia)**
Nazwa przedmiotu w języku angielskim: **Chemistry**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3076**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	2				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. zakres chemii i fizyki szkoły średniej

CELE PRZEDMIOTU

C1. Zapoznanie studentów z tymi działami chemii, których znajomość jest potrzebna w toku dalszego studiowania przedmiotów pokrewnych z chemią np. materiałoznawstwa, metaloznawstwa, tworzyw sztucznych.
C2. Zapoznanie studentów z podstawową wiedzą chemiczną umożliwiającą zrozumienie praw i reguł chemicznych oraz właściwości fizykochemicznych materiałów stosowanych w technice ze szczególnym uwzględnieniem metali, stopów i polimerów.
C3. Nabycie przez studentów umiejętności łączenia wiedzy z zakresu chemii i takich przedmiotów jak na przykład fizyka, materiałoznawstwo, ekologia.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Ma podstawową wiedzę chemiczną z zakresu budowy materii, stanów skupienia. Zna właściwości substancji w poszczególnych stanach skupienia.
PEU_W02 - Ma podstawową wiedzę z zakresu chemii nieorganicznej z szczególnym uwzględnieniem budowy metali, stopów, przewodnictwa elektronowego. Ma podstawową wiedzę z zakresu chemii organicznej ze szczególnym uwzględnieniem paliw oraz polimerów.
PEU_W03 - Ma podstawową wiedzę z zakresu optyki i nanotechnologii.

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Budowa atomu, kryteria podziału i struktura materii, pierwiastki, związki.	2
Wy2	Układ okresowy pierwiastków, struktura, grupy pierwiastków, konfiguracja elektronowa, odmiany alotropowe, izotopy.	4
Wy3	mechanizmy wiązania chemicznego (jonowe, atomowe, metaliczne), charakterystyka przykładowych materiałów jonowych, kowalencyjnych i metalicznych, przyczyny ich właściwości.	2
Wy4	Charakterystyka podstawowych stanów skupienia; analiza przyczyn i skutków takich wielkości jak ciśnienie, dyfuzja, gęstość, lepkość, napięcie powierzchniowe, zwilżalność; wstępna charakterystyka ciał amorficznych i krystalicznych	4
Wy5	Metale - przyczyny plastyczności, przewodnictwa elektronowego i cieplnego, połysku i nieprzeźroczystości; charakterystyka stopów - kryteria podziału, budowa, zastosowanie podstawowych stopów	4
Wy6	Przewodnictwo - teoria pasmowa, nadprzewodniki, mechanizm przewodzenia prądu w półprzewodnikach "p" i "n"	2

Wy7	Mieszaniny - kryteria podziału, charakterystyka roztworów właściwych (mechanizmy rozpuszczalności), koloidów i zawiesin, mechanizm rozproszenia światła, stężenia	2
Wy8	Elementy krystalografii, komórka elementarna, centrowanie, elementy symetrii, defekty struktury.	4
Wy9	Podstawy chemii organicznej: węglowodory, izomery, gaz ziemny, ropa naftowa - produkty; wstęp do polimerów, charakterystyka wybranych materiałów polimerowych	4
Wy10	Zajęcia zaliczeniowe – kolokwium.	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. wykład informacyjny
N2. wykład tradycyjny z wykorzystaniem transparencji i slajdów
N3. konsultacje
N4. praca własna – samodzielne studia i przygotowanie do egzaminu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01 - PEU_W03	kolokwium zaliczeniowe
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
Wiarygodne strony internetowe, notatki z wykładu

LITERATURA UZUPEŁNIAJĄCA
opracowania tematyczne dotyczące prezentowanych na Wykładzie zagadnień

OPIEKUN PRZEDMIOTU
dr hab. Marek Jasiorski tel.: 320-32-21 email: marek.jasiorski@pwr.edu.pl

Wydział Mechaniczny PWR   Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Theory of Machines (Maszynoznawstwo)**
Nazwa przedmiotu w języku angielskim: **Theory of Machines**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3077**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	1				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Student ma uporządkowaną wiedzę na temat procesów fizycznych i chemicznych w zakresie szkoły średniej.
2. Student posiada elementarną umiejętność kojarzenia zasad działania wybranych maszyn i pojazdów ze znanymi prawami fizyki i chemii jako podstawy ich funkcjonowania.
3. Student potrafi wykorzystywać posiadaną wiedzę do analizy sposobów działania prostych układów mechanicznych.

CELE PRZEDMIOTU

C1. Poznanie ogólnych zasad działania maszyn i urządzeń oraz ich roli we współczesnym świecie.
C2. Nabycie wiedzy i umiejętności analizy materialnej i funkcjonalnej postaci (struktury) maszyny. Określenie relacji między silnikiem, organami roboczymi i układem napędowym. Zapoznanie się z dyrektywą maszynową UE i jej wymaganiami.
C3. Nabycie podstawowej wiedzy w zakresie związków maszyny z otoczeniem technicznym, będących podstawą procesu konstrukcji maszyn.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Rozumie rolę maszyn i urządzeń we współczesnej technice. Zna podstawowe zasady działania i budowy maszyn roboczych i pojazdów oraz silników jako źródeł energii mechanicznej.
PEU_W02 - W wyniku przeprowadzonych zajęć student ma świadomość struktury podziału maszyn ze względu na funkcję oraz konstrukcję, umiejąc jednocześnie dokonać identyfikacji poszczególnych podzespołów maszyn oraz układów maszynowych.

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie. Omówienie zakresu wykładu i wymagań zaliczeniowych. Rola techniki w rozwoju cywilizacji.	1
Wy2	Pojęcie techniki i systemu technicznego. Macierz transformacji materii, energii i informacji. Definicje maszyn: klasyczna, funkcjonalna oraz UE.	2
Wy3	Analogie występujące pomiędzy środowiskami fizycznymi.	1
Wy4	Klasyfikacja maszyn. Przykłady maszyn i systemów maszynowych.	2
Wy5	Konstrukcja, zasada działania oraz podstawowe parametry silników stosowanych w napędach maszyn.	2
Wy6	Pojęcie układu napędowego. Funkcje realizowane przez układy napędowe maszyn i urządzeń oraz ich struktura. Przykładowe charakterystyki obciążeń.	2
Wy7	Typowe elementy wykorzystywane w konstrukcji maszyn.	2
Wy8	Podstawy systemów sterowania maszyn, układy automatycznej regulacji, pojęcie systemu mechatronicznego. Podstawowe definicje i struktura układów mechatronicznych.	2
Wy9	Pisemne kolokwium zaliczeniowe.	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład informacyjny N2. prezentacja multimedialna

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02	kolokwium
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
[1] Biały W.: Maszynoznawstwo. WNT, Warszawa 2003.
[2] Chwiej M. Maszynoznawstwo ogólne. PWN, Warszawa 1983 (IV wyd.).
[3] Wołek M.: Maszynoznawstwo ogólne. PWN, Warszawa 1978.
[4] Orlik Z.: Maszynoznawstwo. WSziP, Warszawa 1989.
[5] Gnutek Z., Kordylewski W.: Maszynoznawstwo energetyczne. Wyd. Politechniki Wrocławskiej, Wrocław 2003.
[6] Mille A., Kijewski J., Pawlik K., Szolc T.: Maszynoznawstwo. WSziP, Warszawa 2003.
[7] Olszewska M. (red.): Podstawy mechatroniki. Wyd. REA. Warszawa 2006.
[8] Schmid D. (red.): Mechatronika. Wyd. REA. Warszawa 2002.

LITERATURA UZUPEŁNIAJĄCA
[1]Hryniewicz A.: Energia. Wyzwanie XXI wieku. Wyd. Uniwersytetu Jagielońskiego, Kraków 2002.
[2]Krick E.U.: Wprowadzenie do techniki i projektowania technicznego. WNT, Warszawa 1975.
[3]Szumanowski A.: Czas energii. WKiŁ, Warszawa 1988.
[4]Charles Panati: Niezwykłe dzieje zwykłych rzeczy. Książka i Wiedza, Warszawa 2004.
[5]Encyklopedia Techniki. MUZA SA.
[6] Pritschow G.: Techika sterowania obrabiarkami i robotami przemysłowymi. Oficyna Wyd. Politechniki Wrocławskiej 1993.
[7] Ochoa G., Corey M.: Kalendarium nauki i techniki. Wyd. Zysk i S-ka, Poznań.

OPIEKUN PRZEDMIOTU

dr inż. Tomasz Siwulski tel.: 71 320-28-92 email: tomasz.siwulski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Engineering Graphics: Engineering Drawing (Grafika inżynierska - zapis konstrukcji)**

Nazwa przedmiotu w języku angielskim: **Engineering Graphics: Engineering Drawing**

Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**

Specjalność (jeśli dotyczy): **Mechanical engineering design**

Poziom i forma studiów: **I stopień, stacjonarne**

Rodzaj przedmiotu: **obowiązkowy**

Kod przedmiotu: **W10MBM-SI3078**

Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15			30	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30			60	
Forma zaliczenia	Zaliczenie na ocenę			Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	1			2	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				2	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6			1.4	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Podstawowa wiedza z zakresu geometrii wykreślnej
2. Podstawowe umiejętności rysowania i obsługi sprzętu komputerowego.
3. Umiejętność korzystania z zasobów cyfrowych internetu.

CELE PRZEDMIOTU

C1. Nabycie wiedzy i umiejętności w zakresie rzutowania prostokątnego w odwzorowaniu elementów przestrzeni na płaszczyźnie z wykorzystaniem widoków i przekrojów oraz zasad zapisu konstrukcji.
C2. Nabycie wiedzy i umiejętności w zakresie wymiarowania i tolerowania wymiarów elementów maszynowych, a także oznaczania ich cech powierzchni oraz tolerancji kształtu i położenia.
C3. Nabycie wiedzy i umiejętności w zakresie graficznego przedstawiania połączeń elementów maszyn oraz zasad normalizacji w zapisie konstrukcji, a także zapisu elementów (rysunki wykonawcze) i złożonych układów (rysunki złożeniowe) oraz zasad schematyzacji.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Student zna i jest w stanie objaśnić reguły zapisu konstrukcji i tworzenia dokumentacji technicznej elementów i podzespołów urządzeń mechanicznych.
PEU_W02 - Student wie jak nazwać podstawowe parametry charakteryzujące geometryczne cechy wytworu oraz zaproponować jak te informacje zapisać.
PEU_W03 - Student zna zasady graficznego przedstawienie połączeń elementów maszyn oraz zapisu znormalizowanych elementów maszyn.

II. Z zakresu umiejętności:
PEU_U01 - Student umie sporządzić sposobem odręcznym i komputerowo (CAD) rysunkową dokumentację techniczną oraz schematyzację układów technicznych.
PEU_U02 - Student umie odczytywać zapis dokumentacji technicznej elementu maszynowego i złożonych układów technicznych oraz zapis schematyczny.
PEU_U03 - Student umie identyfikować i zapisać podstawowe połączenia elementów maszyn.

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie. Zasady zapisu konstrukcji. Normalizacja w dokumentacji technicznej. Rzuty prostokątne i aksonometryczne. Kompozycja rysunku.	2
Wy2	Rodzaje widoków w rysunku technicznym. Zastosowanie przekrojów i kładów. Przedstawianie szczegółów.	2
Wy3	Zapis układu wymiarów. Reguły i zasady wymiarowania elementów maszyn. Sposoby zapisu wymiarów tolerowanych oraz pasowań.	2
Wy4	Przedstawianie chropowatości powierzchni. Tolerancje kształtu, położenia oraz tolerancje złożonych.	2
Wy5	Zapis graficzny podstawowych połączeń maszyn - połączenia rozłączne i nierozłączne. Zapis znormalizowanych elementów maszyn.	2
Wy6	Rodzaje rysunków w zapisie konstrukcji. Rysunek wykonawczy, złożeniowy. Zapis schematyczny.	2

Wy7	Kolokwium zaliczeniowe	2
Wy8	Omówienie kolokwium i podsumowanie kursu.	1
		Suma: 15
Forma zajęć – Projekt		Liczba godzin
Proj1	Wprowadzenie. Podstawowe zasady tworzenia rysunku z wykorzystaniem techniki komputerowej. Wykonywanie prostych rysunków z wykorzystaniem programu komputerowego (CAD): organizacja edytora graficznego, podstawowe funkcje rysowania (linia, okrąg, łuk itp.)	2
Proj2	Podstawowe techniki rysunku odręcznego - linia, łuk, okrąg, elipsa. Rysowanie prostych elementów maszyn.	2
Proj3	Widoki elementów maszyn na podstawie rysunków aksonometrycznych. Szkic techniczny odręczny. Kompozycja rysunku. Rysunek komputerowy (funkcje edycji i modyfikacji rysunków)	2
Proj4	Widoki elementów maszyn o większym stopniu złożenia. Rysunek komputerowy (funkcje edycji i modyfikacji rysunków - kontynuacja)	2
Proj5	Przekroje prostych elementów maszyn. Rysowanie elementów symetrycznych (półwidok-półprzekrój).	2
Proj6	Rysowanie obrotowych elementów maszyn (wałki, tuleje). Przekroje i kłady.	2
Proj7	Rysunek wykonawczy. Wymiarowanie. Zasady wymiarowania. Tolerancje. Opis powierzchni.	2
Proj8	Zapis graficzny połączeń spawanych oraz połączeń klejonych. Rysunek wykonawczy elementu typu rama, korpus lub podpora składającego się z części połączonych metodą spawania lub klejenia.	2
Proj9	Zapis graficzny połączeń gwintowych. Rysunek zespołu elementów zawierających połączenie gwintowe.	2
Proj10	Kolokwium zaliczeniowe	2
Proj11	Zadanie konstrukcyjne - omówienie tematu. Szkic konstrukcyjny zespołu maszynowego stanowiącego treść zadania.	2
Proj12	Zadanie konstrukcyjne. Rysunek złożeniowy zespołu maszynowego.	2
Proj13	Zadanie konstrukcyjne. Rysunki wykonawcze elementów zespołu maszynowego.	2
Proj14	Zadanie konstrukcyjne. Rysunki wykonawcze elementów zespołu maszynowego. Rysunek schematyczny.	2
Proj15	Ocena zadań konstrukcyjnych. Zaliczenie.	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem technik multimedialnych N2. praca własna - przygotowanie do projektu N3. dyskusja problemowa N4. samodzielne rozwiązywanie zadań rysunkowych pod kierunkiem prowadzącego.

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	kartkówki (quizy) po wykładach
F2	PEU_W01, PEU_W02, PEU_W03	kolokwium
P = 0.1*F1+0.9*F2		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01-PEU_U03	kolokwium
F2	PEU_U01-PEU_U03	Ocena zadania konstrukcyjnego
F3	PEU_U01-PEU_U03	Ocena zadań rozwiązywanych na zajęciach
P = 0.6*F1+0.3*F2+0.1*F3		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
[1] Giesecke F. et al. Technical Drawing with Engineering Graphics. 15th Edition. — Prentice Hall, 2016
[2] Stefano Tornincasa. Technical Drawing for Product Design. Springer Nature Switzerland AG, 2021
[3] David Madsen. Engineering Drawing and Design. Cengage Learning, Inc; Edycja 6, 2016
[4] Supporting materials for the lecture, e.g. ePortal WUST

LITERATURA UZUPEŁNIAJĄCA
[1] Websites for AutoCAD learning eg.
https://autocad-beginners.blogspot.com/2018/01/content-of-autocad-tutorials.html

OPIEKUN PRZEDMIOTU

Prof. dr hab. inż. Wojciech Wieleba tel.: +4871 320-27-74 email: wojciech.wieleba@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Engineering Materials Technology (Technologia materiałów inżynierskich)**

Nazwa przedmiotu w języku angielskim: **Engineering Materials Technology**

Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**

Specjalność (jeśli dotyczy): **Mechanical engineering design**

Poziom i forma studiów: **I stopień, stacjonarne**

Rodzaj przedmiotu: **obowiązkowy**

Kod przedmiotu: **W10MBM-SI3079**

Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60		60		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	2		2		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			2		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2		1.4		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma podstawową wiedzę z dziedzin fizyki i matematyki. Potrafi posługiwać się podstawowymi przyrządami pomiarowymi, np. suwmiarką.
2. Potrafi analizować informacje, które są zawarte w instrukcjach do ćwiczeń laboratoryjnych.
3. Wykazuje umiejętność pracy w zespole.

CELE PRZEDMIOTU

C1. Poznanie procesów metalurgicznych przetwarzania rud metali, otrzymywania stali i metali nieżelaznych.
C2. Poznanie podstawowych metod badania właściwości mechanicznych stali i metali nieżelaznych oraz zasad formowania wyrobów metodami metalurgii proszków.
C3. Nabywanie i utrwalanie kompetencji społecznych polegających na umiejętności pracy w grupie studenckiej mającej na celu efektywne rozwiązywanie problemów.
C4. Nabycie wiedzy o podstawowych właściwościach mechanicznych materiałów inżynierskich, takich jak: wytrzymałość na rozciąganie, wytrzymałość na ściskanie, udarność, twardość poprzez udział w badaniach wybranych materiałów.
C5. Nabycie wiedzy o sposobach wykonywania badań nieniszczących, takich jak: metody wizualne, penetracyjne, magnetyczne, radiologiczne i ultradźwiękowe poprzez udział w ich przeprowadzaniu na przykładowych częściach.
C6. Nabycie wiedzy w zakresie prób technologicznych oraz formowania wyrobów metodą metalurgii proszków poprzez udział w eksperymencie.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - W wyniku przeprowadzonych zajęć wykładowych student powinien być w stanie zdefiniować podstawowe właściwości fizyczne materiałów inżynierskich, wymienić i opisać sposoby przetwarzania rud metali, scharakteryzować procesy metalurgiczne otrzymywania metali i stopów metali.
PEU_W02 - W wyniku przeprowadzonych zajęć laboratoryjnych student powinien być w stanie zdefiniować właściwości mechaniczne metali i stopów, opisać metody badań niszczących i nieniszczących, scharakteryzować metody przeprowadzania prób technologicznych.
PEU_W03 - W wyniku przeprowadzonych zajęć student powinien być w stanie rozróżniać podstawowe materiały inżynierskie, scharakteryzować ich właściwości fizyczne i mechaniczne, zidentyfikować metody badań właściwości materiałów inżynierskich.

II. Z zakresu umiejętności:
PEU_U01 - W wyniku przeprowadzonych wykładów student powinien umieć analizować procesy metalurgiczne otrzymywania metali, porównywać właściwości materiałów inżynierskich.
PEU_U02 - W wyniku przeprowadzonych zajęć laboratoryjnych student powinien umieć przeprowadzić w ograniczonym zakresie podstawowe próby wytrzymałościowe rozciągania, ściskania, udarności i pomiarów twardości oraz próby technologiczne.
PEU_U03 - W wyniku przeprowadzonych zajęć student powinien umieć pozyskiwać informacje z literatury, mieć umiejętność samokształcenia się, wykonać pomiary, wyznaczać wartości oraz oceniać pewność podstawowych właściwości mechanicznych.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Wykazuje umiejętności potrzebne w zespołowej współpracy dotyczącej doskonalenia metod wyboru strategii mającej na celu optymalne rozwiązywanie powierzonych grupie problemów.
PEU_K02 - Potrafi obiektywnie oceniać argumenty, racjonalnie tłumaczyć i uzasadniać własny punkt widzenia z wykorzystaniem wiedzy z zakresu podstawowych zagadnień inżynierii materiałowej.
PEU_K03 - Przestrzega obyczaje i zasady obowiązujące w środowisku akademickim.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład	Liczba godzin

Wy1	Sprawy organizacyjne.	1
Wy2	Ogólne wiadomości o właściwościach materiałów inżynierskich. Materiały ogniotrwałe i paliwa w procesach pirometalurgicznych.	2
Wy3	Metalurgia żelaza. Przetwórstwo rud, proces wielkopiecowy.	2
Wy4	Wytwarzanie stali, wpływ domieszek na właściwości stali.	2
Wy5	Metalurgia miedzi. Przetwórstwo rud, procesy pirometalurgiczne i hydrometalurgiczne wytwarzania miedzi i ich stopów.	2
Wy6	Metalurgia aluminium. Przetwórstwo rud, procesy otrzymywania tlenku aluminium i wytwarzania oraz rafinacji aluminium.	2
Wy7	Metalurgia cynku. Przetwórstwo rud, procesy pirometalurgiczne i hydrometalurgiczne wytwarzania cynku i jego stopów.	2
Wy8	Otrzymywanie metali trudnotopliwych metodami metalurgii proszków oraz techniki wytwarzania wyrobów z proszków metali.	2
		Suma: 15
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Sprawy organizacyjne, warunki BHP.	1
Lab2	Ogólne wiadomości o metalach i stopach technicznych - wytwarzanie stopów.	2
Lab3	Statyczna próba rozciągania metali.	2
Lab4	Styczna próba ściskania metali i próba udarności.	2
Lab5	Pomiary twardości metali i stopów.	2
Lab6	Badania nieniszczące.	2
Lab7	Próby technologiczne.	2
Lab8	Wytwarzanie elementów maszyn z proszków metali.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. praca własna – przygotowanie do laboratorium N3. eksperyment laboratoryjny N4. przygotowanie sprawozdania N5. praca własna – samodzielne studia i przygotowanie do egzaminu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się

F1	PEU_W01, PEU_W02, PEU_W03	Kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01-PEU_U03, PEU_K01-PEU_K03	Odpowiedzi ustne, kartkówki
P = średnia z F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA 1. Mirski Z., Technologia i badanie materiałów inżynierskich : laboratorium. Oficyna Wydawnicza Politechniki Wrocławskiej, 2017. 2. Krynicki L., L. Sozański, Technologia metali. Wydawnictwo Politechniki Wrocławskiej, 1994. LITERATURA UZUPEŁNIAJĄCA Materiały uzupełniające do ćwiczeń nr 1-5. Biblioteka W10 (bud. B4, III piętro).

OPIEKUN PRZEDMIOTU
dr inż. Tomasz Wojdat tel.: (71) 320 40 68 email: tomasz.wojdat@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Thermodynamics (Termodynamika techniczna)**
Nazwa przedmiotu w języku angielskim: **Applied thermodynamics**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3080**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60		60		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	2		2		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			2		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2		1.4		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Znajomość zagadnień objętych programem nauczania fizyki w zakresie przedmiotu Fizyka
2. Umiejętność samodzielnego wykonywania ćwiczeń laboratoryjnych, poparta elementarną sprawnością manualną
3. Świadomość konieczności pracy grupowej i umiejętność jej realizacji

CELE PRZEDMIOTU

C1. W oparciu o prawa termodynamiki zrozumienie zasad przemian gazowych i możliwości ich wykorzystania w technice
C2. Znajomość podstaw działania maszyn energetycznych i umiejętność wyznaczania ich sprawności
C3. Znajomość podstaw działania maszyn przepływowych oraz podstaw termodynamiki przepływów naddźwiękowych
C4. Znajomość podstaw działania sprężarek i umiejętność wyznaczania ich sprawności

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Ma podstawową wiedzę z zakresu fizyki umożliwiającą wyjaśnienie faktów oraz zjawisk zachodzących w świecie przyrody i w technice
PEU_W02 - Potrafi interpretować i analizować obiegi maszyn energetycznych

II. Z zakresu umiejętności:
PEU_U01 - Potrafi rozwiązywać zadania i problemy w oparciu o zdobytą wiedzę oraz informacje pozyskane z literatury naukowo-technicznej w języku polskim i angielskim, baz danych i innych źródeł
PEU_U02 - Potrafi prowadzić obliczenia maszyn energetycznych w oparciu o zmienne parametry termodynamiczne

III. Z zakresu kompetencji społecznych:
PEU_K01 - Rozumie znaczenie wykorzystywania metod matematycznych w reprezentowanej dyscyplinie inżynierskiej.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Podstawowe definicje: parametry lokalne, parametry globalne, parametry właściwe, ciśnienie, temperatura, zerowa zasada termodynamiki	2
Wy2	Równanie stanu gazu doskonałego. Równanie stanu gazu rzeczywistego	2
Wy3	Przemiany termodynamiczne. Ciepło przemiany. Pracy przemian - praca absolutna, techniczna i użyteczna	2
Wy4	Pojemność cieplna ciała przy stałym ciśnieniu i stałej objętości. Zmiana energii wewnętrznej. Zmiana entalpii.	2
Wy5	Bilans energii. Pierwsza zasada termodynamiki dla układów otwartych i zamkniętych.	2
Wy6	Równanie politropy. Praca i ciepło przemiany politropowej. Przemiany charakterystyczne – praca i ciepło przemian charakterystycznych	3
Wy7	Druga zasada termodynamiki. Entropia. Podstawy obiegów termodynamicznych i ich sprawność. Obieg Carnota.	3

Wy8	Obiegi porównawcze maszyn energetycznych. Sprawność obiegów porównawczych	4
Wy9	Sprężarki tłokowe i rotodynamiczne, wykres indykatorowy i praca sprężarki.	2
Wy10	Termodynamika przepływów ściśliwych. Bilans energii dla przepływów ściśliwych. Pierwsza zasada termodynamiki dla przepływów ściśliwych	2
Wy11	Przepływ gazów przez dysze, równanie Bernoullego, dynamiczne działanie strugi, wyznaczanie lokalnej prędkości dźwięku	2
Wy12	Podstawowe prawa dotyczące przekazywania ciepła na drodze konwekcji, promieniowania, przewodzenia	2
Wy13	Zaliczenie	2
		Suma: 30

Forma zajęć – Laboratorium		Liczba godzin
Lab1	Wyznaczenie ciepła właściwego gazu dla przemiany politropowej	2
Lab2	Wyznaczanie współczynnika korekcyjnego dla przemiany adiabatycznej	2
Lab3	Wyznaczenie sprawności wolumetrycznej sprężarki tłokowej	2
Lab4	Badanie procesu adiabatycznego wypływu z dyszy. Wyznaczenie elipsy Bendemanna	3
Lab5	Badanie przemiany izotermicznej. Praktyczna realizacja prawa Boyle'a Mariotte'a	2
Lab6	Badanie procesu przenikania ciepła przez przegrodę płaską przy: a) występowaniu konwekcji i promieniowania, b) zastosowaniu ekranu osłabiającego promieniowanie	2
Lab7	Izobaryczne ogrzewanie z wykorzystaniem regeneracji ciepła	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład informacyjny N2. wykład problemowy N3. praca własna – samodzielne studia i przygotowanie do egzaminu N4. konsultacje N5. praca własna – przygotowanie do laboratorium

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_K01	Kolokwium

P = F1

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_K01, PEU_U01, PEU_U02	Kartkówka, sprawozdanie z zajęć laboratoryjnych
F2	PEU_K01, PEU_U01, PEU_U022	Kartkówka, sprawozdanie z zajęć laboratoryjnych
F3	PEU_K01, PEU_U01, PEU_U02	Kartkówka, sprawozdanie z zajęć laboratoryjnych
F4	PEU_K01, PEU_U01, PEU_U02	Kartkówka, sprawozdanie z zajęć laboratoryjnych
F5	PEU_K01, PEU_U01, PEU_U02	Kartkówka, sprawozdanie z zajęć laboratoryjnych
F6	PEU_K01, PEU_U01, PEU_U02	Kartkówka, sprawozdanie z zajęć laboratoryjnych
F7	PEU_K01, PEU_U01, PEU_U02	Kartkówka, sprawozdanie z zajęć laboratoryjnych
P = (F1+F2+F3+F4+F5+F6+F7)/7		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

[1] Szargut, Jan and Termodynamika Techniczna. Wydawnictwo Politechniki Śląskiej. Gliwice, 2009.
[2] Wiśniewski, Stefan. Termodynamika Techniczna. Wydawnictwa Naukowo-Techniczne, 1993.

LITERATURA UZUPEŁNIAJĄCA

[1] Tuliszka, E. and Z. Koszla-Olachowska. Termodynamika Techniczna: Zbiór Zadań : Praca Zbiorowa. Wydaw. Politechniki Poznańskiej, 1980.
[2] Teodorczyk, A. Zbiór Zadań Z Termodynamiki Technicznej. Wydawnictwa Szkolne i Pedagogiczne, 1992.

OPIEKUN PRZEDMIOTU

dr inż. Aleksander Górniak email: aleksander.gorniak@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Fundamentals of Materials Science (Podstawy materiałoznawstwa)**
Nazwa przedmiotu w języku angielskim: **Fundamentals of Materials Science**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3081**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60		30		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	2		1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2		0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Podstawy fizyki na poziomie szkoły średniej.
2. Podstawowa wiedza z chemii, umiejętność posługiwania się terminologią chemiczną.
3. Podstawowa wiedza z matematyki, umiejętność tworzenia i interpretacji równań i wykresów.

CELE PRZEDMIOTU

C1. Nabycie wiedzy o ważnych w technice grupach stopów metali, systemów ich oznaczania, własnościach oraz kryteriach ich stosowania w określonych warunkach eksploatacyjnych.
C2. Poznanie podstaw krystalografii i własności struktur krystalicznych.
C3. Nauczenie interpretacji i zastosowań wykresów równowagi faz w przewidywaniu i planowaniu własności i zastosowań materiałów. inżynierskich
C4. Poznanie struktur i własności stopów układu żelazo- cementyt.
C5. Nabycie wiedzy o budowie, własnościach i zastosowaniach tworzyw sztucznych, ceramiki i materiałów kompozytowych.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Zna grupy materiałów inżynierskich oraz kryteria ich klasyfikacji.
PEU_W02 - Zna podział stopów żelaza, potrafi interpretować ich mikrostruktury i określić właściwości.
PEU_W03 - Potrafi określić podstawowe własności i obszary zastosowań oraz grupy gatunków w obszarze tworzyw sztucznych, kompozytów i ceramik

II. Z zakresu umiejętności:
PEU_U01 - Potrafi zinterpretować mikrostruktury wyrobów po różnych procesach wytwarzania i powiązać je z właściwościami mechanicznymi.
PEU_U02 - Potrafi, na etapie projektowania, dobrać stal niestopową i żeliwo niestopowe, dokonać świadomego wyboru stanu dostawy oraz składu chemicznego.

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Własności mechaniczne i fizyczne materiałów metalicznych. Zależności między procesem wytwarzania, strukturą i właściwościami materiałów.	2
Wy2	Elementy krystalografii, wiązanie metaliczne, sieci krystaliczne metali.	2
Wy3	Defekty struktury krystalicznej.	2
Wy4	Równowaga i kryteria równowagi. Zarodkowanie i krystalizacja.	2
Wy5	Stopy. Budowa i rodzaje stopów. Fazy międzymetaliczne. Charakterystyka faz występujących w stopach metali.	2
Wy6	Wykresy równowagi fazowej układów dwuskładnikowych. Reguła faz.	2
Wy7	Wykres równowagi żelazo-cementyt. Analiza wykresu.	2
Wy8	Wpływ zawartości węgla na mikrostruktury i własności stopów żelaza.	2
Wy9	Klasyfikacja i zasady oznaczania stali niestopowych.	2
Wy10	Klasyfikacja i zasady oznaczania żeliw i staliw niestopowych.	2

Wy11	Polimery i tworzywa sztuczne – klasyfikacja, właściwości i zastosowanie.	2
Wy12	Ceramika i szkła – klasyfikacja, właściwości i zastosowanie.	2
Wy13	Materiały kompozytowe – klasyfikacja, właściwości i zastosowanie.	2
Wy14	Kolokwium zaliczeniowe	2
Wy15	Kolokwium zaliczeniowe	2
		Suma: 30
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Wprowadzenie. Cel i metody badań materiałów. Budowa i obsługa mikroskopu metalograficznego.	2
Lab2	Badania makroskopowe, analiza powierzchni przełomów, makrostruktury materiałów i wad pochodzenia technologicznego.	2
Lab3	Analiza wykresów równowagi układów dwuskładnikowych.	2
Lab4	Badania mikrostruktury stopów jedno i wielofazowych w stanie nietrawionym i trawiony.	2
Lab5	Analiza wykresu równowagi fazowej żelazo - cementyt.	2
Lab6	Wpływ zawartości węgla na mikrostruktury i właściwości stali i staliw.	2
Lab7	Żeliwa – klasyfikacja, mikrostruktury w stanie nietrawionym i trawionym, właściwości, zastosowanie.	2
Lab8	Podsumowanie i zaliczenie zajęć laboratoryjnych.	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. praca własna – samodzielne studia i przygotowanie do egzaminu N3. eksperyment laboratoryjny N4. praca własna – przygotowanie do laboratorium N5. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02	kartkówka
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
[1] Haimann.R; Metaloznawstwo; Wyd.PWr; 2000
[2] Dobrzański.L.A, Materiały inżynierskie i projektowanie materiałowe. Podstawy nauki o materiałach i metaloznawstwo, WNT, 2006
[3] Blicharski M., Wstęp do inżynierii materiałowej, WNT, 2012
[4] Dudziński W., Widanka K., Ćwiczenia laboratoryjne z materiałoznawstwa, Oficyna Wydawnicza PWr, 2012

LITERATURA UZUPEŁNIAJĄCA
[1] Dudziński W., Materiały konstrukcyjne w budowie maszyn, Wyd.PWr; 1994
[2] Ashby M. F., Jones D.R.H., Materiały inżynierskie, t. 1 i 2, WNT; 1996

OPIEKUN PRZEDMIOTU
dr hab. inż. Dominika Grygier tel.: 320-38-45 email: dominika.grygier@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Mechanics I (Mechanika I)**
Nazwa przedmiotu w języku angielskim: **Mechanics I**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3082**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30	30			
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60	60			
Forma zaliczenia	Zaliczenie na ocenę	Zaliczenie na ocenę			
Grupa kursów					
Liczba punktów ECTS	2	2			
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		2			
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2	1.4			

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Analiza matematyczna (różniczkowanie, całkowanie)
2. Algebra (na poziomie szkoły średniej) + algebra liniowa (macierze, wyznaczniki)
3. Geometria euklidesowa i trygonometria

CELE PRZEDMIOTU

C1. Rozwiązywanie problemów technicznych statycznych i kinematycznych w oparciu o prawa mechaniki klasycznej
C2. Wykonywanie statycznych analiz wytrzymałościowych elementów maszyn

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - potrafi zdefiniować podstawowe pojęcia w mechanice (siła, moment siły), zna równania mechaniki klasycznej w statyce, zna wybrane metody rozwiązywania kratownic, belek i ram,
PEU_W02 - posiada wiedzę z geometrii mas (momenty statyczne, bezwładności, dewiacji)
PEU_W03 - posiada wiedzę w zakresie podstawowych pojęć z kinematyki punktu i kinematyki ciała sztywnego (prędkość, przyspieszenie, liczba stopni swobody, równania toru i ruchu)

II. Z zakresu umiejętności:
PEU_U01 - potrafi rozwiązywać typowe konstrukcje inżynierskie (kratownice, belki, ramy) w warunkach obciążeń statycznych: reakcje w podporach, siły wewnętrzne (formie analitycznych funkcji i ich wykresów)
PEU_U02 - potrafi wyznaczyć położenia środków mas, momenty statyczne i momenty bezwładności podstawowych układów mechanicznych oraz główne centralne osie i momenty bezwładności w układzie płaskim
PEU_U03 - potrafi obliczać prędkości i przyspieszenia dowolnie wybranych punktów typowych układów mechanicznych i ich elementów

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Program, wymagania, literatura. Zarys algebry wektorów	2
Wy2	Siła, moment siły, wektor główny i moment główny układu sił, warunki równowagi, aksjomaty statyki. Zmiana bieguna momentu	2
Wy3	Zbieżny układ sił. Kratownice. Metoda wydzielania węzłów	2
Wy4	Wyznaczanie sił reakcji w przypadkach płaskich układów sił (zastosowania w belkach, kratownicach, płaskich ramach itp)	2
Wy5	Metoda Rittera wyznaczania sił w wybranych prętach kratownicy. Redukcja płaskiego układu sił. Metoda Culmanna.	2
Wy6	Siły wewnętrzne w belkach statycznie wyznaczalnych (metody analityczne)	2
Wy7	Wyznaczanie sił wewnętrznych w ramach	2
Wy8	Środki mas w układach dyskretnych i ciągłych. Momenty statyczne	2
Wy9	Momenty bezwładności, transformacja równoległa i obrotowa	2
Wy10	Główne centralne osie i momenty bezwładności w układzie płaskim	2
Wy11	Kinematyka punktu (tor, prędkość, przyspieszenie). Ruch krzywoliniowy, przyspieszenie styczne i normalne. Kinematyka w naturalnym układzie współrzędnych i układzie biegunowym	2
Wy12	Pojęcie ciała sztywnego. Stopnie swobody. Klasyfikacja ruchów ciała sztywnego. Wzory na prędkość i przyspieszenie w ruchu ogólnym	2
Wy13	Kinematyka ruchu obrotowego ciała sztywnego. Prędkość i przyspieszenie obrotowe. Ruch płaski. Metody wyznaczania prędkości w ruchu płaskim (chwilowy środek obrotu, centroida)	2

Wy14	Kolokwium 1	2
Wy15	Kolokwium 2	2
		Suma: 30
Forma zajęć – Ćwiczenia		Liczba godzin
Ćw1	Podstawowe działania na wektorach: sumowanie analityczne i wykreślne, mnożenie skalarne i wektorowe itp.	2
Ćw2	Wyznaczanie sił w prętach układów płaskich (kratownicach) metodą wydzielania węzłów z zastosowaniem równań równowagi węzłów oraz wykreślnie z zastosowaniem wieloboku sił	2
Ćw3	Wyznaczanie sił reakcji w podporach w dowolnych układach płaskich metodami analitycznymi	2
Ćw4	Wyznaczanie sił reakcji w podporach w układach przestrzennych (jeden przykład)	1
Ćw5	Wyznaczanie sił w dowolnie wybranych prętach kratownicy (metodą Rittera)	1
Ćw6	Wyznaczanie sił wewnętrznych w belkach	2
Ćw7	Wyznaczanie sił wewnętrznych w belkach (c. d). Belki z przegubami.	2
Ćw8	Wyznaczanie sił wewnętrznych w ramach (proste ramy płaskie co najwyżej z jednym węzłem)	2
Ćw9	Wyznaczanie środków mas i momentów statycznych	2
Ćw10	Wyznaczanie momentów bezwładności w układach płaskich dyskretno-ciągłych i momentów dewiacji względem dowolnej osi z zastosowaniem tw. Steinera	2
Ćw11	Wyznaczanie położenia głównych centralnych osi i wartości głównych centralnych momentów bezwładności w układach płaskich (jeden przykład)	2
Ćw12	Rozwiązywanie zadań z kinematyki punktu materialnego w kartezjańskim układzie odniesienia	2
Ćw13	Rozwiązywanie zadań z kinematyki ruchu obrotowego i postępowego ciała sztywnego	2
Ćw14	Wyznaczanie prędkości w ruchu płaskim ciała sztywnego. Metoda superpozycji i chwilowego środka obrotu dla prędkości.	2
Ćw15	Kolokwium 1	2
Ćw16	Kolokwium 2	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. ćwiczenia rachunkowe N3. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	sprawdzian pisemno-ustny
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Ćwiczenia)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03	sprawdzian pisemny
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

1. B. Gabryszewska, A. Pszonka: „Mechanika", cz. I, Statyka, PWr, 1988
2. J. Leyko :"Mechanika ogólna", Tom 1 Statyka i kinematyka, PWN 2022
3. J. Zawadzki, W. Siuta:„Mechanika ogólna", PWN, Warszawa 1971
4. J. Misiak : „Mechanika ogólna. Statyka i kinematyka". Tom I, WNT, Warszawa 1993
5. Cz. Witkowski, „Zbiór zadań z mechaniki". Część I. „Kinematyka". PWr. 1999
6. Z. Jaśniewicz, „Zbiór zadań ze statyki", PWr. 1996
7. J. Nizioł: " Metodyka rozwiązywania zadań z mechaniki", PWN 2023

LITERATURA UZUPEŁNIAJĄCA

1. J. Giergiel : „Mechanika ogólna", WNT, Warszawa 1980
2. B. Skalmierski: „Mechanika" PWN, Warszawa 1977
3. S. Piasecki, J. Rżysko: „Mechanika" WNT, Warszawa 1977,
4. W. Siuta: „Mechanika techniczna", WNT, Warszawa 1968

OPIEKUN PRZEDMIOTU

dr hab. inż. Daniel Lewandowski tel.: 320-28-99 email: daniel.lewandowski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Ecology (Ekologia)**
Nazwa przedmiotu w języku angielskim: **Ecology**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3083**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	1				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma podstawową wiedzę w zakresie szkoły średniej z chemii, biologii, ekologii.
2. Posługuje się literaturą przedmiotu, wykorzystując zarówno podręczniki jak i wiarygodne źródła internetowe.

CELE PRZEDMIOTU

C1. Zapoznanie z zagadnieniami z zakresu ekologii oraz ochrony środowiska.
C2. Poznanie zagrożeń wynikających z działalności człowieka.
C3. Poznanie nowoczesnych rozwiązań służących ochronie środowiska.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Ma wiedzę na temat zagrożeń wynikających z działalności przemysłowej
PEU_W02 - Zna podstawowe konwencje międzynarodowe i polskie akty prawne w dziedzinie ochrony środowiska.
PEU_W03 - Potrafi scharakteryzować nowoczesne rozwiązania służące ochronie środowiska.

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:
PEU_K01 - Ma świadomość ważności zrozumienie pozatechnicznych skutków działalności człowieka, w tym jej wpływu na środowisko i związanej z tym odpowiedzialności za podejmowane decyzje.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie do przedmiotu - Ekologiczne problemy współczesnego świata.	1
Wy2	Konwencjonalne źródła energii (węgiel, ropa naftowa i gaz ziemny) i ich wpływ na środowisko.	2
Wy3	Odnawialne źródła energii (energia słoneczna, wiatru, wody, geotermalna).	2
Wy4	Sposoby magazynowania energii.	1
Wy5	Biomasa i biopaliwa	1
Wy6	Przyczyny i skutki zanieczyszczenia powietrza (efekt cieplarniany, dziura ozonowa, smog, kwaśne deszcze).	2
Wy7	Ekologiczne rozwiązania stosowane w samochodach (katalizator, DPF, EGR, sonda lambda). Samochody zeroemisyjne.	1
Wy8	Zanieczyszczenia wody. Oczyszczanie ścieków i uzdatnianie wody	2
Wy9	Zanieczyszczenie i degradacja gleby. Utrata bioróżnorodności.	1
Wy10	Kolokwium zaliczeniowe.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. konsultacje
N2. prezentacja multimedialna

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01 ÷ PEU_W03	Kolokwium pisemne
F2	PEU_K01	
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA Wiarygodne źródła internetowe LITERATURA UZUPEŁNIAJĄCA

OPIEKUN PRZEDMIOTU
dr hab. Agnieszka Baszczuk tel.: 320-32-21 email: agnieszka.baszczuk@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Programming in MATLAB (Informatyka podstawy programowania Matlab)**

Nazwa przedmiotu w języku angielskim: **Programming in MATLAB**

Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**

Specjalność (jeśli dotyczy): **Mechanical engineering design**

Poziom i forma studiów: **I stopień, stacjonarne**

Rodzaj przedmiotu: **obowiązkowy**

Kod przedmiotu: **W10MBM-SI3084**

Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				30	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				60	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				2	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				2	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				1.4	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma elementarną wiedzę w zakresie budowy komputera i jego elementów składowych oraz na temat systemów operacyjnych i zasad budowy algorytmów.
2. Ma wiedzę w zakresie matematyki, obejmującą podstawowe zagadnienia z algebry, analizy i geometrii.
3. Posiada podstawową wiedzę na temat narzędzi CAE.

CELE PRZEDMIOTU

C1. Poznanie zasad programowania w systemie Matlab, w zastosowaniu do wykonywania obliczeń inżynierskich i naukowych.
C2. Poznanie zasad statystycznej analizy wyników eksperymentu oraz ich wizualizacji (grafika 2-D i 3-D) w środowisku Matlab.
C3. Poznanie zasad modelowania prostych systemów technicznych z wykorzystaniem modułu Simulink.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Student potrafi przeprowadzić obliczenia matematyczne w środowisku Matlab obejmujące m.in.: rachunek macierzowy oraz zagadnienia związane z rozwiązywaniem układów równań algebraicznych.
PEU_U02 - Student potrafi wykorzystać grafikę dwuwymiarową i trójwymiarową do wizualizacji danych eksperymentalnych i
wyników obliczeń.
PEU_U03 - Student potrafi zidentyfikować i skonstruować prosty model obiektu oraz przeprowadzić jego symulację w programie Matlab/Simulink.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Student potrafi analizować problemy i je rozwiązywać w sposób kreatywny z wykorzystaniem nowoczesnych narzędzi informatycznych.
PEU_K02 - Student potrafi korzystać z literatury zalecanej do kursu oraz samodzielnie wyszukiwać i poszerzać zdobytą wiedzę.
PEU_K03 - Student rozumie potrzebę systematycznej i samodzielnej pracy w celu opanowania niezbędnych umiejętności z zakresu kursu.

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Wprowadzenie do programowania w środowisku Matlab.	2
Proj2	Podstawy obliczeń algebraicznych i logicznych.	2
Proj3	Rachunek wektorowy i macierzowy w Matlabie.	2
Proj4	Programowanie przy zastosowaniu skryptów.	2
Proj5	Programowanie z wykorzystaniem funkcji.	2
Proj6	Wizualizacja danych eksperymentalnych z wykorzystaniem grafiki 2D i 3D.	2
Proj7	Instrukcje matematyczne typu polyfit, polyval. Moduł "curve fitting"	2
Proj8	Analiza statystyczna danych.	2
Proj9	Rozwiązywanie układów równań liniowych.	2
Proj10	Zapoznanie z biblioteką środowiska Simulink.	2

Proj11	Podstawy zastosowania Simulink w obszarze automatyki.	2
Proj12	Budowanie modeli i symulacja zjawisk fizycznych w środowisku Simulink.	2
Proj13	Kontrola i sterowanie modelem tempomatu.	2
Proj14	Regulator proporcjonalno-całkująco-różniczkujący w Simulink.	2
Proj15	Kolokwium.	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. ćwiczenia rachunkowe N2. konsultacje N3. praca własna - przygotowanie do projektu N4. ćwiczenia problemowe

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02, PEU_K03	Bieżaca ocena przygotowania do realizacji kolejnych tematów projektu. Sprawdzenie zdobytych wiadomości na podstawie zadań oraz sprawozdań. Kolkwium
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

MATLAB: an introduction with applications, Amos Gilat 2017

LITERATURA UZUPEŁNIAJĄCA

www.mathworks.com

OPIEKUN PRZEDMIOTU
dr inż. Dariusz Poroś tel.: 27-91 email: dariusz.poros@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Statistics for Engineers (Statystyka inżynierska)**
Nazwa przedmiotu w języku angielskim: **Statistics for Engineers**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3085**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15			15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30			30	
Forma zaliczenia	Zaliczenie na ocenę			Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	1			1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6			0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma podstawową wiedzę w zakresie matematyki potwierdzone pozytywnymi ocenami na świadectwie dojrzałości

CELE PRZEDMIOTU

C1. Zapoznanie studentów z modelami statystycznymi i możliwościami ich zastosowania
C2. Zapoznanie studentów z metodami statystycznymi i możliwościami ich zastosowań
C3. Zapoznanie studentów z z rozkładami prawdopodobieństwa i możliwościami ich zastosowań

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - zna podstawowe pojęcia i fakty z zakresu statystyki matematycznej
PEU_W02 - zna podstawowe rozkłady prawdopodobieństwa ich parametry i metody ich szacowania

II. Z zakresu umiejętności:
PEU_U01 - potrafi stosować analizę statystyczną do otrzymanych danych i wyciągać wnioski z przeprowadzonej analizy
PEU_U02 - potrafi stosować podstawowe narzędzia do określenia typu rozkładu prawdopodobieństwa oraz oszacować jego parametry

III. Z zakresu kompetencji społecznych:
PEU_K01 - nabywanie i utrwalanie kompetencji w zakresie rozumie konieczność samokształcenia, w tym poprawiania umiejętności koncentracji uwagi i skupienia się na rzeczach istotnych oraz rozwijania zdolności do samodzielnego stosowania posiadanej wiedzy i umiejętności oraz wyszukiwanie informacji oraz jej krytycznej analizy

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Statystyczne metody analizy danych – istota modelowania statystycznego. Opisowa analiza danych: formy reprezentacji danych statystycznych, miary położenia, zmienności, asymetrii i koncentracji.	2
Wy2	Opracowanie i prezentacja materiału statystycznego. Grupowanie danych – szeregi proste i rozdzielcze. Histogram i dystrybuanta empiryczna.	2
Wy3	Zmienne losowe i ich rozkłady. Charakterystyki liczbowe rozkładu. Wybrane rozkłady dyskretne i ciągłe.	2
Wy4	Estymacja przedziałowa. Przedziały ufności dla wartości średniej, wariancji, wskaźnika struktury.	2
Wy5	Hipotezy statystyczne parametryczne. Testowanie hipotez o wartości przeciętnej, o równości dwóch wartości przeciętnych. Testowanie hipotez o wskaźniku struktury i o równości dwóch wskaźników struktury. Testowanie hipotez o wariancji i o równości dwóch wariancji.	2
Wy6	Testowanie hipotez nieparametrycznych. Test zgodności chi-kwadrat, Kołmogorowa-Smirnowa. Test niezależności chi-kwadrat Pearsona.	2
Wy7	Analiza korelacji i regresji. Metoda najmniejszych kwadratów. Liniowa funkcja regresji. Estymacja parametrów funkcji regresji. Przedziały ufności parametrów regresji liniowej.	2
Wy8	Zaliczenie	1
		Suma: 15

Forma zajęć – Projekt		Liczba godzin
Proj1	Sprawy organizacyjne. Wprowadzenie do korzystania z arkusza kalkulacyjnego. Funkcje matematyczne i statystyczne Excela. Statystyka opisowa – obliczanie miar położenia, zmienności, asymetrii i koncentracji.	2

Proj2	Budowa szeregów rozdzielczych. Wyznaczanie parametrów szeregu rozdzielczego (średnia, odchylenie standardowe itp.). Graficzna prezentacja zbioru danych – histogram i dystrybuanta empiryczna oraz wykres ramkowy.	2
Proj3	Podstawowe rozkłady spotykane w statystyce matematycznej: rozkład normalny, wykładniczy, Weibulla itp. Wyznaczanie parametrów rozkładu. Określenie rodzaju rozkładu na podstawie histogramu i dystrybuanty.	2
Proj4	Obliczenia w zakresie estymacji punktowej i przedziałowej wartości oczekiwanej, wskaźnika struktury (frakcji), wariancji i odchylenia standardowego.	2
Proj5	Obliczenia w zakresie weryfikacji hipotez statystycznych. Parametryczne testy istotności dla wartości oczekiwanej i dla wariancji populacji generalnej. Test dla dwóch wariancji, dla dwóch średnich i dwóch wskaźników struktury.	2
Proj6	Obliczenia w zakresie nieparametrycznych testów istotności – test zgodności chi-kwadrat2 Pearsona, test zgodności lambda Kołmogorowa.	2
Proj7	Obliczenia w zakresie analiza korelacji i regresji. Metoda najmniejszych kwadratów. Liniowa funkcja regresji. Estymacja parametrów funkcji regresji. Przedziały ufności parametrów regresji liniowej.	2
Proj8	Zaliczenie	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. ćwiczenia rachunkowe N2. wykład tradycyjny z wykorzystaniem transparencji i slajdów N3. dyskusja problemowa

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02	Zaliczenie
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się

F1	PEU_U01, PEU_U02, PEU_K01	Zaliczenie
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
<u>LITERATURA PODSTAWOWA</u> [1] Bobrowski D: Probabilistyka w zastosowaniach technicznych. Warszawa 1986, WNT[2] Nowak R.: Statystyka dla fizyków. Warszawa 2002, Wydawnictwo Naukowe PWN[3] Ostasiewicz W. (red.): Statystyczne metody analizy danych. Wrocław 1999, Wydawnictwo AE we Wrocławiu[4] Zeliaś A., Pawełek B., Wanat S.: Metody statystyczne. Zadania i sprawdziany. Warszawa 2002, PWE <u>LITERATURA UZUPEŁNIAJĄCA</u> [1] Bąk I., Markowicz I., Mojsiewicz M., Wawrzyniak K.: Statystyka w zadaniach. Część I i II. Warszawa 2001. Wydawnictwo Naukowo-Techniczne[2] Cieciura M., Zacharski J.: Metody probabilistyczne w ujęciu praktycznym. Warszawa 2007, VIZJA PRESS&IT Sp. z o. o.[3] Dobosz M.: Wspomagana komputerowo statystyczna analiza wyników badań. Warszawa 2001, Akademicka Oficyna Wydawnicza EXIT.[4] Frątczak E., Gach-Ciepiela U., Babiker H.: Analiza historii zdarzeń. Elementy teorii, wybrane przykłady zastosowań. Warszawa 2005, Szkoła Główna Handlowa w Warszawie.[5] Kukiełka L: Podstawy badań inżynierskich. Warszawa 2002, Wydawnictwo Naukowe PWN. [6] Maliński M.: Statystyka matematyczna wspomagana komputerowo. Gliwice 2000, Wydawnictwo Politechniki Śląskiej [7] Paleczek W.: Metody analizy danych na przykładach. Częstochowa 2004, Politechnika Częstochowska[8] Turzeniecka D.: Ocena niepewności wyniku pomiarów. Poznań 1997, Wydawnictwo Politechniki Poznańskiej

OPIEKUN PRZEDMIOTU
dr hab. inż. Artur Kierzkowski tel.: 71 320-20-04 email: artur.kierzkowski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Engineering Graphics 3D (Grafika inżynierska 3D)**
Nazwa przedmiotu w języku angielskim: **Engineering Graphics 3D**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3086**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				30	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				60	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				2	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				2	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				1.4	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Wymagana jest wiedza z zakresu kursu "Grafika inżynierska - geometria wykreślna"
2. Wymagana jest wiedza z zakresu kursu "Grafika inżynierska - zapis konstrukcji"
3. Wymagane są podstawowe umiejętności obsługi sprzętu komputerowego

CELE PRZEDMIOTU

C1. Nabycie wiedzy i umiejętności w zakresie modelowania przestrzennego części i zespołów maszyn
C2. Nabycie wiedzy i umiejętności w zakresie badania i analiz maszyn i urządzeń na modelach wirtualnych (wirtualne prototypy)
C3. Nabycie wiedzy i umiejętności w zakresie wykonywania dokumentacji technicznej 2D części i zespołów na podstawie modeli 3D

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Student powinien umieć budować modele przestrzenne części maszyn
PEU_U02 - Student powinien umieć budować modele przestrzenne zespołów maszyn i urządzeń z modeli części oraz przeprowadzić analizy poprawności modeli i ich parametrów
PEU_U03 - Student powinien umieć wykonać dokumentację rysunkową 2D na podstawie modelu przestrzennego

III. Z zakresu kompetencji społecznych:
PEU_K01 - Student nabywa umiejętności ponoszenia odpowiedzialności za wykonaną pracę

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Wprowadzenie do modelowania bryłowego - podstawowe operacje modelowania brył,zasady tworzenia szkicu płaskiego, relacje w szkicu (relacje geometryczne i wymiarowe)	2
Proj2	Modelowania bryłowe podstawowe - zaawansowane operacje na szkicach płaskich, modelowanie bryłowe metodami wyciągnięcia	2
Proj3	Modelowanie bryłowe podstawowe - operacje na bryłach: fazowanie, zaokrąglanie, pochylanie ścian, elementy konstrukcyjne (punkt. oś, płaszczyzna), tworzenie żeber, kreator otworów, operacje powielania elementów brył	2
Proj4	Modelowania bryłowe podstawowe - zaawansowane operacje na szkicach płaskich - relacje funkcyjne parametrów, modelowanie bryłowe metodami obrotu, operacje obróbki modeli - modele skorupowe	2
Proj5	Modelowania bryłowe podstawowe - modelowanie bryłowe metodami obrotu, modele jedno i wielobryłowe	2
Proj6	Zaawansowane operacje bryłowe- wyciągnięcie po ścieżce, wyciągnięcie złożone, podział brył, części typu "zwój"	2
Proj7	Projekt zespołu: koncepcja, wykonanie części zespołu (urządzenia) poznanymi metodami modelowania i obróbki brył	2

Proj8	Projekt zespołu: przygotowanie do budowania zespołu - złożenia części, wiązania i relacje części w zespole	2
Proj9	Projekt zespołu: budowanie zespołu z modeli części, edycja części w zespole, biblioteki części standardowych	2
Proj10	Projekt zespołu: modelowanie części w środowisku zespołu, adaptacyjność części	2
Proj11	Projekt zespołu: analiza poprawności funkcjonalnej zespołu (analizy parametrów, analiza kinematyczna, analiza kolizji) usuwanie błędów projektowych, analizy obciążeń	2
Proj12	Projekt zespołu: analizy obciążeń, reakcji i sił w węzłach, prezentacja modelu	2
Proj13	Projekt zespołu: generowanie dokumentacji płaskiej dla części - rysunki wykonawcze części	2
Proj14	Projekt zespołu: generowanie dokumentacji płaskiej dla zespołu- rysunki złożeniowe zespołu	2
Proj15	Zaliczenie przedmiotu: praca zaliczeniowa wykonywana na zajęciach	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. prezentacja projektu N2. dyskusja problemowa N3. praca własna - przygotowanie do projektu N4. samodzielna praca własna przy komputerze pod kierunkiem prowadzącego

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03 PEU_K01	kolokwium, udział w dyskusjach problemowych
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA https://knowledge.autodesk.com/support/inventor/ LITERATURA UZUPEŁNIAJĄCA Zbiór ćwiczeń Autodesk Inventor 2020 Kurs podstawowy Fabian Stasiak

OPIEKUN PRZEDMIOTU
dr inż. Tadeusz Lewandowski tel.: 71 320-24-65 email: tadeusz.lewandowski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Fluid Mechanics (Mechanika płynów)**
Nazwa przedmiotu w języku angielskim: **Fluid Mechanics**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3087**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30	15			
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60	30			
Forma zaliczenia	Zaliczenie na ocenę	Zaliczenie na ocenę			
Grupa kursów					
Liczba punktów ECTS	2	1			
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		1			
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2	0.7			

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Student ma uporządkowaną wiedzę z zakresu matematyki, obejmującą algebrę i analizę matematyczną analizę wektorową
2. Uporządkowana wiedza z zakresu fizyki klasycznej, mechaniki.
3. Uporządkowana wiedza z zakresu podstaw projektowania maszyn.

CELE PRZEDMIOTU

C1. Poznanie podstawowych praw mechaniki w odniesieniu do dynamiki przepływów cieczy i gazów.
C2. Umiejętność wykorzystania podstawowych praw mechaniki płynów w budowie i projektowaniu maszyn.
C3. Umiejętność wykorzystania podstawowych praw mechaniki płynów w eksploatacji maszyn.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Umieć definiować podstawowe prawa w mechanice płynów
PEU_W02 - Objaśniać zasady działania maszyn i zjawisk zachodzących w ich budowie i eksploatacji.
PEU_W03 - Wskazywać na powiązania między podstawowymi prawami mechaniki płynów, a zasadami działań elementów wyposażenia maszyn.

II. Z zakresu umiejętności:
PEU_U01 - Analizować przebieg zjawisk związanych z przepływami w eksploatacji maszyn.
PEU_U02 - Uporządkowana wiedza w zakresie teorii budowy maszyn.
PEU_U03 - Umie łączyć prawa mechaniki płynów z zagadnieniami projektowania i eksploatacji maszyn.

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wstęp, właściwości cieczy i gazów, siły i naprężenia w płynach, Płyny newtonowskie i nienewtonowskie.	2
Wy2	Metody analizy ruchu płynów, linie prądu, przepływy potencjalne i wirowe. Metody wizualizacji przepływów. Kinematyka płynów	2
Wy3	Podstawowe równania mechaniki płynów, równanie ciągłości, równanie zachowania pędu dla cieczy doskonałych i rzeczywistych (równanie Eulera i Naviera-Stokesa)	2
Wy4	Równania hydrostatyki, naczynia połączone, napór cieczy na ściany, pływalność i stateczność ciał pływających.Równowaga płynu.	3
Wy5	Dynamika płynu nielepkiego, równanie Bernoulliego, przykłady zastosowań: pomiary prędkości, wypływ cieczy przez otwory, ssące działanie strugi.	2
Wy6	Zasada pędu i momentu pędu, reakcja hydrodynamiczna, podstawy teorii maszyn przepływowych.	2
Wy7	Dynamika płynów lepkich. Klasyfikacja przepływów, przepływ laminarny. Podstawy teorii warstwy przyściennej. Równanie Naviera-Stockesa	2
Wy8	Przykłady rozwiązań równań N-S, przepływy w przewodach osiowosymetrycznych.	2

Wy9	Przejście przepływu laminarnego w turbulentny. Doświadczenie Reynoldsa. Elementy teorii przepływów turbulentnych. Metody obliczania przepływów turbulentnych. Oderwanie warstwy przyściennej.	4
Wy10	Hydrodynamiczna teoria smarowania w łożyskach, przepływy przez szczeliny.	1
Wy11	Opływ ciał, opory opływu, wypór hydrodynamiczny, płat nośny, charakterystyki hydrodynamiczne profili.	2
Wy12	Przepływ płynów w przewodach pod ciśnieniem. Przepływ w przewodzie zamkniętym o przekroju kołowym. Straty hydrauliczne wywołane tarciem. Straty hydrauliczne wywołane oporami miejscowymi.	2
Wy13	Ustalony przepływ płynów w systemach hydraulicznych.Nieustalony przepływ płynów w przewodach.	2
Wy14	Metody numeryczne w mechanice płynów.	2
		Suma: 30
Forma zajęć – Ćwiczenia		Liczba godzin
Ćw1	Wprowadzenie do ćwiczeń z mechaniki płynów. Rozwiązywanie zadań z zakresu podstawowych właściwości płynów.	1
Ćw2	Zadania ilustrujące zastosowanie równania Eulera i prawa Pascala. Obliczanie sił hydrostatycznych. Naczynia połączone. Pomiary manometryczne.	2
Ćw3	Statyka płynów. Napór na powierzchnie proste i zakrzywione.	2
Ćw4	Statyka płynów. Zagadnienia wyporu. Płyn w równowadze.	2
Ćw5	Zastosowanie równania Bernoulliego i równania ciągłości do obliczania przepływu cieczy i do pomiaru prędkości przepływu. Pomiar prędkości miejscowej.	3
Ćw6	Obliczanie strat ciśnienia w przewodach zamkniętych. Wyznaczanie charakterystyki rurociągu.	2
Ćw7	Obliczanie przepływów przez szczeliny.	2
Ćw8	Kolokwium zaliczeniowe.	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład problemowy N2. wykład tradycyjny z wykorzystaniem transparencji i slajdów N3. ćwiczenia rachunkowe

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01 - PEU_W03	kolokwium
P = 0.5*F1+0.5*FC		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Ćwiczenia)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03	kolokwium
P = F1=FC		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
Bukowski J., Kijkowski P.: Kurs mechaniki płynów. PWN Warszawa 1980.
Jeżowiecka-Kabsch K., Szewczyk H.: Mechanika płynów. Oficyna Wydawnicza PWr, Wrocław 2001.
Troskolański A.T.: Hydromechanika, WNT, Warszawa 1967.

LITERATURA UZUPEŁNIAJĄCA
Prosnak W.J.: Mechanika płynów. Tom I. PWN, Warszawa 1970.
Burka S.E., Nałęcz T.J.: Mechanika płynów w przykładach. PWN, Warszawa 1994.
Zieliński A.: Wybrane zagadnienia z mechaniki płynów. Oficyna Wydawnicza PWr, Wrocław 2011

OPIEKUN PRZEDMIOTU

dr inż. Krzysztof Patralski tel.: 2667 email: krzysztof.patralski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Materials Science (Materiałoznawstwo)**
Nazwa przedmiotu w języku angielskim: **Materials Science**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3088**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	90		60		
Forma zaliczenia	Egzamin		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	3		2		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			2		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.8		1.4		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Podstawowe wiadomości z fizyki i chemii.
2. Zaliczenie wykładu z Podstaw materiałoznawstwa (wymaganie nie ma charakteru formalnego- dotyczy wiedzy i umiejętności formułowanych w karcie przedmiotu – Podstawy materiałoznawstwa)
3. Ma podstawową wiedzę z zakresu mechaniki klasycznej i termodynamiki.

CELE PRZEDMIOTU

C1. Nabycie wiedzy o ważnych w technice grupach stopów metali, systemów ich oznaczania, własnościach oraz kryteriach ich stosowania w określonych warunkach eksploatacyjnych.
C2. Nabycie umiejętności rozumienia równowagi między wytrzymałością, a plastycznością materiałów metalicznych oraz możliwością sterowania tymi własnościami poprzez skład chemiczny i mikrostrukturę kształtowaną w procesie wytwarzania gotowych wyrobów.
C3. Nabycie wiedzy o podstawach obróbki cieplnej, cieplno-chemicznej i plastycznej stopów żelaza.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Elementarna wiedza na temat podstawowych materiałów konstrukcyjnych, ich właściwości i możliwości zastosowania w budowie maszyn, urządzeń i pojazdów.
PEU_W02 - Rozumie przemiany fazowe zachodzące w stopach metali i wie jaki mają wpływ na dobór parametrów obróbki cieplnej i cieplno-chemicznej wyrobów znajdujących zastosowania w budowie maszyn, urządzeń i pojazdów.
PEU_W03 - Rozumie informacje, podawane w normach materiałowych, dotyczące stanów dostawy, zalecanej obróbki cieplnej oraz możliwych do osiągnięcia własności.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi dobrać rodzaj i parametry obróbki cieplnej dla określonych gatunków stopów w celu uzyskania zadanych własności
PEU_U02 - Potrafi zinterpretować mikrostruktury wyrobów po różnych procesach wytwarzania i powiązać je z własnościami.

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Przemiany fazowe w stopach żelaza z węglem podczas nagrzewania i chłodzenia.	2
Wy2	Obróbka cieplna podstawowa stopów żelaza z węglem. Wyżarzanie. Hartowanie i odpuszczanie.	2
Wy3	Wykresy CTP. Hartowność.	2
Wy4	Obróbka powierzchniowa: hartowanie powierzchniowe, nawęglanie, azotowanie.	2
Wy5	Odkształcenie plastyczne i wyżarzanie rekrystalizujące metali.	2
Wy6	Wpływ pierwiastków stopowych na przemiany fazowe w stalach.	2
Wy7	Stale stopowe konstrukcyjne.	2
Wy8	Wysokostopowe stale odporne na korozję.	2
Wy9	Stale o szczególnych własnościach: stale żarowytrzymałe i żaroodporne	2

Wy10	Stale do kształtowania na zimno. Wielofazowe stale nowej generacji.	2
Wy11	Stale stopowe narzędziowe.	2
Wy12	Klasyfikacja i zasady oznaczania żeliw i staliw stopowych.	2
Wy13	Stopy aluminium – klasyfikacja, oznaczanie, struktury i właściwości, obróbka cieplna, kryteria doboru.	2
Wy14	Stopy metali lekkich i ciężkich (magnez, tytan, beryl, cynk, ołów, nikiel, kobalt) – klasyfikacja, oznaczanie, struktury i właściwości, obróbka cieplna, kryteria doboru.	2
Wy15	Stopy miedzi – klasyfikacja, struktury i właściwości, zastosowanie	2
		Suma: 30
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Odkształcenie plastyczne i wyżarzanie rekrystalizujące stali.	2
Lab2	Wpływ obróbki cieplnej na mikrostrukturę i właściwości stali.	2
Lab3	Mikrostruktury stali po obróbce powierzchniowej.	2
Lab4	Mikrostruktury i właściwości stali narzędziowych.	2
Lab5	Mikrostruktury i właściwości stali odpornych na korozję.	2
Lab6	Mikrostruktury i własności stopów aluminium.	2
Lab7	Mikrostruktury i własności stopów miedzi.	2
Lab8	Podsumowanie i zaliczenie zajęć laboratoryjnych.	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. praca własna – samodzielne studia i przygotowanie do egzaminu N3. praca własna – przygotowanie do laboratorium N4. eksperyment laboratoryjny N5. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	Egzamin
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02	kartkówka
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
[1] Haimann.R; Metaloznawstwo; Wyd.PWr; 2000
[2] Dobrzański.L.A, Materiały inżynierskie i projektowanie materiałowe. Podstawy nauki o materiałach i metaloznawstwo, WNT, 2006
[3] Blicharski M., Wstęp do inżynierii materiałowej, WNT, 2012.

LITERATURA UZUPEŁNIAJĄCA
[1] Dudziński W., Materiały konstrukcyjne w budowie maszyn, Wyd.PWr; 1994
[2] Ashby M. F., Jones D.R.H., Materiały inżynierskie, t. 1 i 2, WNT; 1996

OPIEKUN PRZEDMIOTU
dr hab. inż. Dominika Grygier tel.: 320-38-45 email: dominika.grygier@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Mechanics II (Mechanika II)**
Nazwa przedmiotu w języku angielskim: **Mechanics II**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3089**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30	30			
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60	60			
Forma zaliczenia	Egzamin	Zaliczenie na ocenę			
Grupa kursów					
Liczba punktów ECTS	2	2			
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		2			
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2	1.4			

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Analiza matematyczna (różniczkowanie, całkowanie), algebra liniowa, geometria euklidesowa, trygonometria
2. Równania różniczkowe (zwyczajne, liniowe) w zakresie metody rozdzielania zmiennych i metody równania charakterystycznego
3. Mechanika w zakresie statyki i kinematyki

CELE PRZEDMIOTU

C1. Rozwiązywanie problemów technicznych mechanizmów w zakresie kinematyki - prędkości i przyspieszenia.
C2. Znajomość metod analitycznych w zakresie stosowania zasad dynamiki klasycznej dla typowych układów mechanicznych (układy dyskretne: punkt, układ punktów z więzami holonomicznymi, ciało sztywne).
C3. Rozwiązywanie problemów technicznych konstrukcji i układów mechanicznych pod obciążeniami dynamicznymi.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Potrafi zdefiniować podstawowe pojęcia w dynamice układów mechanicznych (pęd, kręt, siła bezwładności, praca, energia kinetyczna i potencjalna)
PEU_W02 - Zna podstawowe pojęcia w dziedzinie drgań swobodnych i wymuszonych układów mechanicznych o jednym stopniu swobody (częstość drgań własnych, charakterystyki częstotliwościowe,rezonans).
PEU_W03 - Zna podstawowe zasady dynamiki (ruchu środka masy, pędu, krętu, d'Alemberta). Zna pojęcie układów zachowawczych i zasadę zachowania energii. Zna równania dynamiki ruchu obrotowego i płaskiego ciała sztywnego. Zna dynamikę ruchu kulistego.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi obliczać prędkości i przyspieszenia w ruchu płaskim i kulistym ciała sztywnego. Potrafi wyprowadzić równania ruchu punktu materialnego swobodnego i nieswobodnego dla zmiennych w czasie obciążeń dynamicznych stosując II zasadę dynamiki Newtona.
PEU_U02 - Potrafi obliczać częstości drgań swobodnych dla układów o jednym stopniu swobody z liniowymtłumieniem wiskotycznym i bez tłumienia. Potrafi wyprowadzać równania ruchu i obliczać jego parametry (prędkości i przyspieszenia kątowe) dla ciał sztywnych obciążonych momentem
PEU_U03 - Potrafi wyznaczać siły reakcji więzów w warunkach obciążeń dynamicznych. Potrafi obliczać energię kinetyczną i potencjalną dla złożonych układów mechanicznych. Potrafi stosować zasadę zachowania energii do wyznaczania równań różniczkowych ruchu układów zachowawczych.

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Program, wymagania, literatura. Przypomnienie podstaw kinematyki. Prędkości w ruchu płaskim.	2
Wy2	Przyspieszenia w ruchu płaskim. Chwilowy środek przyspieszeń.	2
Wy3	Kinematyka punktu w układzie złożonym. Ruch względny. Przyspieszenie Coriolisa.	2
Wy4	Podstawowe zasady mechaniki klasycznej. Kinematyka a dynamika. Modele dyskretne i ciągłe układów dynamicznych w mechanice.	2
Wy5	Druga zasada dynamiki Newtona (zastosowania w dynamice punktu swobodnego i nieswobodnego). Pojęcie sił bezwładności i zasada d'Alemberta. Zasada kinetostatyki.	2

Wy6	Drgania układu jedno-masowego o jednym stopniu swobody z liniowym tłumieniem wiskotycznym i bez tłumienia. Zapis zespolony. Drgania swobodne.	2
Wy7	Drgania wymuszone harmonicznie, charakterystyki częstotliwościowe, rezonans. Wymuszenia dynamiczne i kinematyczne.	2
Wy8	Pęd i zasada zachowania pędu. Zmiana pędu i impuls siły. Kręt i zasada zachowania krętu.	2
Wy9	Pojęcie pracy. Praca elementarna. Energia kinetyczna i potencjalna. Zasada równoważności pracy i energii kinetycznej. Zasada zachowania energii mechanicznej. Układy zachowawcze. Przykłady zastosowań.	2
Wy10	Układy wielo-masowe. Więzy, stopnie swobody. Wykorzystanie drugiej zasady dynamiki Newtona w układach wielo-masowych nieswobodnych.	2
Wy11	Zasada ruchu środka masy i zasada pędu w układach wielo-masowych.	2
Wy12	Kręt ogólny i zasada krętu w układach wielo-masowych. Wprowadzenie do dynamiki ciała sztywnego. Dynamika ruchu postępowego i obrotowego ciała sztywnego.	2
Wy13	Wykorzystanie zasady krętu i równania dynamiki ruchu obrotowego w określaniu częstości drgań swobodnych układów złożonych. Masy i sztywności zastępcze.	2
Wy14	Wyznaczanie reakcji dynamicznych w ruchu obrotowym. Metoda redukcji sił bezwładności. Sposoby wyważania układów wirujących.	2
Wy15	Kręt w ruchu płaskim ciała sztywnego i dynamika ruchu płaskiego ciała. Energia kinetyczna ciała sztywnego w ruchu ogólnym. Twierdzenie Königa.	2
		Suma: 30
Forma zajęć – Ćwiczenia		Liczba godzin
Ćw1	Rozwiązywanie zadań z kinematyki punktu, ruchu obrotowego i płaskiego ciała sztywnego. Obliczenia prędkości w ruchu płaskim: metodą superpozycji i metodą chwilowego środka obrotu.	2
Ćw2	Rozwiązywanie zadań z przyspieszeń w ruchu płaskim dla mechanizmów. Metoda superpozycji oraz metoda chwilowego środka przyspieszeń.	2
Ćw3	Rozwiązywanie zadań z kinematyki ruchu złożonego. Ruch względny. Przyspieszenie Coriolisa.	2
Ćw4	Rozwiązywanie zadań z dynamiki punktu materialnego swobodnego z zastosowaniem II zasady dynamiki Newtona (ruch prostoliniowy i krzywoliniowy pod wpływem sił: stałych, zmiennych w czasie, zależnych od prędkości ruchu).	2
Ćw5	Rozwiązywanie zadań z dynamiki punktu z wykorzystaniem zasady d'Alemberta i metody kinetostatyki.	2
Ćw6	Rozwiązywanie przykładów zadań z dynamiki punktu materialnego nieswobodnego z zastosowaniem II zasady dynamiki Newtona.	2
Ćw7	Rozwiązywanie zadań z dynamiki ruchu względnego punktu materialnego.	2
Ćw8	Rozwiązywanie zadań z drgań swobodnych punktu materialnego o jednym stopniu swobody (wyznaczanie częstości drgań swobodnych i równań ruchu) - tłumionych i bez tłumienia.	2
Ćw9	Rozwiązywanie zadań z drgań wymuszonych punktu materialnego o jednym stopniu swobody. Wyznaczanie częstości rezonansowej.	2

Ćw10	Rozwiązywanie zadań z dynamiki punktu materialnego z wykorzystaniem zasad: zmiany pędu i impulsu siły, zachowania energii mechanicznej, równoważności pracy i zmiany energii kinetycznej.	2
Ćw11	Rozwiązywanie zadań z dynamiki ruchu postępowego i obrotowego ciała sztywnego z wykorzystaniem zasady ruchu środka masy, zasady krętu i równania dynamiki ruchu obrotowego ciała sztywnego.	2
Ćw12	Rozwiązywanie zadań z zakresu reakcji dynamicznych w podporach ciała poruszającego się ruchem obrotowym. Wykorzystanie metody kinetostatyki.	2
Ćw13	Rozwiązywanie zadań z zakresu wyznaczania równań ruchu dla ciał sztywnych poruszających się ruchem płaskim.	2
Ćw14	Kolokwium 1	2
Ćw15	Kolokwium 2	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. ćwiczenia rachunkowe N3. konsultacje N4. praca własna – samodzielne studia i przygotowanie do egzaminu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	egzamin pisemno-ustny
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Ćwiczenia)

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01,PEU_U02,PEU_U03	Kolokwium
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
1. B. Gabryszewska, A. Pszonka: „Mechanika”, cz. II „Kinematyka i dynamika”, PWr, 1998
2. J. Zawadzki, W. Siuta: „Mechanika ogólna”, PWN, Warszawa 19713.
3. J. Misiak : „Mechanika ogólna. Dynamika”. Tom II, WNT, Warszawa 1993
4. J. Leyko :"Mechanika ogólna", Tom 1 Statyka i kinematyka, PWN 2022
5. J. Leyko :"Mechanika ogólna", Tom 2 Dynamika, PWN 2022
6. J. Nizioł: " Metodyka rozwiązywania zadań z mechaniki", PWN 2023
7. I. W. Mieszczerski, "Zbiór zadań z Mechaniki", PWN 1971

LITERATURA UZUPEŁNIAJĄCA
1. J. Giergiel : „Mechanika ogólna”, WNT, Warszawa 1980
2. B. Skalmierski: „Mechanika” PWN, Warszawa 19773.
3. M. Klasztorny: „Mechanika” Dolnośląskie Wyd. Edukacyjne, Wrocław 2000
4. W. Krysicki, L. Włodarski, "Analiza matematyczna w zadaniach II", PWN 2000

OPIEKUN PRZEDMIOTU

dr hab. inż. Daniel Lewandowski tel.: 320-28-99 email: daniel.lewandowski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Polymers (Tworzywa sztuczne)**
Nazwa przedmiotu w języku angielskim: **Polymers**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3090**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60		30		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	2		1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2		0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma podstawową wiedzę w obszarze materiałoznawstwa i chemii.

CELE PRZEDMIOTU

C1. Nabycie podstawowej wiedzy dotyczącej budowy, otrzymywania, modyfikacji i własności tworzyw polimerowych.
C2. Nabycie podstawowej wiedzy dotyczącej technologii stosowanych do przetwórstwa tworzyw polimerowych.
C3. Zdobycie umiejętności doboru tworzyw polimerowych w podstawowych zastosowaniach.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Zna podstawowe grupy polimerów, ich budowę, własności.
PEU_W02 - Zna technologie stosowane do przetwórstwa tworzyw polimerowych.
PEU_W03 - Zna podstawowe zastosowania tworzyw polimerowych.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi identyfikować materiały polimerowe,
PEU_U02 - Potrafi wskazać technologię przetwórstwa do wytwarzania wybranego wyrobu z tworzywa sztucznego.
PEU_U03 - Umie dobierać materiały polimerowe do określonych zastosowań.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Wyszukiwania informacji oraz jej krytycznej analizy.
PEU_K02 - Zespołowej współpracy dotyczącej doskonalenia metod wyboru strategii mającej na celu optymalne rozwiązywanie powierzonych grupie problemów.
PEU_K03 - Przestrzegania obyczajów i zasad obowiązujących w środowisku akademickim.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wiadomości podstawowe, historia materiałów polimerowych, nazewnictwo, zalety i wady tworzyw polimerowych.	2
Wy2	Porównanie wybranych własności tworzyw polimerowych z metalami.	2
Wy3	Klasyfikacja i podział tworzyw polimerowych. Procesy polimeryzacji i wytwarzania tworzyw sztucznych.	2
Wy4	Modele mechaniczne zachowania się polimerów. Zachowanie się tworzyw w trakcie przetwórstwa. Reologia polimerów.	2
Wy5	Modyfikacja polimerów, mieszanie z dodatkami. Przygotowanie tworzyw do przetwórstwa.	2
Wy6	Technologie i techniki łączenia wyrobów z tworzyw polimerowych	2
Wy7	Technologia wtryskiwania i jej odmiany	2
Wy8	Praktyczne aspekty technologii wtryskiwania	2
Wy9	Technologia wytłaczania i jej odmiany	2
Wy10	Technologia termoformowania	2
Wy11	Narzędzia w technologiach przetwórstwa tworzyw	2
Wy12	Przetwórstwo żywic i wytwarzanie kompozytów, technologie niszowe	2
Wy13	Zastosowanie tworzyw polimerowych	2
Wy14	Biodegradowalność polimerów	2
Wy15	Test zaliczeniowy	2
		Suma: 30

Forma zajęć – Laboratorium		Liczba godzin
Lab1	Introduction to the laboratory, omówienie zasad zaliczenia laboratorium	1
Lab2	Tworzywa polimerowe - własności, zastosowanie i i metody identyfikacji	2
Lab3	Technologie łączenia wyrobów z tworzyw polimerowych	2
Lab4	Własności mechaniczne materiałów polimerowych	2
Lab5	Tarcie i zużycie materiałów polimerowych	2
Lab6	Technologie przetwórstwa pierwotnego - wytłaczanie	2
Lab7	Technologie przetwórstwa pierwotnego - wtryskiwanie	2
Lab8	Technologie przetwórstwa wtórnego - termoformowanie próżniowe	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. praca własna – przygotowanie do laboratorium N3. eksperyment laboratoryjny N4. przygotowanie sprawozdania

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01	kartkówka
F2	PEU_U02	kartkówka, odpowiedzi ustne
F3	PEU_U03	kartkówka, odpowiedzi ustne
F4	PEU_K01, PEU_K02, PEU_K03	odpowiedzi ustne, przygotowanie sprawozdania

P = (F1+F2+F3+F4)/4

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
<u>LITERATURA PODSTAWOWA</u> 1. Processing of polymers; Defonseka Chris.; Boston : De Gruyter; 2020; 2. INTRODUCTION TO POLYMERS; Young Robert; LONDON : CHAPMAN AND HALL; 1991; 3. An introduction to plastics; Elias Hans-Georg; Weinheim : Wiley-VCH; 2003; <u>LITERATURA UZUPEŁNIAJĄCA</u> 1. Physical properties of polymers; Mark James; Cambridge University Press; 2004;

OPIEKUN PRZEDMIOTU
dr inż. Roman Wróblewski tel.: 320-21-70 email: r.m.wroblewski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Chipless Processes - Casting (Techniki wytwarzania - odlewnictwo)**
Nazwa przedmiotu w języku angielskim: **Chipless Processes - Casting**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3091**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60		30		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	2		1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2		0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma podstawową wiedzę o procesach metalurgicznych przetwarzania rud metali oraz otrzymywania stopów żelaza i metali nieżelaznych. Ma uporządkowaną wiedzę o rodzajach metalicznych materiałów inżynierskich – ich właściwościach, zastosowaniach i zasadach doboru. Ma wiedzę w zakresie struktur stali, żeliwa i stopów metali nieżelaznych, zasad ich klasyfikacji i oznaczania.
2. Potrafi określić cechy mikrostruktury materiałów metalicznych, identyfikować fazy na podstawie wykresów równowagi, rozróżniać mikrostruktury pod względem zawartości węgla w stali, wpływu obróbki cieplnej.
3. Potrafi czytać i interpretować rysunki i schematy stosowane w dokumentacji technicznej.

CELE PRZEDMIOTU

C1. Nabycie podstawowej wiedzy o podstawowych technikach wytwarzania wyrobów metodami odlewniczymi.
C2. Zdobycie umiejętności doboru oraz krytycznej analizy dobranej technologii odlewania i podstawowych parametrów procesu.
C3. Nabycie i utrwalenie kompetencji społecznych obejmujących inteligencję emocjonalną polegającą na umiejętności współpracy w grupie mającej na celu efektywne rozwiązywanie problemów. Nabycie poczucia odpowiedzialności, przestrzegania obyczajów obowiązujących w środowisku akademickim i społeczeństwie.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Zna podstawowe technologie ręcznego i maszynowego wytwarzania form odlewniczych.
PEU_W02 - Zna podstawowe metody otrzymywania i obróbki metalurgicznej stopów odlewniczych.
PEU_W03 - Posiada podstawową wiedzę o projektowaniu wyrobów odlewanych i procesach wytwarzania oraz zasadach doboru technologii odlewania zależnej od rodzaju stopu.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi, dla prostego wyrobu, przeanalizować i zaprojektować proces wytwarzania oprzyrządowania odlewniczego.
PEU_U02 - Potrafi dobrać odpowiednią technologię odlewania oraz określić podstawowe parametry procesu.
PEU_U03 - Potrafi dobrać odpowiednią metodę obróbki stopu odlewniczego oraz określić podstawowe parametry procesu.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Potrafi wyszukiwać informacje oraz je krytycznie analizować, obiektywnie oceniać argumenty, racjonalnie tłumaczyć i uzasadniać własny punkt widzenia z wykorzystaniem wiedzy z zakresu odlewnictwa.
PEU_K02 - Ma świadomość znaczenia zespołowej współpracy dotyczącej doskonalenia metod wyboru strategii mającej na celu optymalne rozwiązywanie powierzonych grupie studentów problemów.
PEU_K03 - Rozumie potrzebę przestrzegania obyczajów i zasad obowiązujących w środowisku akademickim i społeczeństwie.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Sprawy organizacyjne. Omówienie specyfiki techniki wytwarzania przedmiotów ze stanu ciekłego, podstawowe pojęcia i algorytmy wytwarzania odlewów.	1
Wy2	Zasady projektowania i budowa oprzyrządowania odlewniczego.	2
Wy3	Materiały stosowane do wytwarzania mas formierskich i rdzeniowych oraz metody wytwarzania i badania właściwości tych mas.	2
Wy4	Metody ręcznego i maszynowego wytwarzania form i rdzeni odlewniczych.	2
Wy5	Wytwarzanie form i rdzeni z mas chemoutwardzalnych i termoutwardzalnych.	2
Wy6	Wytwarzanie odlewów metodą precyzyjną traconych modeli. Wytwarzanie odlewów w formach trwałych.	2

Wy7	Wytapianie stopów odlewniczych. Obróbka metalurgiczna stopów odlewniczych i cieplna odlewów.	2
Wy8	Omówienie podstawowych przyczyn powstawania wad odlewów. Podsumowanie kursu. Sprawdzian wiadomości.	2
		Suma: 15

Forma zajęć – Laboratorium		Liczba godzin
Lab1	Sprawy organizacyjne. Wprowadzenie. BPH laboratorium odlewnictwa. Specyfika kształtowania wyrobów ze stanu ciekłego metalu. Podstawowe pojęcia i algorytmy wytwarzania odlewów.	1
Lab2	Badanie materiałów i mas formierskich.	2
Lab3	Budowa modeli i rdzennic. Technologia pełnej formy.	2
Lab4	Ręczne wytwarzanie form i rdzeni odlewniczych.	2
Lab5	Maszynowe wytwarzanie form i rdzeni odlewniczych.	2
Lab6	Wytwarzanie odlewów w formach z mas chemoutwardzalnych i termoutwardzalnych.	2
Lab7	Wytwarzanie odlewów w formach trwałych.	2
Lab8	Badanie właściwości stopów odlewniczych.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. praca własna – przygotowanie do laboratorium N3. praca własna – samodzielne studia i przygotowanie do egzaminu N4. przygotowanie sprawozdania N5. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03,	kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02, PEU_K03,	kartkówka, sprawozdanie
P = average F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
[1] Granat K. Laboratorium z odlewnictwa, skrypt PWr, Wrocław 2007;
[2] Perzyk M. i inni; Odlewnictwo WNT Warszawa 2000;
[3] Murza-Mucha P., Techniki wytwarzania – Odlewnictwo. PWN, Warszawa 1978;
[4] Tabor A. Odlewnictwo wyd. „Akapit” Kraków 1996;

LITERATURA UZUPEŁNIAJĄCA
[1] Lewandowski J. L.; Tworzywa na formy odlewnicze, wyd.: „Akapit” Kraków 1997;
[2] Błaszkowski K. Technologia formy i rdzenia, Warszawa 1990;
[3] Poradnik inżyniera – Odlewnictwo WNT Warszawa 1986;
[4] Perzyk M. i inni: Materiały do projektowania procesów odlewniczych, skr. P. Warsz. Warszawa 1981;
[5] Jaworski R. Ćwiczenia laboratoryjne z Budowy Maszyn, cz. I Odlewnictwo, skrypt PWr, Wrocław 1981;

OPIEKUN PRZEDMIOTU

dr inż. Mateusz Stachowicz tel.: 713204235 email: mateusz.stachowicz@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Fundamentals of Materials Strength (Podstawy wytrzymałości materiałów)**

Nazwa przedmiotu w języku angielskim: **Fundamentals of Materials Strength**

Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**

Specjalność (jeśli dotyczy): **Mechanical engineering design**

Poziom i forma studiów: **I stopień, stacjonarne**

Rodzaj przedmiotu: **obowiązkowy**

Kod przedmiotu: **W10MBM-SI3092**

Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30	15			
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60	30			
Forma zaliczenia	Zaliczenie na ocenę	Zaliczenie na ocenę			
Grupa kursów					
Liczba punktów ECTS	2	1			
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		1			
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2	0.7			

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Znajomość matematyki wyższej - w szczególności algebry wektorów, rachunku całkowego i równań różniczkowych.
2. Znajomość podstaw inżynierii materiałowej
3. Znajomość mechaniki ciała sztywnego w szczególności w zakresie zasad statyki układów prętowych, belek i geometrii mas

CELE PRZEDMIOTU

C1. Poznanie podstaw i zakresu zastosowań mechaniki jednorodnych i niejednorodnych ciał odkształcalnych
C2. Nabycie umiejętności wyznaczania naprężeń i odkształceń
C3. Nabycie umiejętności doświadczalnego wyznaczania mechanicznych własności materiałów i wykorzystywania ich do określania naprężeń dopuszczalnych

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Student potrafi zdefiniować uogólnione prawo Hooke'a i potrafi je wykorzystać do obliczeń naprężeń i odkształceń w elementach konstrukcyjnych poddanych złożonemu stanowi naprężeń
PEU_W02 - Student potrafi sformułować warunki wytrzymałościowe dla różnych konstrukcji prętowych i belkowych oraz posiada wiedzę niezbędną do zaprojektowania przekrojów elementów konstrukcyjnych
PEU_W03 - Zna najbardziej użyteczne hipotezy wytężeniowe i zakres ich stosowania oraz posiada wiedzę niezbędną do rozwiązywania klasycznych zadań z mechaniki

II. Z zakresu umiejętności:
PEU_U01 - Potrafi stosować prawo Hooke'a do obliczeń naprężeń i odkształceń
PEU_U02 - Potrafi przeprowadzić analizę wytrzymałościową konstrukcji prętowych i belkowych
PEU_U03 - Potrafi zaprojektować pręt ściskanym odporny na utratę stateczności

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie. Podstawowe założenia i pojęcia. Doświadczalne wyznaczanie własności wytrzymałościowych. Naprężenia dopuszczalne i współczynnik bezpieczeństwa.	2
Wy2	Rozciąganie i ściskanie. Zagadnienia statycznie wyznaczalne i niewyznaczalne. Układy prętowe obciążone termicznie. Spiętrzenie naprężeń	2
Wy3	Teoria stanu naprężenia. Koło Mohra dla płaskiego stanu naprężenia. Związki fizyczne dla przestrzennego stanu naprężenia	2
Wy4	Teoria stanu stanu odkształcenia. Podstawy technicznych pomiarów odkształceń	2
Wy5	Skręcanie prętów o przekroju kołowym	2
Wy6	Skręcanie prętów o przekroju dowolnym. Skręcanie profili cienkościennych	2
Wy7	Czyste ścinanie. Ścinanie techniczne. Obliczanie połączeń rozłącznych i nierozłącznych - przykłady obliczeń	2
Wy8	Ogólny przypadek zginania belki. Zginanie proste. Belki o stałej wytrzymałości na zginanie	2
Wy9	Zginanie ukośne. Zginanie z udziałem siły poprzecznej. Środek ścinania	2

Wy10	Przemieszczenia w belkach. Równanie różniczkowe linii ugięcia	2
Wy11	Wyboczenie prętów ściskanych	2
Wy12	Zginanie z rozciąganiem lub ściskaniem. Rdzeń przekroju	2
Wy13	Energia sprężysta odkształcenia objętościowego i postaciowego. Zależności między energią sprężystą, naprężeniem i odkształceniem	2
Wy14	Hipotezy wytężenia materiału w złożonym stanie naprężeń. Naprężenie zredukowane.	2
Wy15	Kolokwium zaliczeniowe	2
		Suma: 30
Forma zajęć – Ćwiczenia		Liczba godzin
Ćw1	Układy prętowe statycznie wyznaczalne i niewyznaczalne przy rozciąganiu i ściskaniu	2
Ćw2	Transformacja płaskiego stanu naprężeń i odkształceń. Uogólnione prawo Hooke'a.	3
Ćw3	Skręcanie prętów o przekroju kołowym. Skręcanie profili cienkościennych	2
Ćw4	Wyznaczanie naprężeń w zginanej belce	2
Ćw5	Wyznaczanie linii ugięcia belki	2
Ćw6	Wyboczenie prętów - obliczenia	2
Ćw7	Kolokwium zaliczeniowe	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. ćwiczenia rachunkowe

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	kolokwium zaliczeniowe
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Ćwiczenia)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03	kolokwium zaliczeniowe
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
Zielnica J., Wytrzymałość Materiałów, WPP, wyd. III, Poznań 2000, str. 554.
Niezgodziński M. E., Niezgodziński T.: Wytrzymałość materiałów. PWN, Warszawa 1998.
Niezgodziński M. E., Niezgodziński T.: Wzory, wykresy i tablice wytrzymałościowe. WNT, Warszawa 1996.
Niezgodziński M. E., Niezgodziński T.: Zadania z wytrzymałości materiałów. WNT, Warszawa 1997.
M. Ostwald: Podstawy wytrzymałości materiałów. Wydawnictwo Politechniki Poznańskiej, Poznań 1997
Jakubowicz A., Orłoś Z., Wytrzymałość materiałów, WNT, Warszawa, 1984
Magnucki K., Szyc W., Wytrzymałość materiałów w zadaniach: pręty, płyty i powłoki obrotowe, Wydawnictwo Naukowe PWN, 2000.

LITERATURA UZUPEŁNIAJĄCA
Broek D.: Elementary engineering - fracture mechanics. Noordhoff Int. Publishing, Leyden, 1974.
Ashby M. F.: Jones D. R.: Materiały inżynierskie. Własności i zastosowania. WNT, Warszawa 1995.
R. C. Hibbeler - Mechanics of Materials, Pearson Prentice Hall
S. Timoshenko, Strength of Materials Part 1, Elementary Theory and Problems, D. Van Nostrand Company, Inc
Willems N., Easley T. J., Rolfe S. T., Strength of Materials, Mc GrawHill Book Company, 1981.
Gere M., Timoshenko S., Mechanics of Materials, PWS-Kent Publishing Company, Boston, 1984.

OPIEKUN PRZEDMIOTU

dr hab. inż. Grzegorz Lesiuk tel.: 713204216 email: grzegorz.lesiuk@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Ordinary Differential Equations (Równania różniczkowe zwyczajne)**
Nazwa przedmiotu w języku angielskim: **Ordinary Differential Equations**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3093**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15	15			
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30	30			
Forma zaliczenia	Zaliczenie na ocenę	Zaliczenie na ocenę			
Grupa kursów					
Liczba punktów ECTS	1	1			
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		1			
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6	0.7			

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Zna rachunek różniczkowy i całkowy funkcji jednej zmiennej, a także wykorzystywane w nim inne gałęzie matematyki, ze szczególnym uwzględnieniem algebry liniowej.
2. Umie obliczać pochodne funkcji jednej zmiennej, umie obliczać całki nieoznaczone i oznaczone metodami przez części i przez podstawienie.
3. Umie obliczać wyznaczniki i zna ich własności, umie obliczać wartości własne i wektory własne macierzy.

CELE PRZEDMIOTU

C1. Zdobycie podstawowej wiedzy o równaniach różniczkowych zwyczajnych I i II rzędu oraz na temat układów równań różniczkowych.
C2. Zdobycie umiejętności dobrania właściwej metody rozwiązywania równań różniczkowych zwyczajnych oraz układów równań różniczkowych.
C3. Kształtowanie i utrwalanie umiejętności wyszukiwania informacji oraz jej analizy.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Ma teoretyczną wiedzę dotyczącą równań różniczkowych i metod ich rozwiązywania.
PEU_W02 - Ma wiedzę na temat metod rozwiązywania układów równań różniczkowych.
PEU_W03 - Ma wiedzę dotyczącą zastosowania równań różniczkowych jako modelu matematycznego do opisu zjawisk fizycznych.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi rozwiązać równania różniczkowe I irzędu.
PEU_U02 - Potrafi rozwiązać równania różniczkowe II rzędu.
PEU_U03 - Potrafi rozwiązać układy równań różniczkowych.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Rozumie konieczność systematycznej pracy nad wszelkimi zadaniami; umie oszacować czas potrzebny na realizację zleconego zadania.
PEU_K02 - Zna zakres posiadanej przez siebie wiedzy i posiadanych umiejętności, potrafi rozpoznać braki w wiedzy i uzupełnić je posługując się literaturą.
PEU_K03 - Postępuje etycznie i rozumie znaczenie uczciwości intelektualnej.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Równania różniczkowe I rzędu: pojęcia wstępne. Równania różniczkowe I rzędu o zmiennych rozdzielonych.	1
Wy2	Równania różniczkowe I rzędu jednorodne. Równania różniczkowe I rzędu liniowe niejednorodne. Metoda uzmienniania stałych.	2
Wy3	Krzywe ortogonalne. Metoda geometryczna wyznaczania krzywych całkowych na podstawie izoklin.	2
Wy4	Równania II sprowadzalne do równań I rzędu. Równania różniczkowe II rzędu liniowe jednorodne o stałych współczynnikach.	2
Wy5	Równania różniczkowe liniowe II rzędu liniowe jednorodne. Wrońskian.	2
Wy6	Równania różniczkowe liniowe niejednorodne. Metoda współczynników nieoznaczonych. Metoda uzmienniania stałych.	2
Wy7	Układy równań różniczkowych. Metoda eliminacji.	2

Wy8	Kolokwium	2
		Suma: 15

Forma zajęć – Ćwiczenia		Liczba godzin
Ćw1	Rozwiązywanie równań różniczkowych I rzędu o zmiennych rozdzielonych	1
Ćw2	Rozwiązywanie równań jednorodnych. Rozwiązywanie równań różniczkowych I rzędu liniowych niejednorodnych - metoda uzmienniania stałej.	2
Ćw3	Wyznaczanie krzywych ortogonalnych. Rozwiązywanie równań różniczkowych II rzędu sprowadzalnych do I rzędu.	2
Ćw4	Rozwiązywanie równań różniczkowych II rzędu liniowych jednorodnych i niejednorodnych o stałych współczynnikach. Metoda przewidywania.	2
Ćw5	Rozwiązywanie równań różniczkowych II rzędu niejednorodnych o stałych współczynnikach metodą uzmienniania stałych.	2
Ćw6	Rozwiązywanie równań liniowych jednorodnych z użyciem wzoru Liouville'a.	2
Ćw7	Rozwiązywanie układów równań metodą eliminacji.	2
Ćw8	Kolokwium	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. ćwiczenia rachunkowe N3. konsultacje N4. praca własna - przygotowanie do zajęć oraz kolokwiów

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01 + PEU_W02 + PEU_W03	Kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Ćwiczenia)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01 +PEU_U02 + PEU_U03, PEU_K01	Kolokwium
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

1. M. Gewert, Z. Skoczylas, Równania różniczkowe zwyczajne. Teoria, przykłady, zadania, Oficyna Wydawnicza GIS, Wrocław 2007.
2. W. Żakowski, W. Leksiński , Matematyka cz. IV, WNT, Warszawa 1984.
3. F. Leja, Rachunek różniczkowy i całkowy ze wstępem do równań różniczkowych, PWN, Warszawa 2008.
4. S. Łanowy, F. Przybylak, B. Szlęk, Równania różniczkowe, Wydawnictwo Politechniki Śląskiej, Gliwice 2003.
5. H. Bereś, K. Bereś, Elementy równań różniczkowych. Cz. 1, Wydawnictwo Politechniki Świętokrzyskiej, Kielce 2003.
6. 5. H. Bereś, K. Bereś, Elementy równań różniczkowych. Cz. 2 Rozwiązania zadań, Wydawnictwo Politechniki Świętokrzyskiej, Kielce 2005.
7. W. Krysicki, L. Włodarski, Analiza matematyczna w zadaniach. Część 2, PWN Warszawa 2011.

LITERATURA UZUPEŁNIAJĄCA

1. N. Matwiejew, Metody całkowania równań różniczkowych zwyczajnych, PWN, Warszawa, 1986.
2. N. Matwiejew, Zadania z równań różniczkowych zwyczajnych, PWN, Warszawa 1976.

OPIEKUN PRZEDMIOTU

dr inż. Dorota Aniszewska tel.: 320-27-90 email: dorota.aniszewska@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Fundamentals of Materials Strength (Podstawy wytrzymałości materiałów)**

Nazwa przedmiotu w języku angielskim: **Fundamentals of Materials Strength**

Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**

Specjalność (jeśli dotyczy): **Mechanical engineering design**

Poziom i forma studiów: **I stopień, stacjonarne**

Rodzaj przedmiotu: **obowiązkowy**

Kod przedmiotu: **W10MBM-SI3094**

Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)			15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)			30		
Forma zaliczenia			Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS			1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)			0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Znajomość matematyki wyższej - w szczególności algebry wektorów, rachunku całkowego i równań różniczkowych
2. Znajomość podstaw inżynierii materiałowej
3. Znajomość mechaniki ciała sztywnego w szczególności w zakresie zasad statyki układów prętowych, belek i geometrii mas

CELE PRZEDMIOTU

C1. Poznanie podstaw i zakresu zastosowań mechaniki jednorodnych i niejednorodnych ciał odkształcalnych
C2. Nabycie umiejętności wyznaczania naprężeń i odkształceń
C3. Nabycie umiejętności doświadczalnego wyznaczania mechanicznych własności materiałów i wykorzystywania ich do określania naprężeń dopuszczalnych

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Potrafi stosować prawo Hooke'a do obliczeń naprężeń i odkształceń
PEU_U02 - Potrafi przeprowadzić analizę wytrzymałościową konstrukcji prętowych i belkowych
PEU_U03 - Potrafi zaprojektować pręt ściskanym odporny na utratę stateczności

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Laboratorium		Liczba godzin
Lab1	Wprowadzenie; zasady BHP i organizacja metod pomiarowych w laboratorium	1
Lab2	Badania właściwości mechanicznych metali. Próba rozciągania	2
Lab3	Pomiary odkształceń w elementach konstrukcyjnych metodą elektrycznej tensometrii oporowej	2
Lab4	Badania zmęczeniowe metali	2
Lab5	Wytrzymałość złożona: wytężenie, weryfikacja hipotez - skręcanie ze zginaniem. Wyznaczanie modułu Kirchhoffa - próba czystego skręcania	2
Lab6	Utrata stateczności prętów - wyboczenie. Próba ściskania	2
Lab7	Zginanie proste i ukośne - badania modelowe	2
Lab8	Zajęcia zaliczeniowe	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. eksperyment laboratoryjny
N2. praca własna – przygotowanie do laboratorium

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02	odpowiedzi ustne, sprawozdania laboratoryjne
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
Zielnica J., Wytrzymałość Materiałów, WPP, wyd. III, Poznań 2000, str. 554.
Niezgodziński M. E., Niezgodziński T.: Wytrzymałość materiałów. PWN, Warszawa 1998.
Niezgodziński M. E., Niezgodziński T.: Wzory, wykresy i tablice wytrzymałościowe. WNT, Warszawa 1996.
Niezgodziński M. E., Niezgodziński T.: Zadania z wytrzymałości materiałów. WNT, Warszawa 1997.
M. Ostwald: Podstawy wytrzymałości materiałów. Wydawnictwo Politechniki Poznańskiej, Poznań 1997
Jakubowicz A., Orłoś Z., Wytrzymałość materiałów, WNT, Warszawa, 1984
Magnucki K., Szyc W., Wytrzymałość materiałów w zadaniach: pręty, płyty i powłoki obrotowe, Wydawnictwo Naukowe PWN, 2000.

LITERATURA UZUPEŁNIAJĄCA
Broek D.: Elementary engineering - fracture mechanics. Noordhoff Int. Publishing, Leyden, 1974.
Ashby M. F.: Jones D. R.: Materiały inżynierskie. Własności i zastosowania. WNT, Warszawa 1995.
R. C. Hibbeler - Mechanics of Materials, Pearson Prentice Hall
S. Timoshenko, Strength of Materials Part 1, Elementary Theory and Problems, D. Van Nostrand Company, Inc
Willems N., Easley T. J., Rolfe S. T., Strength of Materials, Mc GrawHill Book Company, 1981.
Gere M., Timoshenko S., Mechanics of Materials, PWS-Kent Publishing Company, Boston, 1984.

OPIEKUN PRZEDMIOTU
dr hab. inż. Grzegorz Lesiuk tel.: 713204216 email: grzegorz.lesiuk@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Industrial Metrology (Metrologia przemysłowa)**
Nazwa przedmiotu w języku angielskim: **Industrial Metrology**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3095**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)			15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)			30		
Forma zaliczenia			Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS			1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)			0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma podstawową wiedzę w zakresie matematyki i fizyki na poziomie szkoły ponadpodstawowej.
2. Posiada umiejętność odczytywania rysunków i schematów zawartych w dokumentacji technicznej.
3. Posiada podstawową wiedzę w zakresie konstrukcji elementów maszyn. Posiada podstawową wiedzę w zakresie technik wytwarzania elementów maszyn

CELE PRZEDMIOTU

C1. Nabycie wiedzy na temat realizacji procesów pomiarowych oraz kontroli w warunkach przemysłowych
C2. Nabycie wiedzy na temat rodzajów i właściwości sprzętu do pomiaru wielkości geometrycznych wykorzystywanych przemysłowych procesach wytwarzania
C3. Wyszukiwanie istotnych informacji oraz ich krytyczna analiza.
C4. Zdobycie wiedzy i umiejętności w zakresie doboru sprzętu pomiarowego, analizy wyników pomiarów, oceny błędów pomiarów i sposobu wyrażania niepewności pomiarowej

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Rozumie wymagania wymiarowe stawiane wyrobom zawartych w dokumentacji technicznej. Potrafi korzystać z norm dotyczących tolerancji wymiarów liniowych i pasowań a także tolerancji geometrycznych. Potrafi obliczać wartości błędów pomiaru, szacować niepewność pomiarową dla różnego rodzaju pomiarów.
PEU_U02 - Umie dokonać doboru odpowiedniego sprzętu pomiarowego oraz dokonać jego konfiguracji w zależności od postawionego zadania pomiarowego. Potrafi korzystać z sprzętu pomiarowego stosowanego w przemyśle maszynowym do pomiaru wielkości geometrycznych.
PEU_U03 - Potrafi rozwiązywać w podstawowym zakresie problemy związane z praktycznym użytkowaniem narzędzi i stanowisk pomiarowych. Potrafi rozpoznać źródła błędów, ich wartości oraz oszacować niepewność pomiarową.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Wyszukiwanie informacji oraz jej krytycznej analizy
PEU_K02 - Obiektywne ocenianie argumentów, racjonalne tłumaczenie i uzasadnianie własnego punktu widzenia z wykorzystaniem wiedzy z zakresu podstaw metrologii.

TREŚCI PROGRAMOWE

Forma zajęć – Laboratorium		Liczba godzin
Lab1	Sprawy organizacyjne.	1
Lab2	Badanie wpływu charakterystyk metrologicznych systemów pomiarowych na ich właściwości pomiarowe	2
Lab3	Projekt i weryfikacja poprawności wykonania sprawdzianu do kontroli wymiarów	2
Lab4	Wzorcowanie wybranych przyrządów pomiarowych	2
Lab5	Wyznaczenie niepewności pomiaru. Budowa budżetu niepewności.	2
Lab6	Pomiary współrzędnościowe 2D na mikroskopie pomiarowym z wykorzystaniem QM Data 200	2
Lab7	Pomiary współrzędnościowe 2D na mikroskopie pomiarowym elementów obrotowych w biegunowym układzie współrzędnych	2
Lab8	Pomiary współrzędnościowe 3D na współrzędnościowej maszynie pomiarowej	2

	Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. eksperyment laboratoryjny N2. praca własna – przygotowanie do laboratorium N3. przygotowanie sprawozdania N4. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01; PEU_U02; PEU_U03; PEU_K01; PEU_K02;	sprawozdanie z ćwiczeń laboratoryjnych, odpowiedź ustna, kartkówka
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA [1] Jakubiec W., Malinowski J.: "Metrologia wielkości geometrycznych". WNT, Warszawa 2018. [2] Instrukcje do ćwiczeń laboratoryjnych. (www.metrologia.pwr.edu.pl) LITERATURA UZUPEŁNIAJĄCA [1] Lisowski M.: „Podstawy Metrologii". Oficyna Wydawnicza PWr, Wrocław 2015 [2] Adamczak S., Makieła W.: " Metrologia w budowie maszyn. Zadania z rozwiązaniami. Wydanie II, zmienione". WNT, Warszawa 2022. [3] Ratajczyk E., Woźniak A.: "Współrzędnościowe Systemy Pomiarowe". Oficyna Wydawnicza PW, Warszawa 2016

OPIEKUN PRZEDMIOTU
dr inż. Marek Kuran tel.: 27-28 email: marek.kuran@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Drive Systems (Układy napędowe pojazdów)**
Nazwa przedmiotu w języku angielskim: **Drive Systems**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3096**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30		30		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	1		1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6		0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. pozytywna ocena z mechaniki, analizy matematycznej oraz podstaw konstrukcji maszyn
2. podstawowa znajomość działania różnych układów maszyn i urządzeń mechanicznych
3. podstawowa umiejętność pracy grupowej.

CELE PRZEDMIOTU
C1. Celem zajęć jest poszerzenie wiedzy z zakresu budowy układów napędowych pojazdów oraz ich elementów. Student zapoznaje się ze sposobami opracowywania i sporządzania charakterystyk poszczególnych podzespołów układów napędowych, charakterystyk trakcyjnych oraz pierwotnych źródeł energii. C2. Celem zajęć jest nabycie praktycznej wiedzy dotyczącej metod obliczania i doboru poszczególnych elementów napędowych oraz określenia metod zapobiegających niepożądanym zjawiskom np. mocy krążącej itp. Zna potrzebę dalszego rozwoju zawodowego. C3. Celem zajęć jest nabycie praktycznych umiejętności planowania eksperymentu, przeprowadzenia go a także interpretacji wyników. Student ma świadomość wpływu wybranych rozwiązań na środowisko i potrafi posługiwać się poprawna terminologią. Nabywa odpowiedzialności za pracę własną i grupową.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ
I. Z zakresu wiedzy: PEU_W01 - potrafi dobierać i zna charakterystyki pierwotnych źródeł energii oraz opisać przepływ mocy poprzez poszczególne elementy układu napędowego w układach hydrostatycznych, hydrokinetycznych i mechanicznych; dobiera podzespoły układów napędowych na podstawie obliczeń i charakterystyk. PEU_W02 - potrafi wskazać układy napędowe obecnie stosowanie oraz udoskonalać je do własnych potrzeb w oparciu o rozrój technologii; PEU_W03 - potrafi opisać i objaśnić zasady działania różnych podzespołów układów napędowych, wskazywać możliwość występowania zjawisk niepożądanych i wskazać metody ich eliminacji. **II. Z zakresu umiejętności:** PEU_U01 - potrafi posługując się również obcojęzyczna literaturą dokonywać interpretacji wyników uzyskanych w trakcie eksperymentu laboratoryjnego oraz korzystać z katalogów; PEU_U02 - potrafi przeanalizować i opracowywać wyniki w celu uzyskania charakterystyk lub mierzonych parametrów w układach napędowych pojazdów i maszyn przy różnych nastawach układu sterowania; PEU_U03 - potrafi zaproponować własne koncepcje układów napędowych i ich układów sterowania realizujących podobne funkcje. **III. Z zakresu kompetencji społecznych:** PEU_K01 - potrafi i rozumie potrzebę ciągłego doszkalania się i pozyskiwania nowych informacji; PEU_K02 - jest odpowiedzialny za podejmowane decyzje zarówno w aspekcie ochrony środowiska naturalnego jak i działalności inżyniera mechanika; PEU_K03 - potrafi pracować w grupie i rozwiązywać powierzone mu zadania również na różnych stanowiskach i ponosi odpowiedzialność za grupowe osiągnięcie zamierzonego celu.

TREŚCI PROGRAMOWE		
Forma zajęć – Wykład		Liczba godzin
Wy1	Konwencjonalne i niekonwencjonalne źródła energii. Metody magazynowania energii mechanicznej, elektrycznej i hydraulicznej. Charakterystyki źródeł energii -zasady sterowania. Niekonwencjonalne źródła energii (np. paliwowe i inne) - przykłady aplikacji i trendy rozwoju	2

Wy2	Systematyka układów napędowych (układy jednoźródłowe, wieloźródłowe, szeregowe, równoległe, hybrydowe) - przykłady aplikacji. Podstawowe funkcje realizowane przez układy napędowe. Budowa i zasada działania poszczególnych elementów znajdujących się za źródłem energii do podłoża (przekładnie, różne typy mechanizmów różnicujących prędkość kół, zwolnice, teoria koła ogumionego).	2
Wy3	Układy napędowe o "sztywnym" i "elastycznym" sprzężeniu kinematycznym. Zagadnienie niezgodności kinematycznej i mocy krążącej w układach napędowych - podstawy fizykalne, skutki techniczne, sposoby eliminacji - przykłady. Sprawność przekładni mechanicznych.	2
Wy4	Podstawy doboru struktury układu napędowego oraz zagadnienia doboru pierwotnego źródła energii: a) typowy układ napędowy mechaniczny b) typowy układ napędowy hydrokinetyczny.Opory ruchu pojazdów i zapotrzebowanie energetyczne maszyn i pojazdów. Teoria koła ogumionego, opory toczenia, współczynnik przyczepności. Charakterystyki trakcyjne pojazdów on-road i offroad.	2
Wy5	Pojazdy elektryczne i ich podział. Parametry określające przydatności silnika elektrycznego stosowanego w układach napędowych pojazdów elektrycznych i hybrydowych. Budowa, metody regulacji prędkości i momentu, mapy sprawności. Obliczanie zredukowanego momentu napędowego i momentu bezwładności do wału silnika. Dobór motoreduktorów i określenia dynamiki układu przeniesienia napędu.	2
Wy6	Hybrydowe szeregowe i równoległe układy napędowe. Metody obliczeń zapotrzebowania mocy podczas ruchu oraz dobór obu źródeł energii, pojemności wtórnego źródła energii, cyklogramy miejskie, poza miejskie.	2
Wy7	Podstawy hamowania rekuperacyjnego pojazdów. Odzysk energii, strategie sterowania układem hamulcowym. Kolokwium zaliczeniowe 45min.	3
		Suma: 15
	Forma zajęć – Laboratorium	Liczba godzin
Lab1	Badania eksperymentalne hydrostatycznego układu napędowego jazdy pojazdu przemysłowego	2
Lab2	Badania eksperymentalne hydrostatycznego układu napędowego unoszenia wysięgnika pojazdu przemysłowego	2
Lab3	Wyznaczanie charakterystyki zewnętrznej silnika spalinowego z zapłonem samoczynnym	2
Lab4	Eksperymentalne wyznaczanie charakterystyki wybranego odbiornika energii i określenie sprawności przeniesienia napędu	2
Lab5	Badanie wpływu sztywności więzi sprężystej w układzie napędowym na jego obciążenia dynamiczne	2
Lab6	Badania eksperymentalne napędu hybrydowego podwozia na gąsienicach elastomerowych	2
Lab7	Porównanie procesu rozruchu układu napędowego z silnikiem asynchronicznym	2
Lab8	Zajęcia organizacyjne. Przedstawienie zasad zaliczenia kursu, planu, BHP. Ogólne wiadomości o realizowanym kursie.	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. prezentacja multimedialna N2. eksperyment laboratoryjny N3. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01 PEU_W02 PEU_W03	egzamin pisemny
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01-PEU_U03 PEU_K01-PEU_K03	kartkówka, sprawozdanie z ćwiczeń, odpowiedź ustna
P = pozytywne oceny z wszystkich ćwiczeń laboratoryjnych		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA Szumanowski A. , tytuł: Układy napędowe z akumulacja energii, PWN, Pieczonka K. , tytuł: Maszyny urabiające, Politechnika Wrocławska, Szydelski Z. , tytuł: Napęd i sterowanie hydrauliczne, WKŁ, Kaczmarek T., tytuł: Napęd elektryczny robotów, Wydawnictwo Politechniki Poznańskiej, Wróbel T. , tytuł: Silniki krokowe, Wydawnictwo Naukowo-Techniczne, Kosmol J., tytuł: Serwonapędy obrabiarek sterowanych numerycznie, Wydawnictwo Naukowo-Techniczne, LITERATURA UZUPEŁNIAJĄCA Dębicki M., tytuł: Teoria samochodu, WNT , rok: Szumanowski A. , tytuł: Czas energii, WKiŁ, rok: 1988 Mitschke M. , tytuł: Dynamika samochodu. Napęd i hamowanie., WKiŁ, Michałowski K. Ocioszyński J.,tytuł: Pojazdy samochodowe o napędzie elektrycznym i hybrydowym, WKiŁ, rok: 1989

OPIEKUN PRZEDMIOTU
dr inż. Aleksander Skurjat tel.: 71 320-23-46 email: Aleksander.Skurjat@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Fundamentals of Machine Design I (Podstawy konstrukcji maszyn I)**
Nazwa przedmiotu w języku angielskim: **Fundamentals of Machine Design I**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3097**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30		15	30	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	90		60	60	
Forma zaliczenia	Egzamin		Zaliczenie na ocenę	Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	3		2	2	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			2	2	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.8		1.4	1.4	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Wiedza:1. Ma podstawową wiedzę o rodzajach materiałów inżynierskich, ich budowie, własnościach i właściwościach, obróbce, zastosowaniach i zasadach doboru. 2. Posiada elementarną wiedzę z zakresu mechaniki, wytrzymałości materiałów i technik wytwarzania. 3. Ma wiedzę w zakresie metod odwzorowywania tworów geometrycznych na płaszczyźnie oraz zasad zapisu konstrukcji elementów maszynowych i wykonywania ich schematów.
2. Umiejętności:1. Potrafi czytać i interpretować rysunki i schematy stosowane w dokumentacji technicznej, potrafi wykonywać dokumentacje techniczną. 2. Ma umiejętność samokształcenia się oraz potrafi pozyskiwać informacje z różnych źródeł, dokonywać ich interpretacji, a także wyciągać wnioski oraz formułować i uzasadniać opinie. 3. Potrafi zastosować w procesie konstruowania wiedzę zdobytą na przedmiotach: Metaloznawstwo, Mechanika, Wytrzymałość materiałów, Grafika inżynierska.
3. Kompetencje: 1. Potrafi myśleć i działać w sposób przedsiębiorczy. 2. Ma świadomość powagi i skutków działalności inżyniera mechanika i rozumie potrzebę działania profesjonalnego (zarówno indywidualnie jak i zespołowo).

CELE PRZEDMIOTU

C1. Nabycie podstawowej wiedzy dotyczącej procesu projektowo-konstrukcyjnego, algorytmicznych i heurystycznych metod tworzenia koncepcji oraz kryteriów ich oceny i wyboru.
C2. Zdobycie wiedzy z zakresu budowy, działania i eksploatacji głównych elementów maszynowych (połączeń) oraz zasad ich doboru i konstruowania.
C3. Zdobycie praktycznej umiejętności realizacji prostego typowego zadania konstrukcyjnego poprzez rozwiązanie zadania, którego treścią jest skonstruowanie prostego urządzenia o napędzie śrubowym (np. prasa śrubowa, ściągacz do łożysk, podnośnik nożycowy, podnośnik samochodowy itp.) z jednoczesnym wykorzystaniem wiedzy dotyczącej połączeń stosowanych w budowie maszyn (śrubowych, sworzniowych, kołkowych, wpustowych, wielowypustowych, wielokarbowych, wciskowych , spawanych i sprężystych).

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Ma wiedzę o metodach tworzenia koncepcji, kryteriach ich oceny i wyboru oraz o algorytmie projektowo-konstrukcyjnym.
PEU_W02 - Ma podstawową wiedzę na temat połączeń w budowie maszyn, ich konstrukcji i obliczeń wytrzymałościowych oraz zastosowaniu.
PEU_W03 - Ma wiedzę o czynnikach wpływających na wytrzymałość zmęczeniową elementów maszynowych i sposobie ich uwzględniania w obliczeniach konstrukcyjnych.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi samodzielnie formułować i rozwiązywać proste zadania techniczne.
PEU_U02 - Potrafi dobrać i obliczyć podstawowe połączenia stosowane w budowie maszyn.
PEU_U03 - Potrafi dobrać optymalne (w świetle przyjętych kryteriów) elementy maszynowe i zna ich ograniczenia.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Potrafi wyszukiwać informacje i dokonywać ich krytycznej analizy.
PEU_K02 - Potrafi pracować samodzielnie i w zespole.
PEU_K03 - Obiektywnie ocenia zadanie, założenia projektowe oraz potrafi uzasadnić wybrane rozwiązanie i sposób jego realizacji.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Program i wymagania. Zdefiniowanie pojęcia wytworu technicznego i konstrukcji. Cechy konstrukcyjne, zasady konstrukcji. Racje istnienia wytworu.	2
Wy2	Projektowanie, a konstruowanie - różnice. Algorytm projektowo- konstrukcyjny, charakterystyka jego etapów, przykłady.	2
Wy3	Algorytmiczne i heurystyczne metody tworzenia koncepcji (metoda pytań elementarnych, tablice i skrzynki morfologiczne, analogia biologiczna i antropomorficzna, burza mózgów, metoda 6 3 5 oraz delficka).	2

Wy4	Kryteria oceny koncepcji. Metody wyboru najlepszego rozwiązania: metoda bilansowania cech pozytywnych i negatywnych, metoda ważenia kryteriów metoda ważenia wariantów rozwiązań. Przykład.	2
Wy5	Naprężenia zmęczeniowe, wytrzymałość zmęczeniowa i sposób jej wyznaczania. Wykres zmęczeniowy Smitha i Haighea.	2
Wy6	Czynniki wpływające na obniżenie wytrzymałości zmęczeniowej elementu maszynowego i sposób ich uwzględnienia w obliczeniach konstrukcyjnych. Zmęczeniowy współczynnik spiętrzenia naprężeń β.	2
Wy7	Metody podwyższania wytrzymałości zmęczeniowej. Naprężenia dopuszczalne k - sposób ich wyznaczania. Współczynnik bezpieczeństwa i rzeczywisty współczynnik bezpieczeństwa.	2
Wy8	Rzeczywisty współczynnik bezpieczeństwa w przypadku złożonego stanu naprężeń. Etapy realizacji obliczeń wytrzymałościowych elementów maszynowych obciążonych siłami zmiennymi. Przykład obliczeniowy (wałek w przekładni zębatej).	2
Wy9	Połączenia w budowie maszyn, klasyfikacja i ogólna ich charakterystyka. Połączenia gwintowe, charakterystyka gwintów oraz wyznaczenie sił i momentów na gwincie.	2
Wy10	Sprawność i samohamowność złącza śrubowego. Minimalna wysokość nakrętki w złączu śrubowym.	2
Wy11	Sposób obliczania złączy śrubowych, wykres złącza śrubowego podatnego.	2
Wy12	Połączenia wpustowe, wielowypustowe, wielokarbowe i kołkowe. Ich charakterystyka i zasady obliczeń.	2
Wy13	Połączenia sworzniowe i spawane. Charakterystyka, sposoby kształtowania i zasady obliczeń.	2
Wy14	Połączenia wciskowe. Analityczne podstawy doboru geometrii i pasowania elementów połączenia wciskowego.	2
Wy15	Stalowe łączniki sprężyste. Podstawy wytrzymałościowych obliczeń wybranych rodzajów sprężyn. Kształtowanie walcowych sprężyn śrubowych.	2
		Suma: 30
	Forma zajęć – Laboratorium	Liczba godzin
Lab1	Wprowadzenie. Szkolenie BHP. Identyfikacja znormalizowanych elementów maszyn.	1
Lab2	Wyznaczanie sztywności statycznej, energii przejmowanej i rozpraszanej elementów sprężysto-tłumiących.	2
Lab3	Wyznaczanie charakterystyki tarciowej poprzecznego łożyska ślizgowego.	2
Lab4	Wyznaczanie oporów ruchu łożysk tocznych stożkowych.	2
Lab5	Teoretyczna oraz praktyczna identyfikacja zjawiska rezonansu w wale maszynowym z jedną nie wyważoną masą.	2
Lab6	Badanie połączeń wciskowych.	2
Lab7	Badanie przekładni pasowej z pasem klinowym pod kątem wpływu poślizgu sprężystego w cięgnie na jej sprawność.	2
Lab8	Wyznaczanie charakterystyki złącza śrubowego podatnego.	2

		Suma: 15
Forma zajęć – Projekt		Liczba godzin
Proj1	Opracowanie założeń konstrukcyjnych dla konstruowanego urządzenia.	3
Proj2	Schematy różnych wariantów rozwiązań oraz szkic konstrukcyjny (bez uszczegółowień) wybranego rozwiązania wraz z uzasadnieniem jego przyjęcia.	5
Proj3	Przeprowadzenie obliczeń konstrukcyjnych dla napędu śrubowego i innych elementów w konstruowanym urządzeniu.	12
Proj4	Sporządzenie rysunku złożeniowego projektowanego urządzenia i rysunków wykonawczych wskazanych przez prowadzącego zajęcia.	10
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. ćwiczenia rachunkowe N3. konsultacje N4. eksperyment laboratoryjny N5. praca własna – samodzielne studia i przygotowanie do egzaminu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01 - PEU_W03	egzamin, kartkówki
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01 - PEU_U03, PEU_K01 - PEU_K03	Kartkówki, odpowiedzi ustne, sprawozdanie z ćwiczeń laboratoryjnych
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01 - PEU_U03, PEU_K01 - PEU_K03	obrona projektu, kartkówki, ocena części obliczeniowej projektu, ocena przygotowania projektu
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

1) Robert Mott, Edward Vavrek, Jyhwen Wang, Machine elements in mechanical design, Pearson, 2017
2) Norton, Robert L., Machine Design: An Integrated Approach, Pearson, 2019
3) Shigley, Joseph Edward. Red., Standard Handbook Of Machine Design, McGraw-Hill Education Ltd, 2004

LITERATURA UZUPEŁNIAJĄCA

1) Erik Oberg, Franklin D. Jones, Holbrook Horton, Machinery's Handbook: Large Print, INDUSTRIAL PR INC, 2020
2) Ajeet Singh, Fundamentals of Machine Design: Volume 1, Cambridge University Press, 2017
3) Jack A. Collins, Henry R. Busby, George H. Staab, Mechanical Design of Machine Elements and Machines: A Failure Prevention Perspective, John Wiley & Sons, 2009

OPIEKUN PRZEDMIOTU

dr inż. Tadeusz Leśniewski tel.: 71 320-40-31 email: Tadeusz.Lesniewski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Theory of Mechanisms and Manipulators (Teoria mechanizmów i manipulatorów)**

Nazwa przedmiotu w języku angielskim: **Theory of Mechanisms and Manipulators**

Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**

Specjalność (jeśli dotyczy): **Mechanical engineering design**

Poziom i forma studiów: **I stopień, stacjonarne**

Rodzaj przedmiotu: **obowiązkowy**

Kod przedmiotu: **W10MBM-SI3098**

Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30			30	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60			90	
Forma zaliczenia	Egzamin			Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	2			3	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				3	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2			2.1	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Wiedza w zakresie analizy matematycznej, algebry macierzy
2. Wiedza w zakresie podstawowych praw statyki, kinematyki i dynamiki
3. Umiejętność analizy równań, wyznaczania pochodnych, prostych działań na macierzach i wektorach

CELE PRZEDMIOTU

C1. Nabycie wiedzy w zakresie struktury, kinematyki i dynamiki mechanizmów i manipulatorów
C2. Poznanie i rozumienie własności podstawowych typów mechanizmów i manipulatorów
C3. Nabycie umiejętności wyznaczania wielkości kinematycznych i dynamicznych

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Rozumie podstawy teoretyczne budowy strukturalnej mechanizmów maszyn i robotów
PEU_W02 - Zna metody analizy kinematycznej i dynamicznej układów kinematycznych
PEU_W03 - Potrafi interpretować wyniki analiz, oceniać ich poprawność

II. Z zakresu umiejętności:
PEU_U01 - Potrafi ocenić poprawność strukturalną układów kinematycznych i jej skutki
PEU_U02 - Potrafi wyznaczać wielkości kinematyczne i dynamiczne
PEU_U03 - Potrafi budować modele prostych, płaskich mechanizmów i manipulatorów

III. Z zakresu kompetencji społecznych:
PEU_K01 - Posiada przekonanie o odpowiedzialności za wykonaną pracę

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Struktura mechanizmów, własności ruchowe, więzy bierne	3
Wy2	Kinematyka mechanizmów - metody graficzno-analityczne	3
Wy3	Metody analityczne kinematyki (wektory, rzuty, pochodne)	2
Wy4	Przekładnie zębate obiegowe	2
Wy5	Charakterystyka manipulatorów. Układy płaskie szeregowe i równoległe	2
Wy6	Kinematyka manipulatorów płaskich, jakobian	2
Wy7	Opis macierzowy układów przestrzennych	2
Wy8	Notacja Denavita-Hartenberga	2
Wy9	Wprowadzenie do dynamiki mechanizmów	2
Wy10	Analiza kinetostatyczna	3
Wy11	Analiza sił z uwzględnieniem tarcia w parach kinematycznych, sprawność	3
Wy12	Badanie ruchu układów płaskich	2
Wy13	Nierównomierność biegu maszyny, sposoby regulacji	2
		Suma: 30
Forma zajęć – Projekt		Liczba godzin

Proj1	Wprowadzenie do modelowania mechanizmów w programie SAM (Simulation and Analysis of Mechanisms) – przykłady symulacji	2
Proj2	Struktura mechanizmów: zasady schematyzacji, analiza strukturalna - klasyfikacja par kinematycznych, określanie ruchliwości (kartkówka, zadanie projektowe)	2
Proj3	Reguły modelowania w SAM, samodzielne tworzenie prostych modeli, symulacja pracy, prezentacja wyników.	2
Proj4	Modelowanie mechanizmów z wymiarami, definiowanie napędów, mas, obciążeń.	2
Proj5	Analiza kinematyczna - wyznaczanie położeń (zadanie projektowe)	2
Proj6	Analiza kinematyczna – wyznaczanie prędkości i przyśpieszeń – metody wektorowe (kartkówka, zadanie projektowe)	2
Proj7	Analiza kinematyczna – wyznaczanie prędkości i przyśpieszeń w programie SAM (zadanie projektowe)	2
Proj8	Analiza kinematyczna metodami analitycznymi: równania konturowe, wektory, rzuty, pochodne (zadanie projektowe)	2
Proj9	Manipulatory płaskie – macierzowy opis kinematyki (zadanie projektowe)	2
Proj10	Modelowanie manipulatorów w programie SAM: zadanie proste i odwrotne (zadanie projektowe)	2
Proj11	Analiza mechanizmów obiegowych, wyznaczanie przełożeń (kartkówka, zadanie projektowe)	2
Proj12	Modelowanie przekładni obiegowych i mechanizmów dźwigniowo-zębatych w programie SAM (zadanie projektowe)	2
Proj13	Wyznaczanie sił oddziaływania i wielkości równoważących (kartkówka, zadanie projektowe)	2
Proj14	Wyznaczanie sił oddziaływania z uwzględnieniem tarcia (kartkówka, zadanie projektowe)	2
Proj15	Analiza sił dynamicznych w programie SAM	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład problemowy N2. wykład tradycyjny z wykorzystaniem transparencji i slajdów N3. praca własna - przygotowanie do projektu N4. konsultacje N5. praca własna – samodzielne studia i przygotowanie do egzaminu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	egzamin pisemny
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03	obrona projektu, kartkówka
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
1. Gronowicz A.: Podstawy analizy układów kinematycznych. Oficyna Wydawnicza PWr., Wrocław 2003;
2. Morecki A., Knapczyk J., Kędzior K.: Teoria mechanizmów i manipulatorów. WNT 2002;
3. Miller S.: Teoria maszyn i mechanizmów. Analiza układów mechanicznych. Oficyna Wydawnicza PWr. Wrocław 1996;
4. Gronowicz A. i inni: Teoria maszyn i mechanizmów. Zestaw problemów analizy i projektowania. Oficyna Wydawnicza PWr. Wrocław 2002

LITERATURA UZUPEŁNIAJĄCA
1. Olędzki A.: Podstawy teorii maszyn i mechanizmów. WNT 1987;
2. Morecki A., Oderfeld J.: Teoria maszyn i mechanizmów. PWN 1987;
3. Waldron K., Kinzel G.: Kinematics, Dynamics and Design of Machinery. John Wiley &Sons, Inc. 1999

OPIEKUN PRZEDMIOTU

dr inż. Artur Handke tel.: 71 320-27-10 email: artur.handke@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Geometric Metrology (Metrologia wielkości geometrycznych)**
Nazwa przedmiotu w języku angielskim: **Geometric Metrology**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3099**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30		30		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	1		1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6		0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma podstawową wiedzę w zakresie matematyki i fizyki na poziomie szkoły ponadpodstawowej.
2. Posiada umiejętność odczytywania rysunków i schematów zawartych w dokumentacji technicznej.
3. Posiada podstawową wiedzę w zakresie konstrukcji elementów maszyn. Posiada podstawową wiedzę w zakresie technik wytwarzania elementów maszyn

CELE PRZEDMIOTU

C1. Nabycie wiedzy o wielkościach i jednostkach miar związanych z opisem geometrii wyrobu.
C2. Nabycie wiedzy na temat rodzajów i właściwości sprzętu do pomiaru wielkości geometrycznych
C3. Zdobycie umiejętności posługiwania się sprzętem do pomiaru wielkości geometrycznych
C4. Zdobycie wiedzy i umiejętności w zakresie doboru sprzętu pomiarowego, analizy wyników pomiarów, oceny błędów pomiarów i sposobu wyrażania niepewności pomiarowej
C5. Wyszukiwanie istotnych informacji oraz ich krytyczna analiza
C6. Nabywanie i utrwalanie kompetencji społecznych obejmujących inteligencję emocjonalną, polegającą na współpracy w grupie studenckiej mającej na celu efektywne rozwiązywanie problemów. Odpowiedzialność, uczciwość i rzetelność w postępowaniu, przestrzeganie, obyczajów obowiązujących w środowisku akademickim

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Potrafi zidentyfikować wielkości związane z opisem geometrii wyrobu, umie nazwać jednostki miar służących do ich opisu, rozróżnia uniwersalny i dedykowany sprzęt do pomiaru wielkości geometrycznych, wie jak scharakteryzować jego cechy i właściwości metrologiczne. Zna i potrafi objaśnić pojęcia stosowane w metrologii wielkości geometrycznej
PEU_W02 - Potrafi zdefiniować elementy procesu pomiarowego i ich wpływ na efekt pomiaru

II. Z zakresu umiejętności:
PEU_U01 - Rozumie wymagania wymiarowe stawiane wyrobom, zawarte w dokumentacji technicznej. Potrafi korzystać z norm dotyczących tolerancji wymiarów liniowych i pasowań a także tolerancji geometrycznych. Potrafi szacować niepewność pomiarową dla różnego rodzaju pomiarów.
PEU_U02 - Umie dokonać doboru odpowiedniego sprzętu pomiarowego oraz dokonać jego konfiguracji w zależności od postawionego zadania pomiarowego. Potrafi korzystać z sprzętu pomiarowego stosowanego w przemyśle maszynowym do pomiaru wielkości geometrycznych

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Sprawy organizacyjne. Podstawowe pojęcia metrologii. Wielkości i jednostki miar. Układy jednostek miar SI, wzorce jednostek miar, spójność pomiarowa.	2
Wy2	Klasyfikacja sprzętu pomiarowego do pomiaru geometrii wyrobów i jego charakterystyki metrologiczne.	3
Wy3	Niepewność pomiarowa, jej źródła w pomiarach wielkości geometrycznych. Rola niepewności w orzekaniu o zgodności lub niezgodności wyrobu ze specyfikacją.	2
Wy4	Rodzaje charakterystyk wymiarowych wyrobu. Sposoby ich specyfikacji oraz tolerowanie zgodnie z zapisem norm z serii ISO GPS	2
Wy5	Rodzaje charakterystyk geometrycznych wyrobu. Sposoby ich specyfikacji oraz tolerowanie zgodnie z zapisem norm z serii ISO GPS	2

Wy6	Rodzaje charakterystyk struktury geometrycznej powierzchni wyrobu. Sposoby ich specyfikacji oraz tolerowanie zgodnie z zapisem norm z serii ISO GPS	2
Wy7	Podstawy współrzędnościowej techniki pomiarowej geometrii wyrobów.	2
		Suma: 15

Forma zajęć – Laboratorium		Liczba godzin
Lab1	Sprawy organizacyjne. Ogólne zasady posługiwania się sprzętem pomiarowym	1
Lab2	Pomiary wymiarów liniowych	2
Lab3	Pomiary wymiarów kątowych i stożków	2
Lab4	Pomiary odchyłek geometrycznych	2
Lab5	Pomiary struktury geometrycznej powierzchni	2
Lab6	Identyfikacja i pomiary gwintów zewnętrznych	2
Lab7	Identyfikacja i pomiary kół zębatych walcowych	2
Lab8	Podstawy pomiarów współrzędnościowych	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. eksperyment laboratoryjny N3. przygotowanie sprawozdania N4. praca własna – przygotowanie do laboratorium N5. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01; PEU_W02;	kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się

F1	PEU_U01; PEU_U02;	sprawozdanie z ćwiczeń laboratoryjnych, kartkówka, odpowiedzi ustne
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA [1] Jakubiec W., Malinowski J.: "Metrologia wielkości geometrycznych". WNT, Warszawa 2018. [2] Instrukcje do ćwiczeń laboratoryjnych. (www.metrologia.pwr.edu.pl) LITERATURA UZUPEŁNIAJĄCA [1] Lisowski M.: „Podstawy Metrologii". Oficyna Wydawnicza PWr, Wrocław 2015 [2] Adamczak S., Makieła W.: " Metrologia w budowie maszyn. Zadania z rozwiązaniami. Wydanie II, zmienione". WNT, Warszawa 2022. [3] Adamczak S., Makieła W.: "Pomiary geometryczne powierzchni". WNT, Warszawa 2009. [4] Jakubiec W., Malinowski J., Płowucha W.: "Pomiary gwintów w budowie maszyn". WNT, Warszawa 2010. [5] Ochęduszko K., "Koła zębate. Tom 3. Sprawdzanie". WNT Warszawa 2013 [6] Ratajczyk E., Woźniak A.: "Współrzędnościowe Systemy Pomiarowe". Oficyna Wydawnicza PW, Warszawa 2016

OPIEKUN PRZEDMIOTU
dr inż. Marek Kuran tel.: 27-28 email: marek.kuran@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Chipless Processes -Plastic Forming**
Nazwa przedmiotu w języku angielskim: **Chipless Processes -Plastic Forming**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3100**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60		30		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	2		1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2		0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Posiada wiedzę o podstawowych własnościach mechanicznych materiałów metalicznych
2. Posiada podstawową wiedzę z zakresu matematyki, fizyki i mechaniki
3. Posiada umiejętności w zakresie metod pomiaru, technik mierzenia i oceny wyników pomiaru.

CELE PRZEDMIOTU

C1. Poznanie różnych technologii wytwarzania wyrobów poprzez obróbkę plastyczną. Poznanie wpływu stosowanego sposobu kształtowania na własności wytwarzanych wyrobów.
C2. Poznanie zjawisk ograniczających procesy kształtowania plastycznego.
C3. Poznanie nowoczesnych technologii związanych z kształtowaniem plastycznym.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Zna podstawowe technologie plastycznego kształtowania i istotne parametry procesu.
PEU_W02 - Potrafi w sposób prawidłowy definiować problem z zakresu plastycznego kształtowania i odpowiednio go scharakteryzować.
PEU_W03 - Potrafi dobrać odpowiednią technologię kształtowania plastycznego oraz określić podstawowe parametry procesu.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi wyszukiwać informacje dotyczące plastycznego kształtowania oraz przeprowadzać ich krytyczną analizę
PEU_U02 - Potrafi wykorzystać wiedzę teoretyczną z zakresu obróbki plastycznej zdobytą na wykładzie i zastosować ją w praktyce
PEU_U03 - Potrafi przeprowadzić wybrane badania laboratoryjne i prawidło ocenić ich wyniki.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Potrafi myśleć i działać w sposób kreatywny
PEU_K02 - Nabywa umiejętność pracy zespołowej.
PEU_K03 - Rozumie skutki działalności inżynierskiej.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie; Definicje, zakres oraz historia obróbki plastycznej metali	2
Wy2	Wpływ odkształcania na strukturę i właściwości materiału.	2
Wy3	Obróbka objętościowa. Analiza procesu walcowania blach i profili.	2
Wy4	Przebieg i analiza procesu wyciskania, rodzaje procesów wyciskania	2
Wy5	Przebieg i analiza procesów kucia.	2
Wy6	Wytwarzanie wyrobów metalowych w procesie ciągnienia.	2
Wy7	Procesy kształtowania blach.Analiza procesów cięcia, gięcia i tłoczenia.	2
Wy8	Kolokwium zaliczeniowe	1
		Suma: 15
Forma zajęć – Laboratorium		Liczba godzin

Lab1	Wprowadzenie, zasady BHP. Odkształcanie na zimno i wyżarzanie	2
Lab2	Walcowanie blach i kształtowników.	2
Lab3	Wyciskanie hutnicze i części maszyn.	2
Lab4	Wytwarzanie wyrobów metalowych w procesie ciągnienia.	2
Lab5	Kucie swobodne i matrycowe.	2
Lab6	Tłoczenie- cięcie, gięcie i wytłaczanie.	2
Lab7	Badanie tłoczności blach.	2
Lab8	Zaliczenie.	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. praca własna – przygotowanie do laboratorium N3. przygotowanie sprawozdania N4. eksperyment laboratoryjny

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01÷ PEU_W03	kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01÷PEU_U03 PEU_K01÷PEU_K03	kartkówki, sprawozdanie z ćwiczeń laboratoryjnych, udział w dyskusjach problemowych
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

Gronostajski J., Obróbka plastyczna metali, Wrocław 1974

LITERATURA UZUPEŁNIAJĄCA

http://www.metalplast.pwr.wroc.pl/instrukcje.html

OPIEKUN PRZEDMIOTU

dr hab. inż. Marek Hawryluk tel.: +48 71 32021-64 email: marek.hawryluk@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Chipless Processes -Welding Metallurgy**
Nazwa przedmiotu w języku angielskim: **Chipless Processes -Welding Metallurgy**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3101**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60		30		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	2		1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2		0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma wiedzę o podstawowych własnościach mechanicznych materiałów inżynierskich; ma uporządkowaną wiedzę o rodzajach metalicznych materiałów inżynierskich - ich budowie, właściwościach, zastosowaniach i zasadach doboru. Ma dostateczną wiedzę w zakresie struktur stali i żeliw, zasad ich klasyfikacji i oznaczania; ma podstawową wiedzę na temat obróbki cieplnej i cieplno-chemicznej, ma wiedzę o stalach stopowych oraz metalach i stopach nieżelaznych.

CELE PRZEDMIOTU

C1. Zapoznanie studentów z procesami i technikami spawalniczymi stosowanymi w budowie maszyn.
C2. Nabycie wiedzy w zakresie technik spawalniczych oraz umiejętności doboru parametrów dla tych procesów.
C3. Nabywanie i utrwalanie kompetencji społecznych obejmujących umiejętność współpracy w grupie studenckiej mającej na celu efektywne rozwiązywanie problemów inżynierskich.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Zna podstawowe metody spajania i parametry procesów oraz posiada wiedzę z zastosowań metod spawania, zgrzewania i lutowania w wytwarzaniu wyrobów.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi dobrać odpowiednią metodę łączenia elementów wyrobu oraz określić podstawowe parametry procesu.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Ma świadomość odpowiedzialności za pracę własną oraz gotowość podporządkowania się zasadom pracy w zespole i ponoszenia odpowiedzialności za wspólnie realizowane zadania, prawidłowo ocenia priorytety zadań własnych i grupowych

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie do spawalnictwa. BHP prac spawalniczych.	2
Wy2	Spawanie ręczne elektrodami otulonymi. Spawanie łukiem krytym.	2
Wy3	Spawanie w osłonie gazów ochronnych TIG, MIG, MAG.	2
Wy4	Spawanie laserowe.	2
Wy5	Zgrzewanie rezystancyjne. Zgrzewanie tarciowe.	2
Wy6	Lutowanie miękkie i twarde.	2
Wy7	Klejenie.	2
Wy8	Test zaliczający.	1
		Suma: 15
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Spawalnictwo – wprowadzenie i BHP.	1
Lab2	Spawanie ręczne elektrodami otulonymi.	2
Lab3	Spawanie w osłonie gazów ochronnych TIG, MIG, MAG.	2
Lab4	Naprężenia i odkształcenia spawalnicze. Spawanie łukiem krytym.	2

Lab5	Zgrzewanie elektryczne oporowe i zgrzewanie tarciowe.	2
Lab6	Lutowanie twarde i miękkie.	2
Lab7	Spawanie gazowe stali. Cięcie termiczne - tlenowe i plazmowe.	2
Lab8	Spawanie zrobotyzowane.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. prezentacja multimedialna N3. praca własna – przygotowanie do laboratorium N4. eksperyment laboratoryjny

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01	Test zaliczeniowy
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_K01	kartkówka
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA [1] Ambroziak A. (red.): Techniki Wytwarzania. Spawalnictwo. Laboratorium PWr, skrypt, 2010 [2] Pilarczyk J. (red.): Poradnik inżyniera. Spawalnictwo. tom 1 i 2. PWN, 2003 LITERATURA UZUPEŁNIAJĄCA [1] Klimpel A.: Spawanie, Zgrzewanie i Cięcie Metali., WNT, 1999 [2] Ferenc J., Ferenc K.: Konstrukcje spawane: połączenia, PWN, 2018

OPIEKUN PRZEDMIOTU
dr inż. Tomasz Szulc tel.: 21-25 email: tomasz.szulc@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Strength of Materials (Wytrzymałość materiałów)**
Nazwa przedmiotu w języku angielskim: **Strength of Materials**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3102**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30	15			
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60	60			
Forma zaliczenia	Egzamin	Zaliczenie na ocenę			
Grupa kursów					
Liczba punktów ECTS	2	2			
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		2			
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2	1.4			

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Znajomość podstaw mechaniki ciała stałego: analizy tensorowej, praw statyki.
2. Znajomość podstaw wytrzymałości materiałów
3. Znajomość matematyki wyższej w zakresie rachunku całkowego i różniczkowego - rozwiązywanie równań różniczkowych

CELE PRZEDMIOTU

C1. Rozwiązywanie problemów technicznych w oparciu o prawa mechaniki
C2. Wykonywanie analiz wytrzymałościowych elementów maszyn
C3. Uzyskanie wiedzy z zakresu metod energetycznych w mechanice ciała odkształcalnego

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Student wie jak wyznaczać naprężenia i przemieszczenia w tarczach wirujących oraz w rurach i zbiornikach grubościennych, zna teorię cienkościennych powłok osiowo-symetrycznych, obciążonych ciśnieniem
PEU_W02 - Zna podstawy teoretyczne i metody wyznaczania naprężeń w złożonym stanie naprężenia w dowolnym elemencie konstrukcyjnym
PEU_W03 - Umie zdefiniować energię sprężystą układu i formułować tw. Castigliano i Menabrea-Castigliano

II. Z zakresu umiejętności:
PEU_U01 - Umie sprawdzić warunek wytrzymałościowy i ocenić stan wytężenia w tarczach wirujących oraz w rurach i zbiornikach grubościennych, zna teorię cienkościennych powłok osiowo-symetrycznych, obciążonych ciśnieniem
PEU_U02 - Umie zastosować twierdzenie Castigliano do wyznaczenia przemieszczeń konstrukcji jak również metodę Menabrea-Castigliano do obliczeń układów hiperstatycznych
PEU_U03 - Student potrafi zaprojektować układy mechaniczne oraz przeprowadzić ich analizę wytrzymałościową

III. Z zakresu kompetencji społecznych:
PEU_K01 - potrafi i rozumie potrzebę ciągłego doszkalania się i pozyskiwania nowych informacji.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wieloosiowy stan wytężenia; analiza wybranych, inżynierskich przypadków obciążeniowych oraz ocena stanu wytężenia w oparciu o wybrane hipotezy wytężeniowe	2
Wy2	Metody energetyczne do wyznaczania przemieszczeń w układach prętowych. Układy statycznie niewyznaczalne	2
Wy3	Wyznaczanie przemieszczeń metodą Maxwella-Mohra. Metoda sił.	2
Wy4	Zginanie prętów silnie zakrzywionych	2
Wy5	Ściskanie mimośrodowe prętów smukłych	2
Wy6	Cylindry grubościenne jedno- i wielowarstwowe	2
Wy7	Tarcze i krążki wirujące	2
Wy8	Płyty kołowe obciążone symetrycznie i prostokątne	2
Wy9	Powłoki osiowo-symetryczne	2
Wy10	Obciążenie elementu zależne od czasu i temperatury (pełzanie i relaksacja).	2
Wy11	Zmęczenie materiału – podstawy obliczeń	2
Wy12	Podstawy mechaniki pękania. Określanie prędkości propagacji pęknięć	2
Wy13	Obciążenia udarowe elementów prętowych	2
Wy14	Naprężenia stykowe. Naprężenia przy ściskaniu kul i wałków	2
Wy15	Naprężenia własne – przyczyny powstawania, zapobieganie, badania	2
		Suma: 30

Forma zajęć – Ćwiczenia		Liczba godzin
Ćw1	Obliczenia elementów konstrukcyjnych w złożonym stanie naprężeń	3
Ćw2	Obliczanie przemieszczeń konstrukcji w układach statycznie wyznaczalnych z wykorzystaniem metod energetycznych	2
Ćw3	Układy statycznie niewyznaczalne - rozwiązywanie zadań z wykorzystaniem tw. Menabrea-Castigliano	2
Ćw4	Cylindry grubościenne jedno- i wielowarstwowe - obliczenia	2
Ćw5	Tarcze i krążki wirujące - obliczenia	2
Ćw6	Powłoki osiowo-symetryczne - obliczenia	2
Ćw7	Kolokwium zaliczeniowe	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. ćwiczenia rachunkowe

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	egzamin
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Ćwiczenia)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03	kolokwium zaliczeniowe
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

[1] M. E. Niezgodziński, T. Niezgodziński: Wytrzymałość materiałów, PWN, 1998.
[2] Z. Dyląg, A. Jakubowicz, Z. Orłoś: Wytrzymałość materiałów. Tom I. WNT, 1999.
[3] M. Zakrzewski, J. Zawadzki: Wytrzymałość materiałów, PWN, 1983.
[4] Z. Brzoska: Wytrzymałość materiałów. PWN, 1979.
[5] R. Żuchowski: Wytrzymałość materiałów, Oficyna Wydawnicza PWr., 1996.
[6] M.E. Nizgodziński, T. Niezgodziński: Obliczenia zmęczeniowe elementów maszyn, PWN, Warszawa 1973
[7] Jakowluk A.: Procesy pełzania i zmęczenia w materiałach, WN-T, 1998,
[8] German J. Podstawy mechaniki pękania, Wyd. Politechniki Krakowska, 2011

LITERATURA UZUPEŁNIAJĄCA

[1] S. Katarzyński, S. Kocańda, M. Zakrzewski: Badania własności mechanicznych metali. WNT, 1967.
[2] J. Walczak: Wytrzymałość materiałów oraz podstawy teorii sprężystości i plastyczności, PWN, 1973.
[3] S. Kocańda: Zmęczeniowe niszczenie metali, WN-T, Warszawa 1978,
[4] S. Kocańda, J. Szala., Podstawy obliczeń zmęczeniowych, PWN, Warszawa 1985,
[5] Brózda J.: Wprowadzenie do mechaniki pękania, Politechnika Śląska, Instytut Spawalnictwa, Gliwice 2008

OPIEKUN PRZEDMIOTU

dr hab. inż. Grzegorz Lesiuk tel.: 713204216 email: grzegorz.lesiuk@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Computer Aided Machine Design I (Modelowanie komputerowe w projektowaniu)**

Nazwa przedmiotu w języku angielskim: **Computer Aided Machine Design I**

Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**

Specjalność (jeśli dotyczy): **Mechanical engineering design**

Poziom i forma studiów: **I stopień, stacjonarne**

Rodzaj przedmiotu: **obowiązkowy**

Kod przedmiotu: **W10MBM-SI3103**

Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				30	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Fundamentals of strength of materials, Analytical methods in strength calculations. Knowledge of types of engineering materials.
2. Student can implement a construction project using computer methods in the field of design and numerical analyses.
3. Ability to perform strength analysis using numerical methods.

CELE PRZEDMIOTU

C1. Acquisition of the ability to design the load-bearing structure considering the definied criteria.
C2. Ability to define input data (boundary and initial conditions) necessary for modeling loads acting on the load-bearing structure.
C3. Acquisition the ability to use CAD/CAE systems in designing.
C4. Acquisition and consolidating the ability to work in a group and the ability to search for information.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Student can design a mechanical assembly including the selected criteria, using the appropriate methods, techniques and tools, along with calculations of their components, using the computer-aided design software.
PEU_U02 - Student can correctly formulate the kinetic and kinematic conditions that a machine or machine assembly is subjected to.
PEU_U03 - Student can prepare the documentation concerning the implemented engineering tasks and prepare a presentation of the results of this task.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Acquires the ability to take responsibility for the work done.
PEU_K02 - Able to work in a group, taking different roles.
PEU_K03 - Acquires the teamwork skills.

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Overview of the curriculum. Presentation of the goal and scope of the project. The proposals for the subjects of construction works (multi-body systems).	1
Proj2	Selecting the project subject. Overview of sources: parts catalogs, standards. Neutral design data exchange formats used in CAD.	2
Proj3	Analysis of existing design solutions (multimedia presentation).	2
Proj4	Identification of features and structure. Definition of design assumptions. Analysis of fulfillment of functional requirements and parameters.	2
Proj5	Development of the structural form (considering the kinematic chain) - construction and analysis of the model.	2
Proj6	Analysis of the possibility of using unified subassemblies, parts and drives.	2
Proj7	Development of a preliminary design using CAD systems.	4
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. praca własna - przygotowanie do projektu N2. prezentacja multimedialna N3. prezentacja projektu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02, PEU_K03	Evaluation of the completed project
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
[1] Rusiński E., Czmochowski J., Smolnicki T. Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000
[2] Rakowski G., Kacprzyk Z.: Metoda elementów skończonych w mechanice konstrukcji, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2016
[3] Zienkiewicz O.C.: Metoda elementów skończonych, Arkady 1972

LITERATURA UZUPEŁNIAJĄCA
[1] Szmelter J., Dacko M., Dobrociński S., Wieczorek M.: Metoda elementów skończonych w statyce konstrukcji, Arkady 1979
[2] Gawroński W., Kruszewski J., Ostachowicz W., Tarnowski K., Wittbrodt E.: Metoda elementów skończonych w dynamice konstrukcji, Arkady, Warszawa 1984
[3] Waszczyszyn Z., Cichoń Cz., Radwańska M.: Metoda elementów skończonych w stateczności konstrukcji, Arkady, Warszawa 1990
[4] Kleiber M.: Wprowadzenie do metody elementów skończonych, PWN, Warszawa-Poznań 1989
[5] Cichoń Cz., Cecot W., Krok J., Pluciński P.: Metody Komputerowe w liniowej mechanice konstrukcji, Wydawnictwo Politechniki Krakowskiej, Kraków, 2010
[6] Olszowski B. Wybrane metody numeryczne, Wydawnictwo Politechniki Krakowskiej, Kraków, 2007

OPIEKUN PRZEDMIOTU

dr hab. inż. Jacek Karliński tel.: 71 320-29-46 email: jacek.karlinski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Vehicle Engineering (Budowa pojazdów samochodowych)**
Nazwa przedmiotu w języku angielskim: **Vehicle Engineering**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3104**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	90				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	3				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.8				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Znajomość podstaw konstrukcji maszyn
2. Umiejętność kojarzenia i wykorzystania posiadanej wiedzy

CELE PRZEDMIOTU

C1. Zapoznanie się ze strukturą konstrukcyjną i funkcjonalną układów pojazdu samochodowego
C2. Poznanie podstawowych charakterystyk techniczno-eksploatacyjnych pojazdu samochodowego
C3. Zrozumienie podstawowych zasad doboru rodzajów układów pojazdu samochodowego

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Jest w stanie rozróżnić i scharakteryzować elementy i zespoły pojazdu samochodowego
PEU_W02 - Potrafi zdefiniować i wytłumaczyć ruch pojazdu samochodowego oraz dobrać źródło jego napędu
PEU_W03 - Orientuje się w obecnym stanie i wskazuje trendy rozwojowe w budowie pojazdów samochodowych

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Podstawowe informacje o składnikach systemu transportu drogowego	2
Wy2	Klasyfikacja pojazdów samochodowych. Homologacja. Elementy identyfikacji	2
Wy3	Podstawy mechaniki ruchu pojazdów. Opory ruchu	2
Wy4	Charakterystyki układów napędowych. Dobór źródła napędu pojazdu.	2
Wy5	Budowa podwozi pojazdów samochodowych. Układy: nośny i zawieszenia	2
Wy6	Koła jezdne. Opony	2
Wy7	Budowa układu kierowniczego	2
Wy8	Budowa układu hamulcowego	2
Wy9	Automatyzacja układów pojazdu	2
Wy10	Kryteria oceny bezpieczeństwa samochodowego	2
Wy11	Kompatybilność pojazdów	2
Wy12	Oświetlenie zewnętrzne pojazdu	2
Wy13	Sieci CAN/BUS	2
Wy14	Cechy pojazdów o zabudowach specjalnych	2
Wy15	Kolokwium zaliczeniowe	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. wykład problemowy
N2. prezentacja multimedialna
N3. case study
N4. praca własna – samodzielne studia i przygotowanie do egzaminu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	Aktywność na zajęciach
F2	PEU_W01, PEU_W02, PEU_W03	Kolokwium zaliczeniowe
P = F1*0,2+F2*0,8		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

1.Reimpell J., Betzler J.: Podwozia samochodów. Podstawy konstrukcji. WKŁ Warszawa 2001. Wrzecioniarz P.A., Ambroszko W., Górniak A.: Energy Efficient design of powetrain and body, PWr, 2011.
2.Merkisz, J., Pielecha I., Układy mechaniczne pojazdów hybrydowych, Polit. Poznańska, 2015.
3.Zieliński A., Konstrukcja nadwozi samochodów osobowych i pochodnych. WKiŁ Warszawa 2018
4.Wicher., J. , Bezpieczeństwo samochodów i ruchu drogowego. Pojazdy samochodowe, WKŁ, 2004.
5.Kwaśniowski S. Systemy transportowe. Skr. MWSLiTr we Wrocławiu. W-w 2012

LITERATURA UZUPEŁNIAJĄCA

1. Leon Prochowski, Mechanika ruchu, Pojazdy samochodowe, WKŁ, 2005.
2. Informatory techniczne „Bosch”.
3. Materiały konferencyjne prowadzącego dotyczące rozwiązań układów i zespołów pojazdów samochodowych.
4. Basiewicz T., Gołaszewski A., Rudziński L., Infrastruktura transportu. Of. Wyd. Pol.War. 1998.

OPIEKUN PRZEDMIOTU

dr hab. inż. Zbigniew Sroka email: zbigniew.sroka@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Trybology (Podstawy tribologii)**
Nazwa przedmiotu w języku angielskim: **Trybology**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3105**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60		60		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	2		2		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			2		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2		1.4		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Wiedza:1. Ma uporządkowaną wiedzę o rodzajach materiałów inżynierskich - metalicznych, ceramicznych, polimerowych i kompozytowych.2. Ma podstawową wiedzę dotyczącą budowy, działania i eksploatacji głównych elementów i zespołów maszynowych.3. Ma podstawową wiedzę w zakresie fizyki, chemii, statystyki.
2. Umiejętności:1. Potrafi analizować przełomy makroskopowe, makrostruktury materiałów, wady pochodzenia technologicznego; potrafi określić cechy mikrostruktury materiałów metalicznych.2. Potrafi dobrać materiał na zadany element maszynowy i potrafi zbadać jego podstawowe własności.
3. Kompetencje:1. Ma świadomość ważności i zrozumienie pozatechnicznych aspektów i skutków działalności inżyniera mechanika.2. Ma świadomość ważności zachowania w sposób profesjonalny oraz ma świadomość odpowiedzialności za pracę własną.

CELE PRZEDMIOTU

C1. Zapoznanie z procesami tarcia, zuzycia i smarowania w ruchomych węzłach maszynowych oraz z metodami sterowania tymi procesami pod kątem minimalizacji ich skutków (szczególna uwaga zostanie zwrócona na konstrukcyjne i technologiczne metody podwyższenia niezawodności i trwałości węzłów ślizgowych, jak również na problem smarowania i doboru smaru jako skutecznej profilaktyki tarcia i zużycia).
C2. Poznanie wpływu wybranych parametrów wektora tarcia, tj. nacisku, prędkości poślizgu, materiału współpracujących skojarzeń i smaru na charakterystyki tribologiczne par ślizgowych. Zapoznanie z wpływem struktury materiału na zużycie ścierne oraz wpływem sztywności panwi na rozkład nacisków w łożysku ślizgowym.
C3. Pokazanie studentom, że można skutecznie przeciwdziałać negatywnym skutkom tarcia w ruchomym styku ciał stałych poprzez ilustrację na obiektach rzeczywistych wybranych zagadnień omawianych teoretycznie w ramach wykładu.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Posiada wiedzę na temat procesów tarcia, zużycia i smarowania w ruchomych węzłach maszynowych.
PEU_W02 - Zna podstawowe rodzaje środków smarnych oraz ich zastosowanie.
PEU_W03 - Zna konstrukcyjne i technologiczne metody podwyższenia niezawodności i trwałości węzłów ślizgowych.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi dobierać materiały na węzły ślizgowe i rozumie związki i zależności pomiędzy zastosowanym materiałem a jego trwałością.
PEU_U02 - Potrafi przeprowadzić podstawowe badania właściwości materiałów stosowanych w węzłach trących, interpretować je i wdrażać w gotowych węzłach maszyn.
PEU_U03 - Potrafi wykorzystać wiedzę teoretyczną z zakresu tarcia i smarowania zdobytą na wykładzie i zastosować ją w praktyce.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Potrafi wyszukiwać informacje i krytycznie je analizować.
PEU_K02 - Prawidłowo definiuje i rozstrzyga dylematy, przestrzega zasady etyki zawodowej.
PEU_K03 - Potrafi pracować samodzielnie i zespołowo oraz prawidłowo ocenia priorytety zadań własnych i grupowych.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Program i wymagania. Rys historyczny tribologii.	1
Wy2	Styk sprężysty ciał gładkich. Rzeczywisty styk ciał stałych. Zagadnienie warstwy wierzchniej.Procesy tarcia, pojęcia podstawowe i klasyfikacja. Tarcie ślizgowe i toczne. Teorie tarcia.	2
Wy3	Procesy zużywania, ich podział i charakterystyka. Wpływ nacisku i prędkości poślizgu na tarcie i zużycie.	2
Wy4	Charakterystyka materiałów (metalowych i innych) na węzły ślizgowe oraz reguły ich doboru. Prosta i odwrócona para tarcia.	2

Wy5	Podatność, sztywność i konfiguracja elementów jako czynniki zwiększające odporność na zużycie.	2
Wy6	Smar jako materiał konstrukcyjny. Cele smarowania. Sposoby uzyskiwania tarcia płynnego. Podział środków smarnych. Oleje smarne i ich własności. Klasyfikacja olejów.	2
Wy7	Smary plastyczne, ich podział i charakterystyka. Charakterystyka smarów stałych. Kryteria oceny właściwości smarnych olejów i smarów.	2
Wy8	Kolokwium zaliczeniowe.	2
		Suma: 15

Forma zajęć – Laboratorium		Liczba godzin
Lab1	Wyznaczanie właściwości ślizgowych materiałów łożyskowych.	2
Lab2	Wyznaczanie współczynnika tarcia statycznego.	2
Lab3	Badanie smarności smarów plastycznych na aparacie czterokulowym.	2
Lab4	Wyznaczanie własności ciernych materiałów na hamulce i sprzęgła.	2
Lab5	Analiza wpływu sztywności panwi na rozkład nacisków w łożysku ślizgowym.	2
Lab6	Analiza wpływu struktury materiału na zużycie ścierne (tester T-07).	2
Lab7	Wyznaczanie charakterystyk tribologicznych olejów silnikowych.	2
Lab8	Badanie materiałów na zatarcie.	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. praca własna – przygotowanie do laboratorium N3. eksperyment laboratoryjny N4. konsultacje N5. prezentacja multimedialna

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01 - PEU_W03	kolokwium, kartkówki
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01 - PEU_U03, PEU_K01 - PEU_K03	kartkówka - wejściówka, sprawozdanie z ćwiczeń laboratoryjnych, odpowiedzi ustne
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

[1] Lawrowski Z.; Tribologia: Tarcie, zużywanie i smarowanie, Wydawnictwo Politechniki Wrocławskiej, 2008.
[2] Czarny R.; Smary plastyczne. Warszawa, WNT, 2004.
[3] Ćwiczenia laboratoryjne z podstaw konstrukcji maszyn. Praca zbiorowa pod red. F. Szymankiewicza, skrypt PWr., Wrocław , 1990 (szczegółowe instrukcje ćwiczeniowe zamieszczone na stronie internetowej).
[4] Aktualne czasopisma z zakresu tribologii: „Tribologia”, „Wear”, „Tribology letters”.
[5] Bushan B., Modern tribology handbook, 2000, Taylor & Francis Stmnetbase.

LITERATURA UZUPEŁNIAJĄCA

[1] Bartz W.; Schmierfette, Zusammensetzung, Eingeschaften, Prüfung und Anwen-dung. Renningen, Export Verlag 2000
[2] Lawrowski Z.; Technika smarowania. W-a, PWN
[3] Płaza S.; Fizykochemia procesów tribologicznych, Łódź, Wyd. Uniwersytetu Łódzkiego, 1997

OPIEKUN PRZEDMIOTU

dr inż. Tadeusz Leśniewski tel.: 71 320-40-31 email: Tadeusz.Lesniewski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Hydraulic, Hydrotronic and Pneumatic Systems (Hydrostatyczne układy napędowe)**

Nazwa przedmiotu w języku angielskim: **Hydraulic, Hydrotronic and Pneumatic Systems**

Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**

Specjalność (jeśli dotyczy): **Mechanical engineering design**

Poziom i forma studiów: **I stopień, stacjonarne**

Rodzaj przedmiotu: **obowiązkowy**

Kod przedmiotu: **W10MBM-SI3106**

Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30		30		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	1		1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6		0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Posiada podstawową wiedzę z mechaniki płynów.
2. Potrafi rozwiązywać równania różniczkowe zwyczajne stanowiące modele matematyczne elementów i układów hydraulicznych.
3. Znajomość podstawowych zagadnień z mechaniki klasycznej.

CELE PRZEDMIOTU

C1. Zapoznanie studentów z podstawowymi prawami hydrostatycznych i pneumatycznych układów napędowych.
C2. Zaznajomienie studentów z elementami hydraulicznymi i pneumatycznymi, zasadą ich działania.
C3. Zaznajomienie z konfiguracją prostych hydrostatycznych i pneumatycznych układów napędowych.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - W wyniku przeprowadzonych zajęć student powinien być w stanie definiować wymagania stawiane medium roboczemu stosowanemu w napędach płynowych.
PEU_W02 - W wyniku przeprowadzonych zajęć student powinien być w stanie opisywać zasadę działania podstawowych elementów stosowanych w napędach płynowych.
PEU_W03 - W wyniku przeprowadzonych zajęć student powinien być w stanie scharakteryzować pracę podstawowych układów i napędów płynowych.

II. Z zakresu umiejętności:
PEU_U01 - W wyniku przeprowadzonych zajęć student powinien poprawnie analizować pracę elementów i układów pneumatycznych i hydrostatycznych.
PEU_U02 - W wyniku przeprowadzonych zajęć student powinien poprawnie obliczać podstawowe parametry układów pneumatycznych i hydrostatycznych.
PEU_U03 - W wyniku przeprowadzonych zajęć student powinien poprawnie interpretować podstawowe charakterystyki
elementów i układów pneumatycznych i hydrostatycznych.

III. Z zakresu kompetencji społecznych:
PEU_K01 - W wyniku przeprowadzonych zajęć student powinien posiąść zdolności analizowania informacji o różnym poziomie złożoności.
PEU_K02 - W wyniku przeprowadzonych zajęć student powinien posiąść zdolności obiektywnego oceniania argumentów, racjonalnego tłumaczenia i uzasadniania własnego punktu widzenia z wykorzystaniem wiedzy z zakresu hydrostatycznych układów napędowych.
PEU_K03 - W wyniku przeprowadzonych zajęć student powinien posiąść zdolności przestrzegania obyczajów i zasad obowiązujących w środowisku akademickim.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie, omówienie treści wykładu, wymagań i formy zaliczenia. Podstawowe informacje o napędach płynowych - układy hydrauliczne i pneumatyczne, ciśnienie, przepływ.	2
Wy2	Ciecze robocze w układach płynowych- parametry, czystość, filtracja.	2
Wy3	Straty ciśnienia - stary liniowe, miejscowe, na elementach.	2
Wy4	Sprawności: hydrauliczna, objętościowa i całkowita.	2
Wy5	Pompy wyporowe – podział, charakterystyki, sprawności.	2
Wy6	Zawory sterowania kierunkiem przepływu w napędach płynowych.	2

Wy7	Elementy wykonawcze – podział, charakterystyki, sprawności.	2
Wy8	Egzamin.	1
		Suma: 15
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Laboratorium wprowadzające: zasady BHP, warunki zaliczenia laboratorium, prezentacja stanowisk laboratoryjnych.	2
Lab2	Cieczy robocza – lepkość i moduł sprężystości objętościowej.	2
Lab3	Eksperymentalne wyznaczenie charakteru oporów w przewodach hydraulicznych – opory liniowe.	2
Lab4	Opory miejscowe w układach hydraulicznych. Zwężka jako opór miejscowy – zjawisko kawitacji.	2
Lab5	Eksperymentalne wyznaczenie charakterystyki pompy wyporowej.	2
Lab6	Charakterystyki statyczne konwencjonalnego rozdzielacza suwakowego.	2
Lab7	Systemy przygotowania powietrza, pneumatyczne układy zasilające.	2
Lab8	Zaliczenie.	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. prezentacja multimedialna N3. eksperyment laboratoryjny N4. przygotowanie sprawozdania N5. praca własna – przygotowanie do laboratorium

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03, PEU_K03	Kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02	Sprawozdanie
F2	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02	Kolokwium
P = 0,2F1+0,8F2		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

Kollek W.: Podstawy projektowania napędów i sterowań hydraulicznych. Oficyna Wydawnicza PWr, Wrocław 2004
Szydelski Z.: Napęd i sterowanie hydrauliczne, WKŁ, Warszawa 1999.
Stryczek S.: Napęd hydrostatyczny - Elementy i układy. WNT 1984.
Osiecki A.: Napęd hydrostatyczny maszyn, WNT, Warszawa 1996.

LITERATURA UZUPEŁNIAJĄCA

Jędrzykiewicz Z.: Projektowanie układów hydrostatycznych. Podstawy metodyczno-obliczeniowe. Skrypt 1313. AGH Kraków 1992.
Pizoń A.: Hydrauliczne i elektrohydrauliczne układy sterowania i regulacji. WNT 1987.

OPIEKUN PRZEDMIOTU

Prof. dr hab. inż. Wiesław Fiebig tel.: 71 320-27-00 email: Wieslaw.Fiebig@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Finite Elements Method (Metoda elementów skończonych)**
Nazwa przedmiotu w języku angielskim: **Finite Elements Method**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3107**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15			30	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30			60	
Forma zaliczenia	Zaliczenie na ocenę			Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	1			2	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				2	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6			1.4	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Podstawy wytrzymałości materiałów, analizy wytrzymałościowej układów prętowych, tarczowych i płytowych. Znajomość rodzajów materiałów inżynierskich.
2. Algebra macierzy.
3. Znajomość podstawowych narzędzi CAD. Umiejętność przeprowadzenia analizy wytrzymałościowej metodami klasycznymi w zakresie sprężystym dla prostych elementów konstrukcyjnych.

CELE PRZEDMIOTU

C1. Nabycie wiedzy w zakresie podstaw teorii metody elementów skończonych.
C2. Nabycie umiejętności zbudowania odpowiedniego modelu do obliczeń MES.
C3. Umiejętność przeprowadzenia symulacji komputerowych w programie MES.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Zna podstawy teorii metody elementów skończonych
PEU_W02 - Zna zasady budowy modeli numerycznych (geometrycznych i dyskretnych) elementarnych konstrukcji do obliczeń MES
PEU_W03 - Posiada podstawową wiedzę o możliwościach zastosowania metody elementów skończonych w obliczeniach inżynierskich

II. Z zakresu umiejętności:
PEU_U01 - Posiada umiejętność posługiwania się systemami komputerowymi do prowadzenia obliczeń numerycznych z wykorzystaniem MES.
PEU_U02 - Potrafi zastosować odpowiedni rodzaj modelu geometrycznego i dyskretnego do rozwiązania określonego zadania teorii sprężystości.
PEU_U03 - Potrafi przeprowadzić obliczenia MES w zakresie statyki, drgań własnych i stateczności sprężystej.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Nabywa umiejętności ponoszenia odpowiedzialności za wykonaną pracę.
PEU_K02 - Myśleć i działać w sposób kreatywny.
PEU_K03 - Nabywa umiejętność pracy zespołowej.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Rozwój metod numerycznych	1
Wy2	Miejsce metody elementów skończonych w procesie modelowania układów rzeczywistych	1
Wy3	Istota MES, funkcje interpolacyjne, warunki zbieżności metody	2
Wy4	Klasyfikacja elementów skończonych	2
Wy5	Zasady budowy macierzy sztywności elementów skończonych.	4
Wy6	Modelowanie warunków brzegowych w modelach numerycznych.	2
Wy7	Przykłady praktycznego zastosowania nowoczesnych metod obliczeniowych w projektowaniu CAD (MES)	2
Wy8	Kolokwium	1
		Suma: 15
Forma zajęć – Projekt		Liczba godzin

Proj1	Omówienie programu zajęć laboratoryjnych. Wprowadzenie do środowiska programu obliczeniowego.	1
Proj2	Zasady budowania modelu fizycznego, idealizacja układu, uproszczenia stosowane w modelach fizycznych.	2
Proj3	Dyskretyzacja modeli bryłowych, analiza czynników (rodzaj elementu skończonego, gęstość dyskretyzacji) wpływających na dokładność obliczeń.	6
Proj4	Płaski stan naprężenia na przykładzie tarczy prostokątnej z otworem. Analiza dokładności przy zastosowaniu różnych typów elementów skończonych i wpływ gęstości podziału w porównaniu z rozwiązaniem teoretycznym zagadnienia Kirscha.	4
Proj5	Analiza zginania płyty przy zastosowaniu różnych typów i gęstości podziału elementów powłokowych i bryłowych. Wpływ liczby warstw w modelu bryłowym na dokładność obliczeń przemieszczeń i naprężeń w porównaniu z rozwiązaniem teoretycznym. Wykorzystanie symetrii.	4
Proj6	Analiza stanu naprężeń i sił w elementach kratownicy, przy zastosowaniu raz modelu prętowego i raz modelu belkowego. Analiza stateczności sprężystej elementów kratownicy obliczanej za pomocą modelu belkowego.	6
Proj7	Zagadnienie stateczności sprężystej ściskanej osiowo powłoki walcowej. Analiza wpływu geometrii powłoki (średnicy, długości i grubości) na wartość obciążenia krytycznego. Stateczność lokalna i globalna.	2
Proj8	Zagadnienie osiowo-symetryczne na przykładzie grubościennej rury poddanej ciśnieniu wewnętrznemu. Zagadnienie kontaktowe na przykładzie dwóch rur złożonych z zaciskiem. Analiza rozkładu przemieszczeń promieniowych, naprężeń promieniowych i obwodowych.	2
Proj9	Wykonanie projektu - symulacji komputerowej stanu wytężenia wybranej struktury nośnej.	3
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. ćwiczenia problemowe N3. praca własna - przygotowanie do projektu N4. prezentacja projektu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	Kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03 PEU_K01, PEU_K02, PEU_K03	Ocena za projekt
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

Rusiński E., Czmochowski J., Smolnicki T. Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000

Rakowski G., Kacprzyk Z.: Metoda elementów skończonych w mechanice konstrukcji, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2016

Zienkiewicz O.C.: Metoda elementów skończonych, Arkady 1972

LITERATURA UZUPEŁNIAJĄCA

Szmelter J., Dacko M., Dobrociński S., Wieczorek M.: Metoda elementów skończonych w statyce konstrukcji, Arkady 1979

Gawroński W., Kruszewski J., Ostachowicz W., Tarnowski K., Wittbrodt E.: Metoda elementów skończonych w dynamice konstrukcji, Arkady, Warszawa 1984

Waszczyszyn Z., Cichoń Cz., Radwańska M.: Metoda elementów skończonych w stateczności konstrukcji, Arkady, Warszawa 1990

Kleiber M.: Wprowadzenie do metody elementów skończonych, PWN, Warszawa-Poznań 1989

Cichoń Cz., Cecot W., Krok J., Pluciński P.: Metody Komputerowe w liniowej mechanice konstrukcji, Wydawnictwo Politechniki Krakowskiej, Kraków, 2010

Olszowski B. Wybrane metody numeryczne, Wydawnictwo Politechniki Krakowskiej, Kraków, 2007

OPIEKUN PRZEDMIOTU
dr inż. Artur Górski tel.: 71 320-28-47 email: artur.gorski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Fundamentals of Machine Design II (Podstawy konstrukcji maszyn II)**
Nazwa przedmiotu w języku angielskim: **Fundamentals of Machine Design II**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3108**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30			30	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60			90	
Forma zaliczenia	Egzamin			Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	2			3	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				3	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2			2.1	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Wiedza:1. Ma podstawową wiedzę z zakresu metaloznawstwa, materiałów konstrukcyjnych, mechaniki, wytrzymałości materiałów i technik wytwarzania, grafiki inżynierskiej. 2. Posiada podstawową wiedzę z zakresu Podstaw Konstrukcji Maszyn I (proces projektowo-konstrukcyjny, połączenia stosowane w budowie maszyn) oraz wykonywania dokumentacji technicznej za pomocą programu AutoCAD.
2. Umiejętności: 1. Ma umiejętność samokształcenia się oraz potrafi pozyskiwać informacje z różnych źródeł, dokonywać ich interpretacji, a także wyciągać wnioski oraz formułować i uzasadniać opinie. 2. Potrafi zastosować w procesie konstruowania wiedzę zdobytą na przedmiotach: Metaloznawstwo, Mechanika, Wytrzymałość materiałów, Grafika inżynierska, Podstawy Konstrukcji Maszyn I.
3. Kompetencje:1. Potrafi myśleć i działać w sposób przedsiębiorczy. 2. Ma świadomość powagi i skutków działalności inżyniera mechanika i rozumie potrzebę działania profesjonalnego (zarówno indywidualnie jak i zespołowo).

CELE PRZEDMIOTU

C1. Nabycie podstawowej wiedzy dotyczącej projektowania wałów maszynowych (obliczenia konstrukcyjne, dobór cech geometrycznych, rezonans, osadzanie elementów na wale) oraz elementów podtrzymujących wały - łożyska (charakterystyka łożysk tocznych, kryteria doboru, zasady łożyskowania i pasowania).
C2. Zdobycie wiedzy z zakresu budowy, działania, doboru, obliczeń konstrukcyjnych i eksploatacji sprzęgieł oraz zespołów przenoszących i zmieniających ruch obrotowy (przekładnie mechaniczne pasowe, łańcuchowe i zębate).
C3. Zdobycie praktycznej umiejętności realizacji prostego typowego zadania konstrukcyjnego poprzez rozwiązanie zadania, którego treścią jest optymalna konstrukcja zespołu napędowego maszyny roboczej (np. taśmociągu, młyna kulowego, kruszarki, pieca obrotowego itp.) Proces konstruowania jest wspomagany komputerowo zarówno na etapie doboru cech konstrukcyjnych (używa się komputerowych programów wspomagających obliczenia konstruowanych elementów) jak i na etapie graficznego ich zapisu (AutoCAD).

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Zna algorytm obliczeń konstrukcyjnych wałów maszynowych i elementów podtrzymujących wały.
PEU_W02 - Ma poszerzoną wiedzę w zakresie budowy sprzęgieł, ich zastosowania i doboru oraz obliczeń.
PEU_W03 - Ma podstawową wiedzę na temat budowy, działania, zasad doboru i obliczeń konstrukcyjnych zespołów przenoszących i zmieniających ruch obrotowy (przekładnie mechaniczne: pasowe, łańcuchowe i zębate).

II. Z zakresu umiejętności:
PEU_U01 - Potrafi samodzielnie formułować i rozwiązywać proste zadania techniczne.
PEU_U02 - Potrafi dobrać i obliczyć wały, łożyska, sprzęgła i przekładnie mechaniczne.
PEU_U03 - Potrafi skonstruować optymalny (w świetle przyjętych kryteriów) napęd dowolnej maszyny roboczej.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Potrafi wyszukiwać informacje i dokonywać ich krytycznej analizy.
PEU_K02 - Potrafi pracować samodzielnie i w zespole.
PEU_K03 - Obiektywnie ocenia zadanie, założenia projektowe oraz potrafi uzasadnić wybrane rozwiązanie i sposób jego realizacji.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Program kursu i wymagania. Wały i osie – charakterystyka ogólna. Teoretyczne podstawy doboru cech konstrukcyjnych wałów maszynowych. Zasady kształtowania wałów i osi. Zasady i sposoby ustalania elementów na wałach i osiach.	2
Wy2	Zagadnienie wytrzymałości zmęczeniowo – kształtowej wałów. Zjawisko rezonansu. Obliczenia zespołów obrotowych ze względu na wystąpienie rezonansowych drgań giętych.	2
Wy3	Charakterystyka tarcia tocznego i ślizgowego. Podział łożysk, ogólna charakterystyka łożysk tocznych i ślizgowych. Kryteria i sposób doboru łożysk tocznych.	2

Wy4	Zasady łożyskowania zespołów obrotowych. Pasowanie, smarowanie i uszczelnianie łożysk tocznych.	2
Wy5	Ogólna klasyfikacja sprzęgieł. Charakterystyka sprzęgieł nierozłącznych, zasady ich doboru i obliczeń.	2
Wy6	Charakterystyka sprzęgieł rozłącznych. Analiza procesu włączania. Praca rozruchu i praca tarcia w rozruchu, bilans cieplny i trwałość sprzęgła. Promień tarcia w sprzęgle ciernym.	2
Wy7	Przekładnie pasowe, podział, ogólna charakterystyka i kryteria doboru. Sprzężenie cierne pasa z kołem. Poślizg sprężysty, przełożenie rzeczywiste, współczynnik napędu.	2
Wy8	Wyznaczenie sił i naprężeń w pasie. Wymagana siła napięcia wstępnego w pasie oraz sposoby jej regulacji.	2
Wy9	Sprawność przekładni pasowej i trwałość pasa. Charakterystyka materiałów na pasy. Konstrukcja kół pasowych (dobór cech konstrukcyjnych). Obliczenia konstrukcyjne przekładni pasowych z pasem klinowym.	2
Wy10	Przekładnie cięgnowe cd. Przekładnie łańcuchowe, ich charakterystyka i sposób obliczania.	2
Wy11	Przekładnie zębate, podział i charakterystyka. Podstawowe prawo zazębienia. Poślizg międzyrębny. Omówienie zarysów cykloidalnych i ewolwentowego.	2
Wy12	Zarys odniesienia. Normalizacja kół ewolwentowych. Pojęcia podstawowe: moduł, kąt zarysu, kąt i linia przyporu, odcinek i wskaźnik przyporu. Rola tych parametrów w działaniu i obliczeniach przekładni zębatych. Sposoby obróbki kół zębatych.	2
Wy13	Graniczna liczba zębów ze względu na podcięcie zęba u podstawy. Podstawowe rodzaje korekcji zazębienia. Zaostrzenie zęba u wierzchołka.	2
Wy14	Modele obciążenia zęba przy wyznaczaniu naprężeń. Współczynnik obciążenia. Rozkład sił w zazębieniu prostym i skośnym.	2
Wy15	Encyklopedyczne omówienie zalecanych przez ISO metod obliczeń wytrzymałościowych (sprawdzających) kół zębatych.	2
		Suma: 30
Forma zajęć – Projekt		Liczba godzin
Proj1	Opracowanie założeń konstrukcyjnych dla konstruowanego zespołu napędowego (opis: istoty działania , danych sytuacyjnych, danych ilościowych, warunków eksploatacji itp.).	2
Proj2	Schematy różnych wariantów rozwiązań , oraz szkic konstrukcyjny (bez uszczegółowień) wybranego rozwiązania wraz z uzasadnieniem jego przyjęcia.	4
Proj3	Przyjęcie dla każdego podzespołu układu napędowego kryterium optymalizacji i znalezienie przy pomocy odpowiedniego programu komputerowego najlepszego rozwiązania.	12
Proj4	Sporządzenie rysunku złożeniowego i rysunków wykonawczych (wskazanych przez Prowadzącego zajęcia). Rysunki wykonawcze zrobić obowiązkowo za pomocą programu Auto-CAD.	12
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. ćwiczenia rachunkowe N3. konsultacje N4. praca własna - przygotowanie do projektu N5. praca własna – samodzielne studia i przygotowanie do egzaminu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01 - PEU_W03	egzamin, kartkówki
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01 - PEU_U03, PEU_K01 - PEU_K03	obrona projektu, kartkówki, ocena części obliczeniowej projektu, ocena przygotowania projektu
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
1) Robert Mott, Edward Vavrek, Jyhwen Wang, Machine elements in mechanical design, Pearson, 2017
2) Norton, Robert L., Machine Design: An Integrated Approach, Pearson, 2019
3) Shigley, Joseph Edward. Red., Standard Handbook Of Machine Design, McGraw-Hill Education Ltd, 2004

LITERATURA UZUPEŁNIAJĄCA
1) Erik Oberg, Franklin D. Jones, Holbrook Horton, Machinery's Handbook: Large Print, INDUSTRIAL PR INC, 2020
2) Ajeet Singh, Fundamentals of Machine Design: Volume 1, Cambridge University Press, 2017
3) Jack A. Collins, Henry R. Busby, George H. Staab, Mechanical Design of Machine Elements and Machines: A Failure Prevention Perspective, John Wiley & Sons, 2009

OPIEKUN PRZEDMIOTU
dr inż. Tadeusz Leśniewski tel.: 71 320-40-31 email: Tadeusz.Lesniewski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Fundamentals of Automatic Control (Podstawy automatyki)**
Nazwa przedmiotu w języku angielskim: **Fundamentals of Automatic Control**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3109**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30		30		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60		60		
Forma zaliczenia	Egzamin		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	2		2		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			2		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2		1.4		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma podstawową wiedzę z zakresu matematyki obejmującą: funkcje zespolone, równania różniczkowe, układy równań, algebrę macierzy.
2. Ma znajomość podstawowych praw i zasad fizyki.
3. Potrafi opisywać i analizować działanie podstawowych układów mechanicznych i fizycznych.

CELE PRZEDMIOTU

C1. Zapoznanie uczestników kursu ze sposobami opisu własności statycznych i dynamicznych liniowych członów automatyki w budowie maszyn i urządzeń.
C2. Zapoznanie uczestników kursu z podstawowymi układami regulacji i badania ich stabilności.
C3. Zapoznanie uczestników kursu z podstawowymi układami sterowania w mechanice i budowie maszyn.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Ma wiedzę z zakresu podstawowych metod opisu układów automatyki.
PEU_W02 - Ma wiedzę z zakresu podstawowych metod analizy układów automatyki.
PEU_W03 - Ma wiedzę z zakresu podstawowych metod syntezy układów automatyki.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi zdefiniować opis matematyczny układu automatyki.
PEU_U02 - Potrafi przeanalizować działanie układu automatyki.
PEU_U03 - Potrafi zaprojektować układ automatyki.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Potrafi pogłębić wiedzę korzystając z dodatkowych pomocy naukowych.
PEU_K02 - Potrafi myśleć i działać w sposób kreatywny.
PEU_K03 - Rozumie potrzebę przestrzegania obyczajów i zasad obowiązujących w środowisku akademickim i społeczeństwie.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie do wykładu, pojęcia podstawowe, struktura układów automatyki i ich klasyfikacja.	2
Wy2	Podstawowe sygnały automatyki. Opis liniowych układów automatyki: modele matematyczne, transmitancja operatorowa, charakterystyki czasowe.	2
Wy3	Dynamiczne układy nieliniowe. Metody opisu i analizy. Punkt pracy układu dynamicznego, linearyzacja. Charakterystyki statyczne.	2
Wy4	Podstawowe człony dynamiczne i ich modele matematyczne. Przykłady układów fizycznych.	2
Wy5	Opis liniowych układów automatyki: transmitancja widmowa, charakterystyki częstotliwościowe.	2
Wy6	Systemy o strukturze złożonej. Schematy blokowe układów automatyki i metody ich przekształceń.	2
Wy7	Regulatory stosowane w automatyce, klasyfikacja. Regulacja dwupołożeniowa i trójpołożeniowa.	2
Wy8	Regulacja: P, PI, PD, PID. Metody doboru nastaw P, I, D regulatorów.	2
Wy9	Stabilność układów regulacji. Twierdzenie o stabilności, własności systemów stabilnych i niestabilnych. Kryteria stabilności.	2
Wy10	Elementy logiki. Algebra Boole'a. Analiza i synteza układów logicznych. Bramki logiczne.	2
Wy11	Układy sterownia przekaźnikowo - stycznikowe. Projektowanie schematów ideowych.	2
Wy12	Zastosowanie sterowników PLC w automatyce przemysłowej. Projektowanie i zapis algorytmów sterowania.	2

Wy13	Układy logiczne kombinacyjne w systemach sterowania.	2
Wy14	Układy logiczne sekwencyjne w automatyce przemysłowej.	2
Wy15	Podsumowanie. Sprawdzian wiadomości w formie kolokwium.	2
		Suma: 30
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Zajęcia organizacyjne. Przepisy BHP w pracowni automatyki. Wprowadzenie, podstawowe pojęcia. Klasyfikacja układów sterowania.	2
Lab2	Charakterystyki statyczne elementów automatyki.	2
Lab3	Charakterystyki dynamiczne czasowe elementów automatyki.	2
Lab4	Charakterystyki częstotliwościowe elementów automatyki.	2
Lab5	Badania symulacyjne elementów automatyki w środowisku Matlab-Simulink.	2
Lab6	Metoda regulacji dwustawnej.	2
Lab7	Metoda regulacji trójstawnej.	2
Lab8	Badanie własności układów regulacji z regulatorami: P, PI, PID w środowisku Matlab-Simulink.	2
Lab9	Zastosowanie metody regulacji PID w automatyce przemysłowej.	2
Lab10	Sterowanie w układach pneumatyki przemysłowej.	2
Lab11	Elementy i układy sterowania przekaźnikowo - stycznikowego.	2
Lab12	Synteza kombinacyjnych układów sterowania.	2
Lab13	Synteza sekwencyjnych układów sterowania.	2
Lab14	Modelowanie i programowanie procesów sekwencyjnych.	2
Lab15	Modelowanie i programowanie procesów współbieżnych i złożonych.	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. praca własna – przygotowanie do laboratorium N3. przygotowanie sprawozdania N4. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się

F1	PEU_W01-PEU_W03, PEU_K03	egzamin
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01,PEU_K02, PEU_K03	sprawozdanie, kartkówka
P = average F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA [1] Greblicki W., Podstawy automatyki. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2006. [2] Awrejcewicz J., Wodzicki W. Podstawy automatyki, Teoria i przykłady, Łódź 2001 [3] Laboratorium podstaw automatyki i automatyzacji, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2005 LITERATURA UZUPEŁNIAJĄCA [1] Wawrzycki J. Podstawy automatyki. Wykład dla kierunku transport, Wydawnictwo AHE, Łódź 2012

OPIEKUN PRZEDMIOTU
dr inż. Mateusz Stachowicz tel.: 713204235 email: mateusz.stachowicz@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Manufacturing Processes - Machining**
Nazwa przedmiotu w języku angielskim: **Manufacturing Processes - Machining**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3110**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	45		30		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60		60		
Forma zaliczenia	Egzamin		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	2		2		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			2		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2		1.4		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Student powinien być zorientowany w zakresie zagadnień dotyczących rysunku technicznego, podstaw metrologii, odchyłek kształtu i położenia oraz chropowatości powierzchni.
2. Student powinien posiadać podstawową wiedzę z zakresu matematyki, fizyki i materiałoznawstwa.
3. Student powinien posiadać umiejętność ogólnego planowania eksperymentu i rozwiązywania prostych problemów technicznych.

CELE PRZEDMIOTU

C1. Przekazanie podstawowej wiedzy o metodach i możliwościach wytwarzania za pomocą obróbki skrawaniem, obróbki ściernej i erozyjnej.
C2. Prezentacja narzędzi, materiałów i parametrów obróbki stosowanych w różnych technikach wytwarzania.
C3. Przedstawienie możliwości technologicznych i zastosowań różnych metod wytwarzania oraz zapoznanie studentów z metodyką rozwiązywania zagadnień związanych z obróbką materiałów.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Student powinien rozumieć fizyczne i chemiczne podstawy obróbki skrawaniem. Powinien definiować i charakteryzować materiały narzędziowe i stosowane powłoki.
PEU_W02 - Studenci powinni zdefiniować i scharakteryzować najważniejsze metody obróbki skrawaniem. Powinni umieć opisać kinematykę i zastosowanie obróbki skrawaniem. Student powinien potrafić opisać i sklasyfikować maszyny, narzędzia do obróbki skrawaniem oraz znać możliwe efekty technologiczne skrawania.
PEU_W03 - Studenci powinni zdefiniować i scharakteryzować najważniejsze metody obróbki ściernej i erozyjnej. Powinni umieć opisać kinematykę i zastosowanie metod ściernych i erozyjnych. Student powinien sklasyfikować i opisać maszyny, narzędzia do obróbki skrawaniem oraz znać możliwe do uzyskania efekty technologiczne obróbki ściernej i erozyjnej.

II. Z zakresu umiejętności:
PEU_U01 - Student powinien umieć zaplanować eksperyment laboratoryjny z zakresu obróbki skrawaniem, a także wykonać pomiary (np. wytrzymałości, chropowatości powierzchni, zużycia) i przeanalizować wyniki.
PEU_U02 - Student powinien umieć dobrać narzędzia, obrabiarki, parametry i warunki obróbki, zarówno w obróbce skrawaniem, jak i w obróbce ściernej lub erozyjnej, w zależności od oczekiwanych efektów technologicznych.
PEU_U03 - Student powinien umieć analizować problemy w obróbce skrawaniem, a także rozwiązywać proste problemy technologiczne.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Student powinien mieć świadomość profesjonalnego zachowania się na stanowisku pracy oraz znać zasady bezpieczeństwa podczas pracy z maszynami.
PEU_K02 - Studenci powinni mieć świadomość odpowiedzialności za efekty pracy własnej i innych członków zespołu.
PEU_K03 - Student powinien rozumieć potrzebę ciągłego doskonalenia, zdobywania wiedzy i umiejętności zgodnie ze zmieniającymi się wymaganiami technicznymi i społecznymi.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Podstawy obróbki skrawaniem, narzędzia oraz powłoki narzędziowe.	1
Wy2	Geometria narzędzi skrawających na przykładzie toczenia.	2
Wy3	Frezowanie, przeciąganie oraz wiercenie i inne techniki obróbki otworów.	2
Wy4	Obróbka kół zębatych oraz wykonywanie gwintów.	2
Wy5	Zasady obróbki ściernej, szlifowanie i inne obróbki ścierne.	2

Wy6	Obróbka elektroerozyjna części maszyn.	2
Wy7	Wykończeniowe metody obróbki, dogniatanie, docieranie, honowanie i polerowanie.	2
Wy8	Budowa i zastosowanie wybranych obrabiarek.	2
		Suma: 15
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Toczenie - narzędzia, kinematyka, parametry procesu i zastosowanie.	2
Lab2	Wiercenie i inne metody wykonywania otworów.	2
Lab3	Frezowanie - narzędzia, kinematyka, parametry procesu i zastosowanie.	2
Lab4	Obróbki ścierne - szlifowanie.	2
Lab5	Obróbki ścierne - piaskowanie, docieranie i inne.	2
Lab6	Metody wykonywania kół zębatych oraz wycinania gwintów.	2
Lab7	Drążenie elektroerozyjne form, kokili i matryc.	2
Lab8	Wycinanie elektroerozyjne stempli i matryc oraz obróbka materiałów trudnoobrabialnych.	2
Lab9	Obróbka wykańczająca wałków i zastosowanie dogniatania	2
Lab10	Zastosowanie narzędzi diamentowych w obróbce materiałów.	2
Lab11	Mechanika tworzenia wióra.	2
Lab12	Wpływ sztywności układu OUPN i nierównomiernego rozkładu naddatku na niedokładność toczenia.	2
Lab13	Kontrukcja i zastosowanie nowoczesnych narzędzi modułowych	2
Lab14	Podstawy programowania maszyn CNC.	2
Lab15	Procesy montażowe.	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów
N2. eksperyment laboratoryjny
N3. praca własna – przygotowanie do laboratorium
N4. praca własna – samodzielne studia i przygotowanie do egzaminu
N5. przygotowanie sprawozdania

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01; PEU_WO2; PEU_W03	egzamin
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01; PEU_UO2; PEU_U03PEU_K01; PEU_K02; PEU_K03	kartkówka
F2	PEU_U01; PEU_UO2; PEU_U03PEU_K01; PEU_K02; PEU_K03	udział w dyskusji
F3	PEU_U01; PEU_UO2; PEU_U03PEU_K01; PEU_K02; PEU_K03	raport z laboratorium
P = 0,3F1+0,3F2+0,4F3		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA Manufacturing Engineering and Technology, SI Edition, Kalpakjian Serope , Schmid Stephen R., Pearson Education Centre LITERATURA UZUPEŁNIAJĄCA

OPIEKUN PRZEDMIOTU
dr inż. Dariusz Poroś tel.: 27-91 email: dariusz.poros@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Computer Aided Machine Design II (Computer Aided Machine Design II)**

Nazwa przedmiotu w języku angielskim: **Computer Aided Machine Design II**

Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**

Specjalność (jeśli dotyczy): **Mechanical engineering design**

Poziom i forma studiów: **I stopień, stacjonarne**

Rodzaj przedmiotu: **obowiązkowy**

Kod przedmiotu: **W10MBM-SI3111**

Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				30	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				90	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				3	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				3	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				2.1	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Fundamentals of strength of materials, Analytical methods in strength calculations. Knowledge of types of engineering materials.
2. Student can implement a construction project using computer methods in the field of design and numerical analyses.
3. Ability to perform strength analysis using numerical methods.

CELE PRZEDMIOTU

C1. Acquisition of the ability to design the load-bearing structure considering the defined criteria.
C2. Ability to define input data (boundary and initial conditions) necessary for modeling loads acting on the load-bearing structure.
C3. Acquisition of the ability to use CAD/CAE systems in designing.
C4. Acquisition and consolidating the ability to work in a group and the ability to search for information.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Student can design a mechanical assembly including the defined criteria, using the appropriate methods, techniques and tools, along with calculations of the components, using the computer-aided design software.
PEU_U02 - Student can correctly formulate the kinetic and kinematic conditions to which machine or machine assembly is subjected.
PEU_U03 - Student can prepare the documentation concerning the implemented engineering tasks and prepare a presentation of the results of this task

III. Z zakresu kompetencji społecznych:
PEU_K01 - Acquires the ability to take responsibility for the work done.
PEU_K02 - Able to work in a group, taking different roles.
PEU_K03 - Acquires the teamwork skills.

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Overview of the curriculum. Introduction to the environment of adapted tools for computer-aided design.	2
Proj2	Determination of loads acting on the assembly and its individual members in various configurations using CAD.	4
Proj3	Analysis of the selection of materials for individual elements of the designed assembly (devices, machines). Determination of properties and geometric features of members and connecting elements.	2
Proj4	Development of a geometric model for numerical analysis using a computer-aided design (CAD) system.	4
Proj5	Development of a computational model with initial-boundary conditions (numerical model) in CAE systems.	6
Proj6	Numerical studies (depending on the type of project and the type of initial-boundary conditions).	4
Proj7	Development of a project in a computer-aided design (CAD) system.	4

Proj8	Development of technical documentation for the project (assembly drawing and detailed drawings of selected parts).	4
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. praca własna - przygotowanie do projektu N2. prezentacja multimedialna N3. prezentacja projektu N4. przygotowanie sprawozdania

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02, PEU_K03	Evaluation of the completed project
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

[1] Rusiński E., Czmochowski J., Smolnicki T. Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000
[2] Rakowski G., Kacprzyk Z.: Metoda elementów skończonych w mechanice konstrukcji, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2016
[3] Zienkiewicz O.C.: Metoda elementów skończonych, Arkady 1972

LITERATURA UZUPEŁNIAJĄCA

[1] Szmelter J., Dacko M., Dobrociński S., Wieczorek M.: Metoda elementów skończonych w statyce konstrukcji, Arkady 1979
[2] Gawroński W., Kruszewski J., Ostachowicz W., Tarnowski K., Wittbrodt E.: Metoda elementów skończonych w dynamice konstrukcji, Arkady, Warszawa 1984
[3] Waszczyszyn Z., Cichoń Cz., Radwańska M.: Metoda elementów skończonych w stateczności konstrukcji, Arkady, Warszawa 1990
[4] Kleiber M.: Wprowadzenie do metody elementów skończonych, PWN, Warszawa-Poznań 1989
[5] Cichoń Cz., Cecot W., Krok J., Pluciński P.: Metody Komputerowe w liniowej mechanice konstrukcji, Wydawnictwo Politechniki Krakowskiej, Kraków, 2010
[6] Olszowski B. Wybrane metody numeryczne, Wydawnictwo Politechniki Krakowskiej, Kraków, 2007

OPIEKUN PRZEDMIOTU
dr hab. inż. Jacek Karliński tel.: 71 320-29-46 email: jacek.karlinski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Offroad Vehicles Engineering (Inżynieria pojazdów przemysłowych)**
Nazwa przedmiotu w języku angielskim: **Offroad Vehicles Engineering**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3112**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30		30	15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60		60	30	
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę	Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	2		2	1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			2	1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2		1.4	0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Posiada wiedzę z zakresu budowy układów napędowych pojazdów;
2. Potrafi współpracować z grupą oraz indywidualnie rozwiązuje skomplikowane zadania;
3. Posiada wiedzę z zakresu mechaniki, analizy matematycznej oraz podstaw konstrukcji maszyn układów napędowych pojazdów.

CELE PRZEDMIOTU

C1. Celem zajęć jest poszerzenie wiedzy w zakresie budowy i sposobów pracy pojazdów inżynieryjnych w szczególności kołowych i gąsienicowych. Zakres obejmuje również obliczenia oporów ruchu, skrętu różnych układów podwoziowych;
C2. Celem zajęć jest zdobycie praktycznej wiedzy w zakresie obliczania typowych elementów nośnych podwozia kołowego i gąsienicowego. Zajęcia rozszerzają również wiedzę w zakresie stosowania różnych układów podwoziowych pojazdów;
C3. Celem zajęć jest zdobycie wiedzy w zakresie współpracy narzędzia z gruntem, określenie przydatności narzędzi do
różnorodnych prac;
C4. Celem zajęć jest zdobycie umiejętności pracy grupowej, opracowywania wyników.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Potrafi obliczać poszczególne podzespoły układów zawieszeń pojazdów kołowych i gąsienicowych, jak i również z zakresu przeniesienia napędu układów napędowych.
PEU_W02 - Potrafi wskazać właściwe narzędzie do zadania które należy zrealizować. Potrafi szacować siłę trakcyjną. Zna zasadę działania układów hamulcowych pojazdów przemysłowych i oblicza drogę hamowania.
PEU_W03 - Zna podstawy współpracy narzędzia z gruntem oraz zapoznał się z metodami, pozwalającymi na uzyskanie pełnego załadunku.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi posługiwać się również obcojęzyczna literaturą, analizować i dokonywać interpretacji otrzymanych wyników.
PEU_U02 - potrafi przeanalizować i opracowywać wyniki w celu uzyskania charakterystyk lub mierzonych parametrów w układach napędowych pojazdów i maszyn przy różnych nastawach układu sterowania.
PEU_U03 - potrafi zaproponować własne koncepcje układów podwoziowych.

III. Z zakresu kompetencji społecznych:
PEU_K01 - potrafi i rozumie potrzebę ciągłego doszkalania się i pozyskiwania nowych informacji.
PEU_K02 - jest odpowiedzialny za podejmowane decyzje zarówno w aspekcie ochrony środowiska naturalnego jak i działalności inżyniera mechanika.
PEU_K03 - potrafi pracować w grupie i rozwiązywać powierzone mu zadania również na różnych stanowiskach i ponosi odpowiedzialność za grupowe osiągnięcie zamierzonego celu.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie do lokomocji off-road. Lokomocja w naturze. Przegląd metod poruszania się zwierząt i pojazdów o różnych układach podwoziowych z przykładami. Efektywność ruchu. Interakcja pojazdów terenowych z podłożem gruntowym.	2

Wy2	Podział maszyn roboczych na maszyny do robót ziemnych oraz maszyny transportu bliskiego. Ich rodzaje miejsca pracy, zastosowanie z wyróżnieniem problemów związanych z lokomocją tych grup obiektów (ładowarki łyżkowe, spycharki, koparki, zagęszczarki...).	3
Wy3	Teoria ruchu koła ogumionego poruszającego się po różnych podłożach. Charakterystyki i przykłady obliczeń oporów ruchu.Charakterystyki i przykłady obliczeń oporów ruchu off-road. Sprawność koła, współczynnik przyczepności przylgowej, koło wielkogabarytowe, rodzaje bieżnika. Metody badania kół oponowych.	3
Wy4	Mechanika ruchu pojazdu niesamochodowego. Opory ruchu przyczepy, współpraca z pojazdem ciągnącym. Rozkład ciężarów działających na osie zespołu podczas ruchu. Zapotrzebowanie energetyczne podczas ruchu nieustalonego. Zużycie paliwa.	2
Wy5	Hamowanie pojazdów członowych. Wymagania stawiane układom hamulcowym pneumatycznym, hydraulicznym i mieszanym. Elementy składowe układów hamulcowych pojazdów przemysłowych. Ilość wytrącanej energii. Czujniki optymalizujące pracę układu (ciężaru osi, prędkości...). Współpraca przyczepy z ciągnikiem. Redundancja układu.	3
Wy6	Stateczność kierunkowa pojazdów kołowych. Stateczność kierunkowa podczas hamowania pojazdu członowego. Kinematyka skrętu. Zawieszenia pojazdów oraz dopasowanie się położenia kół pojazdu do znacznych krzywizn terenu. Stosowanie elementów sprężystych i tłumiących.	2
Wy7	Automatyzacja w maszynach roboczych. Zasady działania podstawowych czujników położenia i obciążenia, ciśnienia, przepływu celem określenia ich wad i zalet w sterowaniu procesem. Autonomiczne systemy prowadzące pojazd po zadanej trajektorii.	2
Wy8	Zaawansowane układy sterowania: systemy ważące oraz pozycjonujące narzędzie robocze. Roboty inspekcyjne poruszające się np wewnątrz tuneli. Praca pojazdów przemysłowych w warunkach ograniczonej widoczności.	2
Wy9	Teoria ruchu pojazdu gąsienicowego. Przykłady stosowanych gąsienic stalowych i elastomerowych. Porównanie i ich stosowanie. Obliczenia napięcia pasa gąsienicowego pod wpływem sił wewnętrznych i zewnętrznych. Kinematyka skrętu pojazdów gąsienicowych. Opory ruchu tych pojazdów.	3
Wy10	Współpraca gąsienic z gruntem. Wpływ wysokości bieżnika, siła trakcyjna, liczba rolek nośnych, wyznaczanie poślizgu gąsienicy na różnych podłożach. Nierównomierność nacisku gąsienicy a siła trakcyjna. Wyznaczanie sił trakcyjnych.	2
Wy11	Układy kierownicze i zawieszenia pojazdów roboczych. Przykłady zastosowań. Dobór sprężyn pneumatycznych. Rola poszczególnych elementów zawieszenia.	2
Wy12	Pojazdy do zastosowań specjalnych. Teoria pojazdów poduszkowych. Metody wytwarzania poduszki powietrznej, zastosowanie, wady i zalety tej grupy pojazdów. Budowa pojazdów śrubowych i kroczących. Alternatywne źródła energii.	2
Wy13	Badania przebiegowe pojazdów specjalnych. Definiowanie wymagań i metody weryfikacji. Uporządkowanie zdobytej wiedzy i wiadomości. Podsumowanie kursu.	2
		Suma: 30
Forma zajęć – Laboratorium		Liczba godzin

Lab1	Badania podstawowych parametrów wykorzystywanych w terramechanice do opisu ośrodków rozdrobnionych.	2
Lab2	Badania procesu ładowania ośrodka rozdrobnionego łyżką ładowarki.	2
Lab3	Badania oporu gruntu na ścinanie elementem jezdnym.	2
Lab4	Badania procesu urabiania skał zwięzłych nożami o różnym ukształtowaniu.	2
Lab5	Badania normowe obciążeń narzędzia roboczego i obciążeń wywracających pojazdu przemysłowego.	2
Lab6	Badania oporów ruchu pojazdu kołowego	2
Lab7	Badania obciążeń dynamicznych mechanizmu podnoszenia suwnicy pomostowej.	2
Lab8	Badania procesu kopania ośrodka rozdrobnionego łyżką koparki.	2
Lab9	Badania oporów ruchu pojazdu gąsienicowego.	2
Lab10	Badania oporów skrętu oraz sztywności skrętnej kół oponowych.	2
Lab11	Badania zjawiska sprzężenia ciernego gąsienicy elastomerowej z liną.	2
Lab12	Badania parametrów trakcyjnych pojazdu linowego.	2
Lab13	Badania uniwersalnego pojazdu kołowego.	2
Lab14	Badania oporów skrętu kołowego pojazdu przegubowego.	2
Lab15	Właściwości jezdne pojazdów o niekonwencjonalnym sposobie lokomocji.	2
		Suma: 30
Forma zajęć – Projekt		Liczba godzin
Proj1	Celem projektu jest opracowanie układu napędowego pojazdu kołowego lub gąsienicowego. Zakres projektu obejmuje obliczenie sił uciągu, oporów ruchu, momentów napędowych oraz sporządzenie rysunków wykonawczych wybranego podzespołu. Projekt może dotyczyć również doboru geometrii wysięgnika w celu zachowania prostoliniowości ruchu narzędzia oraz układu przeniesienia napędu klasycznego lub hybrydowego. W tym przypadku określa się opory ruchu podczas nabierania urobku oraz dobiera poszczególne elementy. Dobór komponentów powinien uwzględniać osiąganą sprawność końcową pracy mechanizmu. 1. Omówienia zadania do wykonania i określenie wymagań wstępnych; 2. Analiza literaturowa Studenta; 3. Propozycja Studenta celem rozwiązania problemu; 4. Obliczenia i dobór komponentów/wykonanie dokumentacji technicznej; 5. Wniesienie poprawek i uzupełnienie projektu; 6. Złożenie gotowego projektu; 7-8. Grupowe zaprezentowanie projektu.	15
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. prezentacja multimedialna N2. eksperyment laboratoryjny N3. praca własna - przygotowanie do projektu N4. praca własna – przygotowanie do laboratorium N5. praca własna – samodzielne studia i przygotowanie do egzaminu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01-PEU_W03 PEU_U01-PEU_U03 PEU_K01-PEU_K03	Egzamin pisemny
P = pozytywna ocena z egzaminu		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01-PEU_U03 PEU_K01-PEU_K03	kartkówka, odpowiedzi ustne, sprawozdanie z ćwiczeń laboratoryjnych
P = pozytywna ocena ze wszystkich ocenionych ćwiczeń laboratoryjnych		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01-PEU_U03 PEU_K01-PEU_K03	obrona projektu, ocena części obliczeniowej projektu,
P = pozytywnie ocenione wszystkie części składowe projektu		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA 1. Inżynieria maszyn roboczych, K. Pieczonka, OW PWr, 2007 2. Theory of ground vehicles; J. Y. Wong, John Wiley & Sons, New York 3. Tyre and Vehicle Dynamics, H. B. Pacejka, Delft University of Technology 4. Vehicle Dynamisc, Theory and Applicaton, R. N. Jazar, Springer, 2008 5. Automotive Engineering Powertrain, Chassis System and Vehicle Body, A. Crolla, Elsevier, 2009 6. Fundamentals of Vehicle Dynamisc, T. D. Gillespie, Society of Automotive Engeeners, 7. Ciągniki, H. Dajniak, Wydawnictwa Komunikacji i Łączności, 2008 8. Kierowalność i stateczność samochodu, A. Litwinow, WKŁ, 1975 9. Teoria ruchu pojazdu gąsienicowego, Z. Burdziński, WKŁ, 1972 LITERATURA UZUPEŁNIAJĄCA

OPIEKUN PRZEDMIOTU
dr inż. Aleksander Skurjat tel.: 71 320-23-46 email: Aleksander.Skurjat@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Hydraulic Drive Systems (Napęd hydrauliczny)**
Nazwa przedmiotu w języku angielskim: **Hydraulic Drive Systems**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3113**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30		30	15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60	60	30		
Forma zaliczenia	Egzamin	Zaliczenie na ocenę		Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	2	2	1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		2	1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2		1.4	0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Posiada podstawową wiedzę z mechaniki płynów.
2. Posiada podstawową wiedzę z zakresu konstrukcji elementów składowych hydrostatycznych układów napędowych.
3. Posiada podstawową wiedzę z zakresu układów napędowych maszyn.

CELE PRZEDMIOTU

C1. Zapoznanie studentów z funkcjami elementów hydraulicznych w układach hydrostatycznych.
C2. Zapoznanie studentów z hydraulicznymi układami napędowymi w aspekcie sposobu działania oraz architektury.
C3. Zapoznanie studentów z metodami sterowania i regulacji określonych parametrów napędów hydraulicznych oraz bilansem energetycznym układów hydrostatycznych.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - W wyniku przeprowadzonych zajęć student ma wiedzę pozwalającą opisać podstawowe układy hydrauliczne.
PEU_W02 - W wyniku przeprowadzonych zajęć student ma wiedzę pozwalającą objaśnić zasady projektowania hydraulicznych układów napędowych.
PEU_W03 - W wyniku przeprowadzonych zajęć student ma wiedzę pozwalającą scharakteryzować elementy układów hydraulicznych sterujące odpowiednimi parametrami, bądź regulujące określone parametry.

II. Z zakresu umiejętności:
PEU_U01 - W wyniki przeprowadzonych zajęć student umie zaprojektować układ hydrauliczny wraz z układem sterującym - wykonać odpowiednie obliczenia techniczne i na ich podstawie dobrać elementy układu hydraulicznego o odpowiednich wymiarach i właściwościach.
PEU_U02 - W wyniki przeprowadzonych zajęć student umie dokonać pomiarów dotyczących elementów i układów hydraulicznych, a następnie omówić uzyskane wyniki i wyciągnąć odpowiednie wnioski.
PEU_U03 - W wyniki przeprowadzonych zajęć student umie zmontować, uruchomić dokonać nastaw i przeanalizować poprawność pracy hydraulicznych i elektrohydraulicznych układów napędowych.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Potrafi współdziałać i pracować w grupie podczas montażu układów hydraulicznych i elektrohydraulicznych oraz tworzenia sprawozdania z ćwiczenia.
PEU_K02 - Potrafi odpowiednio zaplanować wykonanie pomiarów podczas ćwiczenia laboratoryjnego oraz zaplanować wykonanie projektu.
PEU_K03 - Prawidłowo identyfikuje i rozwiązuje problemy napotkane podczas montażu układów hydraulicznych i elektrohydraulicznych oraz wykonywania projektu. Wyciąga odpowiednie wnioski z przeprowadzonego ćwiczenia.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie, omówienie treści kursu, formy zaliczenia i wymagań, podanie literatury przedmiotu. Właściwości układów hydraulicznych.	2
Wy2	Przekładnia hydrostatyczna – zasada działania, podstawowe parametry i zależności.	2
Wy3	Sposoby regulacji parametrów źródła energii hydraulicznej oraz parametrów elementów wykonawczych układów hydrostatycznych	4
Wy4	Analiza kluczowych parametrów pracy pomp wyporowych.	2

Wy5	Analiza porównawcza układów wielopompowych oraz układów z pompą główną wraz z funkcją priorytetowego rozdziału mocy	2
Wy6	Synchronizacja prędkości ruchu hydraulicznych elementów wykonawczych.	2
Wy7	Funkcje i przykłady zastosowania akumulatorów hydraulicznych w układach hydrostatycznych.	2
Wy8	Sposoby równoczesnego sterowania kilkoma hydraulicznymi elementami wykonawczymi, układy sekwencyjne, logiczne oraz elektrohydrauliczne	2
Wy9	Hydrostatyczne układy napędowe układów jazdy.	2
Wy10	Hydrostatyczne układy napędowe układów roboczych maszyn.	2
Wy11	Hydrostatyczne układy hamulcowe.	2
Wy12	Hydrostatyczne układy skrętu pojazdów.	2
Wy13	Bilans energetyczny oraz emisja energii cieplnej układów hydrostatycznych	2
Wy14	Możliwości zwiększania sprawności układów hydrostatycznych, układy z możliwością rekuperacji energii, architektura układów hydrostatycznych w aspekcie energetycznym.	2
		Suma: 30
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Wprowadzenie – przedstawienie treści laboratoriów, formy zaliczenia, wymagań. Regulamin laboratorium i instruktaż BHP.	2
Lab2	Sterowanie kierunkiem ruchu elementów wykonawczych	2
Lab3	Zastosowanie zaworów ciśnieniowych w układach hydraulicznych.	2
Lab4	Metody odciążania hydraulicznego układu zasilającego.	2
Lab5	Zastosowanie zaworu zwrotnego sterowanego w układach hydraulicznych maszyn roboczych. Metody zabezpieczenia pozycji obciążonego odbiornika.	2
Lab6	Sterowanie dławieniowe-szeregowe prędkością ruchu odbiornika hydraulicznego.	2
Lab7	Sterowanie dławieniowe-równoległe prędkością ruchu odbiornika hydraulicznego.	2
Lab8	Badania porównawcze układów sterowania i regulacji prędkości odbiornika hydraulicznego.	2
Lab9	Układy hydrauliczne typu Load-Sensing z pompą o stałej wydajności.	2
Lab10	Charakterystyki zasilacza z pompą o zmiennej wydajności.	2
Lab11	Układy hydrauliczne typu Load-Sensing z pompą o zmiennej wydajności.	2
Lab12	Układy z prostownikiem hydraulicznym.	2
Lab13	Funkcje akumulatora hydraulicznego.	2
Lab14	Opis stanów nieustalonych układu hydraulicznego – eksperymentalne wyznaczenie podstawowych wskaźników dynamicznych.	2
Lab15	Zaliczenie.	2
		Suma: 30

Forma zajęć – Projekt		Liczba godzin
Proj1	Wprowadzenie do projektu. Przydzielenie tematów projektowych.	3
Proj2	Określenie zakładanych parametrów układu. Generowanie struktury układu hydraulicznego.	2
Proj3	Wykonanie podstawowych obliczeń.	2
Proj4	Dobór elementów układów.	2
Proj5	Wykonanie opisu działania opracowanego układu oraz weryfikacja prawidłowości dobranych elementów w aspekcie funkcji i założonych parametrów układu.	2
Proj6	Określenie końcowych parametrów zaprojektowanego układu. Analiza porównawcza z założeniami wstępnymi.	2
Proj7	Zaliczenie projektu.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład informacyjny N2. praca własna – przygotowanie do laboratorium N3. eksperyment laboratoryjny N4. praca własna - przygotowanie do projektu N5. praca własna – samodzielne studia i przygotowanie do egzaminu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	Egzamin
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U02, PEU_U03, PEU_K01, PEU_K02	Ocena aktywności studenta na zajęciach

F2	PEU_U02, PEU_K01, PEU_K02	Sprawozdanie z ćwiczeń laboratoryjnych
P = 0,2F1+0,8F2		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_K02, PEU_K03	Ocena projektu
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
Kollek W.: Podstawy projektowania napędów i sterowań hydraulicznych. Oficyna Wydawnicza PWr, Wrocław 2004
Szydelski Z.: Napęd i sterowanie hydrauliczne, WKŁ, Warszawa 1999.
Stryczek S.: Napęd hydrostatyczny - Elementy i układy. WNT 1984.
Osiecki A.: Napęd hydrostatyczny maszyn, WNT, Warszawa 1996.
Garbacik A., Szewczyk K.; Napęd i sterowane hydrauliczne. Podstawy projektowania układów. Skrypt Politechniki Krakowskiej, Kraków 1998

LITERATURA UZUPEŁNIAJĄCA
Jędrzykiewicz Z.: Projektowanie układów hydrostatycznych. Podstawy metodyczno-obliczeniowe. Skrypt 1313. AGH Kraków 1992.
Pizoń A.: Hydrauliczne i elektrohydrauliczne układy sterowania i regulacji. WNT 1987.

OPIEKUN PRZEDMIOTU

Prof. dr hab. inż. Wiesław Fiebig tel.: 71 320-27-00 email: Wieslaw.Fiebig@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Internal Combustion Engines (Silniki spalinowe)**
Nazwa przedmiotu w języku angielskim: **Internal Combustion Engines**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3114**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30		30		
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS	1		1		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6		0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Znajomość zasady zachowania: masy, energii i pędu oraz równania stanu czynnika
2. Umiejętność wykonywania ćwiczeń laboratoryjnych w oparciu o elementarne sprawności manualne
3. Świadomość pracy samodzielnej oraz grupowej i umiejętność jej realizacji

CELE PRZEDMIOTU

C1. pozyskanie wiedzy na temat zamiany energii z postaci chemicznej na postać mechaniczną w silniku spalinowym
C2. świadomość wymagań konstrukcyjnych stawianych silnikom celem uzyskania sprawności procesu spalania
C3. zrozumienie wymagań konstrukcyjnych uzyskiwanych dzięki adekwatnym technologią wytwarzania

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - ma wiedzę z zakresu chemii, mechaniki płynów i termodynamiki umożliwiającą dobór paliwa
PEU_W02 - nabywa umiejętności umożliwiające szacowanie wymiany ładunku i ilości paliwa koniecznych do procesu spalania
PEU_W03 - zna parametry oceny sprawności rzeczywistego silnika spalinowego

II. Z zakresu umiejętności:
PEU_U01 - ma umiejętność wykonania testu hamownianego silnika spalinowego
PEU_U02 - ma umiejętność analizy wyników testu i oceny parametrów termodynamicznych
PEU_U03 - ma umiejętność wysunięcia wniosków na podstawie oceny zużycia jednostkowego oraz sprawności mechanicznej

III. Z zakresu kompetencji społecznych:
PEU_K01 - rozumie potrzebę dokształcania z zakresu napędów
PEU_K02 - ma świadomość wielkości sprawności przetwarzania energii i wpływu na środowisko naturalne
PEU_K03 - ma świadomość na temat emisji do środowiska z obecnie stosowanych układów napędowych

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Historia epoki przemysłowej z szczegółowym opisem rozwoju silników spalinowych	2
Wy2	Klasyfikacja silników spalinowych z opisem zastosowań w branżach przemysłu	2
Wy3	Paliwa silnikowe	2
Wy4	Obiegi termodynamiczne, sprawności i dodatkowe parametry oceny sprawności	2
Wy5	Proces spalania w silniku o zapłonie iskrowym	2
Wy6	Proces spalania w silniku o zapłonie samoczynnym	2
Wy7	Pętla wymiany ładunku	2
Wy8	Charakterystyki silników	1
		Suma: 15
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Budowa układu tłokowo-korbowego	2
Lab2	Rozrząd	2
Lab3	Historyczna aparatura wtryskowa	2
Lab4	Układy zasilania typu Common Rail	2
Lab5	Stanowisko hamowniane ISO8178 - opis i wzory	2
Lab6	Stanowisko hamowniane - pomiar	2
Lab7	Obliczenia zużycia jednostkowego paliwa i jednostkowej emisji	2

Lab8	Napęd z ogniwem paliwowym	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. prezentacja multimedialna N3. eksperyment laboratoryjny N4. ćwiczenia rachunkowe N5. dyskusja problemowa

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01	kolokwium
F2	PEU_W02	kolokwium
F3	PEU_W03	kolokwium
P = (F1+F2+F3)/3		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_K01	sprawozdanie
F2	PEU_U02, PEU_K02	sprawozdanie
F3	PEU_U03, PEU_K03	sprawozdanie
P = (F1+F2+F3)/3		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA Heywood, J.B. (1988) Internal Combustion Engine Fundamentals, McGraw-Hill, New York. Stone, R. (2005) Introduction to Internal Combustion Engines, SAE International, Warrendale. LITERATURA UZUPEŁNIAJĄCA ISO8178

OPIEKUN PRZEDMIOTU
dr inż. Marcin Tkaczyk tel.: 71 347-79-18 email: Marcin.Tkaczyk@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Carrying Structures**
Nazwa przedmiotu w języku angielskim: **Carrying Structures**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3115**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15			30	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30			60	
Forma zaliczenia	Zaliczenie na ocenę			Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	1			2	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				2	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6			1.4	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Podstawy wytrzymałości materiałów, analizy wytrzymałościowej układów prętowych, tarczowych i płytowych. Znajomość rodzajów materiałów inżynierskich.
2. Podstawy metody elementów skończonych
3. Potrafi przeprowadzić analizy wytrzymałościowe w zakresie sprężystym prostych elementów konstrukcyjnych

CELE PRZEDMIOTU

C1. Zapoznanie studentów z zasadami kształtowania ustrojów nośnych maszyn o strukturze prętowej, blachownicowej i grubościennej.
C2. Przedstawienie problemów związanych z prawidłowym kształtowaniem połączeń i węzłów konstrukcyjnych ustrojów nośnych poddanych obciążeniom stałym i zmiennym.
C3. Nabycie umiejętności wymiarowania ustrojów prostych struktur nośnych z wykorzystaniem metod komputerowego wspomagania projektowania, w tym szczególnie CAD/CAE.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Wiedza w zakresie projektowania ustrojów nośnych maszyn poddanych obciążeniom zmiennym, narażonych na pęknięcia zmęczeniowe (ramy, kratownice, blachownice, ustroje grubościenne).
PEU_W02 - Posiada wiedzę w zakresie zasad projektowania węzłów konstrukcyjnych i połączeń elementów ustrojów nośnych
PEU_W03 - Wiedza w zakresie wymiarowania ustrojów nośnych w oparciu o normy (dźwignice, projektowanie konstrukcji stalowych) według kryterium wytrzymałości, sztywności i trwałości

II. Z zakresu umiejętności:
PEU_U01 - Potrafi opracować model obliczeniowy prostych ustrojów nośnych maszyn do zagadnień wytrzymałości, stateczności i drgań własnych
PEU_U02 - Potrafi poprawnie sformułować warunki kinetyczne i kinematyczne, jakim poddawany jest ustrój nośny
PEU_U03 - Potrafi prawidłowo zinterpretować wyniki analiz obliczeń numerycznych

III. Z zakresu kompetencji społecznych:
PEU_K01 - Nabywa umiejętności ponoszenia odpowiedzialności za wykonaną pracę
PEU_K02 - Myśleć i działać w sposób kreatywny
PEU_K03 - Nabywa umiejętność pracy zespołowej

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Przegląd rodzajów ustrojów nośnych stosowanych w budowie maszyn	1
Wy2	Analiza awarii i katastrof ustrojów nośnych maszyn	2
Wy3	Modelowanie ustrojów nośnych maszyn	2
Wy4	Zasady łączenia ustrojów nośnych maszyn poddanych obciążeniom zmiennym	2
Wy5	Zasady projektowania ustrojów nośnych cienkościennych, zagadnienie stateczności lokalnej i globalnej	2
Wy6	Zasady projektowania węzłów konstrukcyjnych	2
Wy7	Metody obliczeniowe stosowane w wymiarowaniu ustrojów nośnych - metoda naprężeń dopuszczalnych, metoda stanów granicznych	2
Wy8	Zagadnienie zmęczenia ustrojów nośnych maszyn	2

	Suma: 15

Forma zajęć – Projekt		Liczba godzin
Proj1	Omówienie programu zajęć laboratoryjnych. Wprowadzenie do środowiska programu obliczeniowego.	2
Proj2	Projektowanie, modelowanie grubościennych ustrojów nośnych	2
Proj3	Warunki brzegowe: zasady definiowania podparć, utwierdzeń, symetrii, obciążeń kinetycznych i kinematycznych oraz analiza wytrzymałościowa	2
Proj4	Optymalizacja postaci geometrycznej grubościennego ustroju nośnego (minimalizacja masy)	2
Proj5	Projektowanie i modelowanie cienkościennych ustrojów nośnych (dźwigary dwuteowe, skrzynkowe)	2
Proj6	Optymalizacja postaci geometrycznej cienkościennego ustroju nośnego (minimalizacja masy)	4
Proj7	Projektowanie i modelowanie prętowych struktur nośnych (przestrzenna kratownica)	2
Proj8	Projektowanie i modelowanie węzłów konstrukcyjnych (sztywnych, podatnych i przegubowych)	4
Proj9	Projektowanie i modelowanie ramowych struktur nośnych maszyn i pojazdów	4
Proj10	Optymalizacja postaci konstrukcyjnej struktury nośnej ramowej	2
Proj11	Definiowanie elementarnych obciążeń i ich kojarzeń dla ustrojów nośnych dźwignic	2
Proj12	Analizy drgań własnych, stateczności sprężystej (wyboczenia) struktur nośnych	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. praca własna - przygotowanie do projektu
N2. przygotowanie sprawozdania
N3. prezentacja multimedialna
N4. prezentacja projektu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	Kolokwium i ewentualna poprawa ustnie
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03 PEU_K01, PEU_K02, PEU_K03	Ocena przygotowania projektów
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
Rusinski E., Czmochowski J., Smolnicki T.: The advanced finite element method in the construction of load-bearing (in polish), Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000
Rusiński E.: Finite Element Method. COSMOS/M (in Polish) System, WKiŁ, Warszawa 1994
Rusiński E.: Computer analysis of frames and bodies of vehicles and work machines (in Polish), WKiŁ, Warszawa 1990
Rusiński E.: Principles of design of bearing structures of vehicles (in Polish). Oficyna Wyd. PWr Wrocław 2002

LITERATURA UZUPEŁNIAJĄCA
Augustyn J., Śledziewski E.: Technology of steel welded constructions (in Polish), Arkady, Warszawa 1981
Augustyn J.: Welded and spot-welded joints (in Polish), Arkady, Warszawa 1987
Dudczak A.: Excavators. Theory and design (in Polish), PWN, Warszawa 2000
Ferenc K., Ferenc J.: Welded constructions. Designing connections. (in Polish) WNT, Warszawa 2000
Pieczonka K.: Engineering of work machines. Part I. The basics of mining, driving, lifting and turning (in Polish), Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2007
Żmuda J.: Basic design of metal structures (in Polish), Arkady, Warszawa 1997
EN 1993-1 Eurokod 3 Design of steel structures

OPIEKUN PRZEDMIOTU
dr hab. inż. Jerzy Czmochowski tel.: 71 320 42 84 email: jerzy.czmochowski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Safety of machines and technological processes (Podstawy eksploatacji i remontów maszyn)**

Nazwa przedmiotu w języku angielskim: **Safety of machines and technological processes**

Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**

Specjalność (jeśli dotyczy): **Mechanical engineering design**

Poziom i forma studiów: **I stopień, stacjonarne**

Rodzaj przedmiotu: **obowiązkowy**

Kod przedmiotu: **W10MBM-SI3116**

Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15				15
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60				30
Forma zaliczenia	Egzamin				Zaliczenie na ocenę
Grupa kursów					
Liczba punktów ECTS	2				1
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					1
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2				0.7

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Student ma uporządkowaną wiedzę na temat podstaw projektowania, wytwarzania i użytkowania maszyn.

CELE PRZEDMIOTU

C1. Zapoznanie studenta z metodami oceny i kształtowania bezpieczeństwa maszyn na różnych etapach cyklu życia obiektu technicznego.
C2. Zapoznanie studenta z regulacjami prawnymi w zakresie odpowiedzialności za bezpieczeństwo projektowanych, wytwarzanych i użytkowanych maszyn.
C3. Zapoznanie studenta z metodami identyfikacji zagrożeń poprzez samodzielną oraz zespołową analizę przypadków.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Zna metody oceny i kształtowania bezpieczeństwa i ryzyka w różnych fazach życia obiektów technicznych.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi stosować metody oceny bezpieczeństwa maszyn i procesów oraz identyfikować środki zapobiegawcze i mitygujące rozpoznane zagrożenia.

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie. Omówienie zakresu wykładu i wymagań egzaminacyjnych. Podstawowe pojęcia i definicje. Model wypadku i zabezpieczenia.	1
Wy2	Formułowanie wymagań w zakresie bezpieczeństwa procesu. Metoda identyfikacji zagrożeń HAZOP.	2
Wy3	FMEA / FMECA jako metody wspomagające projektowanie i ocenę bezpieczeństwa obiektu technicznego i procesu technologicznego.	2
Wy4	Metody FTA, ETA.	2
Wy5	Struktura niezawodności systemu nienaprawialnego. Struktury podstawowe i mieszane. Sposoby podnoszenia niezawodności systemów.	2
Wy6	Uwarunkowania prawne w zakresie bezpieczeństwa maszyn i procesów.	2
Wy7	Analiza przypadków utraty bezpieczeństwa maszyn i procesów technologicznych oraz ocena możliwości wcześniejszej identyfikacji występujących zagrożeń.	4
		Suma: 15

Forma zajęć – Seminarium		Liczba godzin
Sem1	Wprowadzenie. Omówienie zakresu merytorycznego seminarium i zasad zaliczenia.	1
Sem2	Formułowanie wymagań w zakresie bezpieczeństwa oraz identyfikacja przyczyn utraty bezpieczeństwa dla zadanego przypadku.	2
Sem3	Zastosowanie metody HAZOP do identyfikacji zagrożeń w wybranym procesie technologicznym.	4
Sem4	Analiza przyczyn i skutków uszkodzeń wybranego podzespołu obiektu technicznego (FMEA).	4
Sem5	Analiza FTA i ETA dla wybranego podzespołu obiektu technicznego. Identyfikacja mechanizmów zabezpieczających i mitygujących zagrożenia.	4
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. prezentacja multimedialna N2. dyskusja problemowa N3. case study N4. wykład informacyjny

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01	egzamin pisemny
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Seminarium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01	udział w dyskusjach problemowych
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

[1] Ważyńska_Fiok K., Jaźwiński J.: Niezawodność systemów technicznych. PWN, Warszawa 1990.
[2] Podstawy racjonalnej eksploatacji maszyn. Red. M. Woropay. Biblioteka Problemów Eksploatacji. ITE, Radom 1996.
[3] Dwiliński L., Wstęp do teorii eksploatacji obiektu technicznego, Wyd. Politechniki Warszawskiej, Warszawa 1991.
[4] Poradnik niezawodności, tom I. Red. J. Migdalski. WEMA, Warszawa 1982.
[5] Poradnik Niezawodności, tom II. Red. J. Migdalski. WEMA, Warszawa 1992.
[6] Lorenc A.K., Szkoda M., Rezerwowanie jako metoda zwiększenia gotowości i niezawodności floty pojazdów. Instytut Logistyki i Magazynowania 2014.
[7] Kozłowski M. (red.), Budowa i eksploatacja pojazdów. Cz. 2, Obsługa, diagnostyka i naprawa zespołów i podzespołów, Wrocław: Vogel Business Media 2005.
[8] Kozłowski M. (red.), Budowa i eksploatacja pojazdów. Cz. 1, Działanie zespołów i podzespołów, Wrocław: Vogel Business Media 2005.

LITERATURA UZUPEŁNIAJĄCA

[1] Szopa T., Niezawodność i bezpieczeństwo, Wyd. Politechniki Warszawskiej, Warszawa 2009.
[2] Młynarski S., Problemy prognozowania niezawodności pojazdów eksploatowanych w transporcie drogowym. Monografie Politechniki Krakowskiej. Seria Mechanika. Kraków: Wydawnictwo PK 2018.
[3] OprzędkiewiczJ., Technologia budowy samochodów: skrypt dla studentów wyższych szkół technicznych do przedmiotów: technologia pojazdów samochodowych i technologia silników spalinowych. Cz. 11, Podstawy niezawodności maszyn i urządzeń. Kraków: Wydawnictwa Politechniki Krakowskiej 1982.

OPIEKUN PRZEDMIOTU
dr inż. Tomasz Siwulski tel.: 71 320-28-92 email: tomasz.siwulski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Manufacturing Systems CNC (Maszyny technologiczne CNC i roboty)**
Nazwa przedmiotu w języku angielskim: **Manufacturing Systems CNC**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3117**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		15	15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30		30	30	
Forma zaliczenia	Zaliczenie na ocenę		Zaliczenie na ocenę	Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	1		1	1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			1	1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6		0.7	0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma podstawową wiedzę dotyczącą procesu projektowo-konstrukcyjnego, budowy i działania elementów i zespołów maszynowych oraz zasad ich doboru i konstruowania.
2. Ma ugruntowaną wiedzę z zakresu podstawowych technik wytwarzania i roli maszyn technologicznych.
3. Potrafi zaprojektować proces technologiczny w zakresie obróbki bezubytkowej i ubytkowej.

CELE PRZEDMIOTU

C1. Poznanie budowy podstawowych maszyn technologicznych CNC, a w szczególności ich układów: sterowania, napędowych i pomiarowych.
C2. Poznanie zasad programowania maszyn CNC oraz zasad budowy i wdrażania programów sterujących, a także poznanie metod wspomagających pracę programisty.
C3. Poznanie zasad i możliwości wykorzystania zautomatyzowanych systemów jedno- i wielomaszynowych do realizacji określonych zadań obróbkowych.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - W wyniku przeprowadzonych zajęć student powinien być w stanie objaśnić budowę i zasady funkcjonowania nowoczesnych maszyn technologicznych CNC, a w szczególności zasady sterowania ich pracą.
PEU_W02 - W wyniku przeprowadzonych zajęć student powinien być w stanie opisać zasady doboru maszyn technologicznych CNC do realizacji określonych zadań obróbkowych.
PEU_W03 - W wyniku przeprowadzonych zajęć student powinien być w stanie opisać podstawy programowania maszyn CNC.

II. Z zakresu umiejętności:
PEU_U01 - W wyniku zajęć student powinien umieć ocenić maszyny technologiczne CNC z uwagi na ich przydatność do realizacji określonych zadań obróbkowych.
PEU_U02 - W wyniku zajęć student powinien umieć opracować strukturę programową dla podstawowych maszyn CNC, potrafi korzystać z podprogramów i cykli standardowych.
PEU_U03 - W wyniku przeprowadzonych zajęć student powinien umieć przeanalizować sposób funkcjonowania maszyny technologicznej.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Potrafi wyszukiwać i korzystać z literatury zalecanej do kursu oraz samodzielnie zdobywać wiedzę.
PEU_K02 - Potrafi wykorzystywać nowoczesne narzędzia informatyczne.
PEU_K03 - Potrafi wykorzystywać nowoczesne narzędzia informatyczne.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Ogólna charakterystyka maszyn technologicznych i ich klasyfikacja. Elementy, mechanizmy i podzespoły maszyn CNC	1
Wy2	Układy napędu głównego i posuwowego maszyn technologicznych, budowa i charakterystyka. Układy pomiarowe, diagnostyki i nadzoru.	2
Wy3	Budowa i podstawy sterowania automatycznego maszyn technologicznych. Klasyfikacja układów sterowania (układy: NC, CNC, DNC, AC i PLC).	2
Wy4	Wprowadzenie do programowania obrabiarek sterowanych numerycznie - podstawy geometryczne sterowania CNC, układy współrzędnych, struktura programu sterującego, interpolacja. Sposoby wspomagania programowania - symulatory obróbki.	4

Wy5	Obrabiarki skrawające do obróbki korpusów, powierzchni obrotowych i płaskich - wiertarki, frezarki, wytaczarki, tokarki. Cechy techniczno-użytkowe i przeznaczenie maszyn.	2
Wy6	Obrabiarki skrawające do obróbki powierzchni obrotowych i płaskich - szlifierki. Elementy budowy i przeznaczenie technologiczne maszyn.	1
Wy7	Obrabiarki do obróbki erozyjnej i laserowej - cechy techniczno-użytkowe i przeznaczenie maszyn.	1
Wy8	Roboty przemysłowe i manipulatory (budowa, klasyfikacja i obszary zastosowań).	2
		Suma: 15
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Wprowadzenie, zapoznanie z maszynami technologicznymi	1
Lab2	Zastosowanie tomografii komputerowej w pomiarach geometrii i defektoskopii	2
Lab3	Technologie Rapid Prototyping oparte na metalach	2
Lab4	Technologie Rapid Prototyping oparte na tworzywach sztucznych	2
Lab5	Konstrukcja, działanie oraz obsługa i programowanie robota przemysłowego	2
Lab6	Obróbka skrawaniem z wykorzystaniem maszyn sterowanych numerycznie	2
Lab7	Manipulator w procesie natryskiwania zimnym gazem	2
Lab8	Zastosowanie robotów w procesach spawania/zgrzewania	2
		Suma: 15
Forma zajęć – Projekt		Liczba godzin
Proj1	Wybór obrabiarki, przygotowanie karty technologicznej, definicja przygotówki, dobór narzędzi i oprzyrządowania, wyznaczanie parametrów obróbki.	1
Proj2	Przygotowanie obrabiarki i środowiska programistycznego, konfiguracja symulatora. Określenie ustawienia przedmiotu obrabianego w przestrzeni roboczej obrabiarki. Tworzenie programu sterującego.	2
Proj3	Programowanie podstawowych zabiegów technologicznych z wykorzystaniem ruchów prostoliniowych.	2
Proj4	Programowanie ruchów po łuku i okręgu. Transformacje układu współrzędnych.	2
Proj5	Programowanie ruchu po konturze z wykorzystaniem korekcji wymiarów narzędzia. Łączenie segmentów ruchu poprzez zaokrąglanie i fazowanie.	2
Proj6	Technika podprogramów, programowanie przyrostowe, wykorzystanie funkcji pętli w przebiegu programu.	2
Proj7	Wykorzystanie cykli obróbkowych w programowaniu.	2
Proj8	Zaawansowane techniki programowania.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. praca własna – przygotowanie do laboratorium N3. praca własna - przygotowanie do projektu N4. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03,	Kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03,	Kartkówka / sprawozdanie z laboratorium
P = średnia arytmetyczna F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U02, PEU_U03,	Ocena przygotowanego projektu
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
<u>LITERATURA PODSTAWOWA</u> CNC Machines, K. K. Appuu Kuttan, Oxford University Press Programming of CNC Machines, Ken Evans, Industrial Press, Inc Digital Fabrication, Kim Williams, Springer Basel Programmable automation technologies an introduction to CNC, robotics and PLCs, Daniel E. Kandray, S.l. : Industrial Press Advances in Manufacturing, Adam Hamrol et al., Cham: Springer Computer Numerical Control Machines and Computer Aided Manufacture, P. Radhakrishnan, London: New Academic Science <u>LITERATURA UZUPEŁNIAJĄCA</u>

OPIEKUN PRZEDMIOTU
dr inż. Marcin Madeja tel.: 3204185 email: marcin.madeja@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Legal aspects of engineering activities (Uwarunkowania prawne działalności inżyniera)**

Nazwa przedmiotu w języku angielskim: **Legal aspects of engineering activities**

Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**

Specjalność (jeśli dotyczy): **Mechanical engineering design**

Poziom i forma studiów: **I stopień, stacjonarne**

Rodzaj przedmiotu: **obowiązkowy**

Kod przedmiotu: **W10MBM-SI3120**

Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15			15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30			30	
Forma zaliczenia	Zaliczenie na ocenę			Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	1			1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6			0.7	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma ugruntowaną wiedzę z zakresu podstaw konstrukcji maszyn, materiałoznawstwa, wytrzymałości materiałów, mechaniki, metod przetwarzania i obróbki materiałów konstrukcyjnych.
2. Potrafi samodzielnie poszukiwać informacji w tekstach źródłowych, kartach katalogowych i Internecie.
3. Umie czytać i tworzyć mechaniczną dokumentację techniczną.

CELE PRZEDMIOTU

C1. Zdobycie podstawowej wiedzy w zakresie wymagań prawnych stawianych wytwórcom maszyn.
C2. Zdobycie podstawowej wiedzy w zakresie bezpieczeństwa eksploatacji maszyn.
C3. Zdobycie praktycznej umiejętności analizy i redukcji ryzyka stwarzanego przez maszyny.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Ma wiedzę odnośnie podstawowych wymagań prawnych stawianych konstruktorom maszyn.
PEU_W02 - Ma podstawową wiedzę dotyczącą procesu redukcji ryzyka przy projektowaniu maszyn.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi zidentyfikować ryzyko stwarzane przez maszynę i zaproponować sposób redukcji tego ryzyka.
PEU_U02 - Potrafi określić normy zharmonizowane adekwatne do danego zagadnienia.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Ma świadomość zagrożeń stwarzanych przez różne rodzaje maszyn.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie do problematyki odpowiedzialności wytwórców maszyn. Dyrektywa maszynowa. Rola konstruktora w procesie redukcji ryzyka.	2
Wy2	Normy zharmonizowane typu A, B i C.	2
Wy3	Zagrożenia stwarzane przez maszyny – rodzaje i identyfikacja.	2
Wy4	Metody oceny ryzyka.	2
Wy5	Środki ochronne stosowane przez konstruktora – konstruowanie maszyn bezpiecznych samych w sobie.	2
Wy6	Środki ochronne stosowane przez konstruktora – stosowanie technicznych środków ochronnych i uzupełniających środków ochronnych.	2
Wy7	Środki ochronne stosowne przez konstruktora – informacje dla użytkownika. Ryzyko resztkowe.	2
Wy8	Instrukcja obsługi maszyny – wymagania prawne.	1
		Suma: 15

Forma zajęć – Projekt		Liczba godzin
Proj1	Przedstawienie maszyny do analizy ryzyka. Określenie wymagań dla analizowanej maszyny.	1
Proj2	Opracowanie wstępnej koncepcji maszyny spełniającej założone wymagania. Próba opracowania maszyny o konstrukcji bezpiecznej samej w sobie.	4

Proj3	Ocena ryzyka maszyny koncepcyjnej.	4
Proj4	Propozycja technicznych środków ochronnych ograniczających ryzyko.	4
Proj5	Ocena ryzyka resztkowego.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów
N2. konsultacje
N3. prezentacja projektu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01	kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01- PEU_U02 PEU_K01	obrona projektu
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
Dyrektywa maszynowa 2006/42/EC

LITERATURA UZUPEŁNIAJĄCA

OPIEKUN PRZEDMIOTU
dr inż. Damian Stefanow tel.: 320-27-18 email: damian.stefanow@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Production System Organisation (Podstawy organizacji produkcji)**
Nazwa przedmiotu w języku angielskim: **Production System Organisation**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3121**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	2				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Zna i rozumie istotę procesu zarządzania i podstawowych funkcji zarządzania.
2. Rozumie podstawowe podstawowe pojęcia i prawa ekonomiczne oraz zjawiska gospodarcze i ich efekty.
3. Ma podstawową wiedzę na temat procesów wytwarzania.

CELE PRZEDMIOTU

C1. Poznanie specyfiki zarządzania przedsiębiorstwem produkcyjnym oraz procesami wytwórczymi.
C2. Poznanie typów organizacji produkcji, a także metod i technik zarządzania różnymi typami procesów wytwórczych.
C3. Nabycie wiedzy z zakresu planowania, organizowania i sterowania systemami oraz procesami produkcyjnymi.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Rozróżnia i charakteryzuje rózne typy systemów produkcyjnych
PEU_W02 - Umie zdefiniować pojęcia dotyczące procesów produkcyjnych i procesów technologicznych
PEU_W03 - Ma wiedzę na temat organizacji produkcji, a także metod i technik zarządzania systemami produkcyjnym

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Charakterystyka organizacji produkcyjnych	2
Wy2	Charakterystyka systemów produkcyjnych	2
Wy3	System wytwórczy, jego organizacja i składowe	2
Wy4	Klasyfikacje procesów produkcyjnych	2
Wy5	Metody sterowania produkcją - systemy ssące. Koncepcja Just In Time. Koncepcja Lean Manufacturing.	4
Wy6	Metody sterowania produkcją - systemy pchające. Koncepcje MRP, MRP II, ERP.	4
Wy7	Metody sterowania produkcją - systemy wyciskające. Koncepcja OPT.	4
Wy8	Metody organizacji systemów produkcyjnych	2
Wy9	Metody zarządzania zapasami produkcyjnymi	2
Wy10	Zasady planowania i harmonogramowania procesów produkcyjnych	4
Wy11	Metody pozyskiwania danych produkcyjnych	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01-PEU_W03	Test pisemny
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA 1. Chlebus E.: "Techniki komputerowe CAx w inżynierii produkcji", Wydawnictwa Naukowo-Techniczne, Warszawa 2000, 2. Durlik I.: "nżynieria zarządzania : Cz. 1 i Cz.2", Wydawnictwo Placet, Warszawa 2007, 3. Liwowski B.: "Podstawowe zagadnienia zarządzania produkcją", Oficyna Ekonomiczna, Kraków 2006 LITERATURA UZUPEŁNIAJĄCA 1. Rogowski A..: "Podstawy organizacji i zarządzania produkcją w przedsiębiorstwie", Wydawnictwa Fachowe CeDeWu, Warszawa 2010, 2. Burchart-Korol D.: "Zarządzanie produkcją i usługami", Wydawnictwo Politechniki Śląskiej, Gliwice 2007

OPIEKUN PRZEDMIOTU
dr inż. Jarosław Chrobot tel.: 20-66 email: jaroslaw.chrobot@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Polymers in Engineering (Tworzywa sztuczne konstrukcyjne)**
Nazwa przedmiotu w języku angielskim: **Polymers in Engineering**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3122**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	90				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	3				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.8				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Podstawowa wiedza dotycząca własności materiałów polimerowych
2. Podstawowa wiedza dotycząca technologii wytwarzania elementów z tworzyw sztucznych
3. Podstawowa wiedza dotycząca projektowania elementów maszyn

CELE PRZEDMIOTU

C1. Nabycie umiejętności zastosowania materiałów polimerowych na elementy maszyn z uwzględnieniem założeń dotyczących warunków pracy, technologii wytwarzania, kosztów produkcji itp.
C2. Poznanie zagadnień związanych z zasadami projektowania elementów maszyn z tworzyw sztucznych
C3. Poznanie zagadnień związanych z projektowaniem połączeń elementów z tworzyw sztucznych

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Student zna charakterystyczne właściwości tworzyw sztucznych i jest w stanie zaproponować materiał polimerowy dla określonego zastosowania technicznego.
PEU_W02 - Student zna zasady projektowania oraz metody obliczeń elementów maszyn z tworzyw sztucznych
PEU_W03 - Student zna metody łączenia elementów maszyn z tworzyw sztucznych

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie. Właściwości materiałów polimerowych stosowanych w budowie maszyn. Charakterystyka własności mechanicznych i eksploatacyjnych materiałów polimerowych - wpływ temperatury i czasu.	2
Wy2	Przegląd polimerowych materiałów konstrukcyjnych - właściwości i zastosowania techniczne. Polimerowe materiały kompozytowe.	4
Wy3	Modelowanie własności mechanicznych materiałów polimerowych. Zastosowanie modeli w obliczeniach uwzględniających lepkosprężystość polimerów.	2
Wy4	Zasady projektowania elementów obudów i korpusów z tworzyw sztucznych - technologiczność, kształtowanie, metody obliczeniowe.	2
Wy5	Metody łączenia elementów z tworzyw sztucznych - połączenia rozłączne i nierozłączne. Projektowanie połączeń, metody obliczeń wytrzymałościowych.	4
Wy6	Tarcie i zużywanie elementów maszyn z tworzyw sztucznych. Łożyska ślizgowe z tworzyw sztucznych - obliczenia i rozwiązania konstrukcyjne.	2
Wy7	Przekładnie zębate z kołami polimerowymi - projektowanie, obliczenia.	2
Wy8	Wykorzystanie metod numerycznych w obliczeniach wytrzymałościowych elementów z tworzyw sztucznych	2
Wy9	Materiały polimerowe w zastosowaniach bioinżynierskich.	2
Wy10	Elementy z tworzyw sztucznych wytwarzane technologią druku 3D. Zagadnienia projektowe.	2

Wy11	Elementy urządzeń hydraulicznych z tworzyw sztucznych - dobór materiałów, projektowanie.	2
Wy12	Kolokwium zaliczające.	2
Wy13	Recykling wyrobów z tworzyw sztucznych. Podsumowanie kursu. Zaliczenie.	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem technik multimedialnych N2. dyskusja problemowa

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03	kartkówki (quizy) po wykładach
F2	PEU_W01, PEU_W02, PEU_W03	kolokwium
P = 0.1*F1+0.9*F2		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
[1] Erhard G.: Designing with Plastics. Hanser Gardner Publications, 2006
[2] Harper Ch. A. Modern Plastics Handbook. McGraw-Hill Comp.2000
[3] Supporting materials for the lecture - ePortal WUST

LITERATURA UZUPEŁNIAJĄCA
[1] Tutorials and brochures of plastics manufacturers on the websites (links are given at the first lecture)

OPIEKUN PRZEDMIOTU

Prof. dr hab. inż. Wojciech Wieleba tel.: +4871 320-27-74 email: wojciech.wieleba@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Vehicles Loading Modelling (Modelowanie obciążeń pojazdów samochodowych)**

Nazwa przedmiotu w języku angielskim: **Vehicles Loading Modelling**

Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**

Specjalność (jeśli dotyczy): **Mechanical engineering design**

Poziom i forma studiów: **I stopień, stacjonarne**

Rodzaj przedmiotu: **obowiązkowy**

Kod przedmiotu: **W10MBM-SI3123**

Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15			15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60			60	
Forma zaliczenia	Zaliczenie na ocenę			Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	2			2	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				2	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2			1.4	

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. znajomość zasad zachowania: masy, energii i pędu
2. umiejętność samodzielnej pracy z komputerem
3. świadomość konieczności samodzielnej pracy i umiejętność jej realizacji

CELE PRZEDMIOTU

C1. Pojęcie możliwości obliczenia pól: prędkości, ciśnienia i temperatury w oparciu o prawa zasad zachowania (masy energii i pędu) aplikowane z użyciem Metody Objętości Skończonych do zagadnień inżynierskich.
C2. Poznanie obciążeń oddziałujących na pojazd samochodowy wynikających z poruszania się pojazdu w ośrodku płynnym (powietrzu) oraz obciążeń cieplnych wynikających z obecności źródeł ciepła i ich oddziaływania na elementy pojazdu.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Ma wiedzę na temat Metody Objętości Skończonych w stopniu umożliwiającym wytłumaczenie aplikacji postaci całkowej równań zasad zachowania (masy, energii i pędu) do wybranego przepływu.
PEU_W02 - Umie zdefiniować wytyczne na temat kształtowania karoserii pojazdów i wybranych elementów pojazdów w zależności od obciążeń którymi są poddane.

II. Z zakresu umiejętności:
PEU_U01 - Potrafi prowadzić symulację wybranego przepływu dla pojazdu samochodowego lub jego elementów.
PEU_U02 - Analizuje wyniki symulacji celem określenia miejsc o maksymalnym obciążeniu.
PEU_U03 - Na podstawie własnej analizy jest w stanie zaprojektować wybrane elementy pojazdów samochodowych.

III. Z zakresu kompetencji społecznych:
PEU_K01 - rozumie potrzebę i ma możliwość ciągłego dokształcania się szczególnie z zakresu oprogramowania komputerowego
PEU_K02 - docenia koniecznośc podnoszenia kompetencji zawodowych, osobistych i społecznych

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wprowadzenie do systemów obliczeniowych typu CFD - definicja pojęć	2
Wy2	Uogólnione równanie transportu - przedstawienie zasad zachowania: masy, energii i pędu (postać całkowa).	2
Wy3	Metoda Objętości Skończonych - Stosowane modele turbulencji.	2
Wy4	Metoda Objętości Skończonych - przedstawienie schematów obliczeniowych (jawny, niejawny, Cranka-Nicolson).	2
Wy5	Metoda Objętości Skończonych - stosowane rozwiązania rachunku macierzowego.	2
Wy6	Typy warunków brzegowych - podstawy matematyczno-fizyczne	2
Wy7	Post-processing - Analiza pola prędkości i cisnienia	2
Wy8	Post-processing - Analiza pola temperatury	1
		Suma: 15

Forma zajęć – Projekt		Liczba godzin
Proj1	Pomiar wartości wejściowych	2
Proj2	Budowa geometrii	1
Proj3	Dyskretyzacja przestrzeni obliczeniowej	2
Proj4	Zdefiniowanie modelu numerycznego	2
Proj5	Zdefiniowanie warunków brzegowych i warunku początkowego	1
Proj6	Przeprowadzenie obliczeń	1
Proj7	Wizualizacja wyników	1
Proj8	Analiza wyników	2
Proj9	Modernizacja obiektu modelowanego - zmiany geometrii	1
Proj10	Przeprowadzenie obliczeń, wizualizacja wyników	1
Proj11	Analiza wyników i redakcja raportu z projektu	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. praca własna - przygotowanie do projektu N3. ANSYS Fluent calculation system N4. przygotowanie sprawozdania N5. prezentacja projektu

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01,PEU_W02	kolokwium
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się

F1	PEU_U01-PEU_U03	raport
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA] O. Węgrzyn, Validation of CFD predictions for flow over a full-scale formula student vehicle using PIV in real conditions J.P. Merkel, Development of Multi-element active aerodynamics for the formula student car J. Tu, G-H Yeoh, Ch. Li., Computational Fluid Dynamics A Practical Approach LITERATURA UZUPEŁNIAJĄCA Seward D., Race Car Design. Katz J., Race Car Aerodynamics, Designing for Speed. https://www.researchgate.net/figure/the-quality-of-connecting-Pitot-tube-to-u-shape-barometer-and the-quality-of-establishing_fig3_309764065, (Access : 08.04.2022)

OPIEKUN PRZEDMIOTU
dr inż. Marcin Tkaczyk tel.: 71 347-79-18 email: Marcin.Tkaczyk@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Fundamentals of Exploitation and Repair (Podstawy eksploatacji i remontów maszyn)**

Nazwa przedmiotu w języku angielskim: **Fundamentals of Exploitation and Repair**

Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**

Specjalność (jeśli dotyczy): **Mechanical engineering design**

Poziom i forma studiów: **I stopień, stacjonarne**

Rodzaj przedmiotu: **obowiązkowy**

Kod przedmiotu: **W10MBM-SI3124**

Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30		15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60			30	
Forma zaliczenia	Zaliczenie na ocenę			Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS	2			1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2		0.7		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma podstawową wiedzę z chemii, fizyki, grafiki inżynierskiej, materiałoznawstwa, konstruowania elementów maszyn. Zna podstawowe elementy maszyn, potrafi je dobierać z katalogu, wie na czym polega konieczność stosowania środków smarnych oraz zasad prewencyjnych w eksploatacji maszyn. Zna podstawowe procesy technologiczne typowych części maszyn. Potrafi chronić środowisko naturalne, racjonalnie wykorzystywać jego zasoby oraz ograniczać generowanie odpadów. Zdaje sobie sprawę z konsekwencji zanieczyszczania środowiska odpadami poprodukcyjnymi.
2. Potrafi rozpoznać zagrożenia związane z działalnością przemysłową eksploatacji maszyn, zna konwencje międzynarodowe i polskie akty prawne w dziedzinie ochrony środowiska. Zna ekologiczne zasady konstruowania, użytkowania i modernizacji maszyn. Ma świadomość ważności i zrozumienie pozatechnicznych aspektów i skutków działalności inżyniera i managera produkcji, w tym jej wpływu na środowisko, i związanej z tym odpowiedzialności za podejmowane decyzje.

CELE PRZEDMIOTU

C1. Nabycie podstawowej wiedzy o procesach eksploatacji maszyn. Zrozumienie systemowego podejścia do eksploatacji, opisu i oceny procesu eksploatacji. Opis technicznego stanu obiektu i jego niezawodności.
C2. Poznanie modeli niezawodności prostych obiektów naprawialnych , nienaprawialnych oraz złożonych.
C3. Zdobycie umiejętności planowania zapasów części zamiennych i materiałów eksploatacyjnych, poznanie zasad wdrażania gospodarki remontowej, metod regeneracji zużytych części maszyn, modernizacja maszyn, pozyskiwania odpadów i ich recyklingu. Poznanie zasad prewencji i diagnostyki w eksploatacji maszyn oraz ekologicznych zasad ich eksploatacji.
C4. Opracowanie wskaźników oceny oraz wyników z symulowanych badań eksploatacyjnych. Nabycie podstawowej wiedzy z zakresu diagnozowania i oceny stanu maszyn poprzez pomiary i analizę parametrów ich pracy takich jak np: zużycie energii, nagrzewanie się zespołów maszyny, poziom drgań i hałasu, dokładność ustalania położenia zespołów. Określenie technicznego stanu maszyny, stopnia jej zużycia i określenie zakresu jej remontu.
C5. Zdobycie umiejętności wyboru systemu remontowego maszyny oraz zorganizowania jego wykonania

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - rozumie systemowe podejście do procesu eksploatacji, umie opisać proces eksploatacji, techniczny stan obiektu, zna zasady oceny jego niezawodności.
PEU_W02 - posiada wiedzę z zakresu oceny technicznego stanu obiektu technicznego, opłacalności remontu maszyny, sposobu jego przygotowania i przeprowadzenia. Rozumie oddziaływanie maszyny i realizowanych procesów na człowieka i na środowisko, zna zasady ekologicznej jej eksploatacji.
PEU_W03 - zna metody oceny technicznego stanu maszyny, umie ocenić potrzebę, opłacalność i zakres przeprowadzenia jej remontu.

II. Z zakresu umiejętności:
PEU_U01 - potrafi ocenić techniczny stan prostych i złożonych obiektów technicznych oraz ich niezawodność
PEU_U02 - potrafi ocenić potrzebę przeprowadzenia remontu obiektu i niezbędny jego zakres, dobrać metodę regeneracji części, sprawować nadzór na zapasem materiałów eksploatacyjnych i części zamiennych.
PEU_U03 - potrafi minimalizować negatywne oddziaływanie maszyny i realizowanego procesu na obsługę i na środowisko

III. Z zakresu kompetencji społecznych:
PEU_K01 - wyszukiwanie informacji o eksploatacji i remontach maszyn i ich krytyczna analiza
PEU_K02 - obiektywna ocena parametrów diagnostycznych, dyskusja w gronie współpracowników i wybór optymalnej metody przywrócenia maszynie pierwotnych resursów pracy
PEU_K03 - obiektywna ocena argumentów, uzasadnianie własnych pomysłów z wykorzystaniem wiedzy z zakresu eksploatacji maszyn

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Podstawowe pojęcia z zakresu eksploatacji maszyn	1
Wy2	Prakseologiczne i systemowe podejście do eksploatacji	2
Wy3	Opis i ocena procesu eksploatacji	2

Wy4	Opis technicznego stanu obiektu	2
Wy5	Pojęcie niezawodności	2
Wy6	Niezawodność prostych obiektów naprawialnych i nienaprawialnych	2
Wy7	Niezawodność złożonych obiektów	2
Wy8	Planowanie zapasów części zamiennych i materiałów eksploatacyjnych	2
Wy9	Technicznie uzasadnione metody regeneracji części maszyn	2
Wy10	Gospodarka remontowa, systemy remontowe, modernizacja maszyn	3
Wy11	Prewencja i diagnostyka w użytkowaniu maszyn	3
Wy12	Pozyskiwanie odpadów, recykling i neutralizacja	1
Wy13	Ekologiczne aspekty konstruowania, eksploatacji i remontów maszyn	2
Wy14	Racjonalne smarowanie maszyn, techniki smarowania, smarowanie minimalne	2
Wy15	Uzdatnianie i neutralizacja środków smarowych, chłodziw i płynów technologicznych	2
		Suma: 30
Forma zajęć – Laboratorium		Liczba godzin
Lab1	Podstawowe stany eksploatacji obiektu technicznego. Wskaźniki oceny procesu eksploatacji.	1
Lab2	Analiza stanu obiektu technicznego (samochód, maszyna robocza) na podstawie zużycia paliwa, energochłonność.	2
Lab3	Analiza nieuszkadzalności wybranego obiektu technicznego. Podstawowe wskaźniki niezawodności.	2
Lab4	Analiza naprawialności wybranego obiektu technicznego. Wyznaczenie czasów napraw i słabych ogniw	2
Lab5	Straty mocy i sprawność złożonych układów napędowych, ocena stanu napędu.	2
Lab6	Ocena energochłonności i stanu łożysk wrzecionowych obrabiarki.	2
Lab7	Akustyczna diagnostyka technicznego stanu zespołów maszyny, badanie dynamicznych własności maszyn.	2
Lab8	Eksploatacyjne własności i wyznaczanie charakterystyki układu napędu posuwu ze śrubą toczną.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. eksperyment laboratoryjny N2. praca własna – przygotowanie do laboratorium N3. wykład tradycyjny z wykorzystaniem transparencji i slajdów N4. przygotowanie sprawozdania N5. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01 ÷ PEU_W03	written exam
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01 ÷ PEU_U03, PEU_K01 ÷ PEU_K03	short test
F2	PEU_U01 ÷ PEU_U03, PEU_K01 ÷ PEU_K03	assessment from the report
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
<u>LITERATURA PODSTAWOWA</u> Ecological and Health Effects of Lubricant Oils Emitted into the Environment, Nowak, Kucharska, Kamiński, Int J Environ Res Public Health 2019. <u>LITERATURA UZUPEŁNIAJĄCA</u> Maintenance and Engineering

OPIEKUN PRZEDMIOTU
dr inż. Paweł Turek email: pawel.turek@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Management in production (Zarządzanie w produkcji)**
Nazwa przedmiotu w języku angielskim: **Management in production**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3125**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	1				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Zna i rozumie istotę procesu zarządzania i podstawowych funkcji zarządzania.
2. Rozumie podstawowe podstawowe pojęcia i prawa ekonomiczne oraz zjawiska gospodarcze i ich efekty.
3. Ma podstawową wiedzę na temat procesów wytwarzania.

CELE PRZEDMIOTU

C1. Poznanie specyfiki zarządzania przedsiębiorstwem produkcyjnym oraz procesami wytwórczymi.
C2. Poznanie metod i technik zarządzania różnymi typami procesów wytwórczych.
C3. Nabycie wiedzy z zakresu planowania, organizowania i sterowania procesami produkcyjnymi.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Rozróżnia i charakteryzuje rózne typy systemów produkcyjnych
PEU_W02 - Umie zdefiniować pojęcia dotyczące procesów produkcyjnych i procesów technologicznych
PEU_W03 - Ma wiedzę na temat metod i technik zarządzania systemami produkcyjnym

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Charakterystyka organizacji produkcyjnych	1
Wy2	Charakterystyka systemów produkcyjnych	1
Wy3	System wytwórczy, jego organizacja i składowe	1
Wy4	Klasyfikacje procesów produkcyjnych	1
Wy5	Typy i formy produkcji	1
Wy6	Metody sterowania produkcją (systemy ssące, pchające i wyciskające)	2
Wy7	Metody organizacji systemów produkcyjnych	2
Wy8	Charakterystyka wąskich gardeł w procesach wytwórczych	2
Wy9	Metody zarządzania zapasami produkcyjnymi	2
Wy10	Zasady planowania i harmonogramowania procesów produkcyjnych	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA 1. Chlebus E.: "Techniki komputerowe CAx w inżynierii produkcji", Wydawnictwa Naukowo-Techniczne, Warszawa 2000, 2. Durlik I.: "nżynieria zarządzania : Cz. 1 i Cz.2", Wydawnictwo Placet, Warszawa 2007, 3. Liwowski B.: "Podstawowe zagadnienia zarządzania produkcją", Oficyna Ekonomiczna, Kraków 2006 LITERATURA UZUPEŁNIAJĄCA 1. Rogowski A..: "Podstawy organizacji i zarządzania produkcją w przedsiębiorstwie", Wydawnictwa Fachowe CeDeWu, Warszawa 2010, 2. Burchart-Korol D.: "Zarządzanie produkcją i usługami", Wydawnictwo Politechniki Śląskiej, Gliwice 2007

OPIEKUN PRZEDMIOTU
dr inż. Jarosław Chrobot tel.: 20-66 email: jaroslaw.chrobot@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Thesis, Seminar (Seminarium dyplomowe)**
Nazwa przedmiotu w języku angielskim: **Thesis, Seminar**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W10MBM-SI3126**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)					15
Liczba godzin całkowitego nakładu pracy studenta (CNPS)					30
Forma zaliczenia					Zaliczenie na ocenę
Grupa kursów					
Liczba punktów ECTS					1
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					1
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)					0.7

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Znajomość zagadnień objętych programem studiów
2. Deficyt punktów ECTS nie większy niż to wynika z uchwały Rady Wydziału

CELE PRZEDMIOTU

C1. Przekazanie wiedzy na temat wymogów pisania pracy dyplomowej inżynierskiej
C2. Nabycie umiejętności prezentacji pracy własnej oraz obrony zawartych tez
C3. Nabycie umiejętności prowadzenia dyskusji na tematy inżynierskie oraz formułowania własnego stanowiska

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ
I. Z zakresu wiedzy: **II. Z zakresu umiejętności:** PEU_U01 - Potrafi przygotować prezentację, omówić cel i zakres pracy inżynierskiej oraz postępy w jej realizacji PEU_U02 - Potrafi prowadzić dyskusje na tematy inżynierskie, w tym prezentować własne stanowisko PEU_U03 - Potrafi sformułować cel pracy inżynierskiej oraz dobrać metody do jego realizacji **III. Z zakresu kompetencji społecznych:** PEU_K01 - Rozumie konieczność ciągłego zdobywania wiedzy i kompetencji zawodowych PEU_K02 - Rozumie potrzebę prowadzenia dyskusji nad sposobem rozwiazywania problemów inżynierskich PEU_K03 - Ma świadomość wpływu swoich decyzji na sposób funkcjonowania przedsiębiorstw

TREŚCI PROGRAMOWE		
Forma zajęć – Seminarium		Liczba godzin
Sem1	Omówienie planu i sposobu prowadzenia seminarium oraz harmonogramu wystąpień	1
Sem2	Przekazanie wiedzy na temat zasad przygotowania prezentacji oraz sposobu jej prowadzenia	1
Sem3	Przekazanie wiedzy na temat pisania pracy dyplomowej inżynierskiej oraz przebiegu egzaminu dyplomowego, wystąpienia	13
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. prezentacja multimedialna N2. konsultacje N3. dyskusja problemowa

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Seminarium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_U03	Ocena sposobu przygotowania, zaprezentowania prezentacji
F2	PEU_K01, PEU_K02, PEU_U02, PEU_K03	Udział w dyskusji

P = 0,8*F1+0,2*F2

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA 1. Kowalkowska, A. (2022). Esej naukowy jako trening przed pisaniem pracy dyplomowej. Tutoring Gedanensis, 7 (3) 2. Majchrzak J.:Metodyka pisania prac magisterskich i dyplomowych, Wydawnictwo Uniwersytetu Ekonomicznego, Poznań 2009 2. Brycz B.: Przewodnik dla piszących prace magisterskie w zakresie zarządzania, Polskie Wydawnictwo Ekonomiczne, Warszawa 2011 LITERATURA UZUPEŁNIAJĄCA 1. Wiszniewski A.: Sztuka pisania. Videograf II, Katowice 2003 2. Wiszniewski A.: Sztuka mówienia. Videograf II, Katowice 2003

OPIEKUN PRZEDMIOTU
dr hab. inż. Mirosław Bocian tel.: 320-27-54 email: miroslaw.bocian@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Military technology in armed conflicts (Technika wojskowa w konfliktach zbrojnych)**

Nazwa przedmiotu w języku angielskim: **Military technology in armed conflicts**

Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**

Specjalność (jeśli dotyczy): **Mechanical engineering design**

Poziom i forma studiów: **I stopień, stacjonarne**

Rodzaj przedmiotu: **wybieralny**

Kod przedmiotu: **W10MBM-SI3128**

Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	2				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ogólna wiedza w obszarze bezpieczeństwa państwa.
2. Podstawowa wiedza z zakresu techniki wojskowej.
3. Ogólna wiedza z prawa konfliktów zbrojnych.

CELE PRZEDMIOTU

C1. Poznanie podstawowych wiadomości o poszczególnych kategoriach uzbrojenia indywidualnego i zbiorowego oraz ich funkcji bojowych na tle historycznym do współczesności.
C2. Nabycie elementarnej wiedzy z zakresu prawa wojennego, bronioznawstwa, możliwości bojowych omawianych systemów uzbrojenia i sposobów jej wykorzystania na tle rozwoju sztuki wojennej od czasów najdawniejszych po czasy współczesne.
C3. Umiejętność interpretacji podstawowych aktów prawnych, zwłaszcza ustawy o broni i amunicji oraz zdolności obronnych państwa.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Posiada wiedzę na temat potencjału obronnego państwa w strukturze bezpieczeństwa wewnętrznego i układów sojuszniczych.
PEU_W02 - Potrafi objaśnić specyfikę uzbrojenia wojska polskiego na tle armii innych krajów w historii i współczesności.
PEU_W03 - Posiada wiedzę z zakresu terminologii wojskowej w obszarze uzbrojenia, zarówno współczesnego, jak i historycznego.

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:
PEU_K01 - Rozumie potrzebę kształtowania świadomości działalności inżynierskiej w ujęciu rozwoju myśli i techniki wojskowej.
PEU_K02 - Umiejętne selekcjonowanie zdolności taktyczno-technicznych elementów uzbrojenia czołowych armii świata.
PEU_K03 - Rozumie potrzebę kształtowania wiedzy z zakresu głównych kierunków rozwoju techniki wojskowej na przykładzie konfliktów zbrojnych.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Podstawowe pojęcia związane z konfliktami zbrojnymi i sprzętem wojskowym - definicje broni i uzbrojenia, rola broni w kulturze i historii ludzkości.	2
Wy2	Broń sieczna i kolna. Dawne machiny wojenne, sprzęt taborowy, rząd koński i oporządzenie jeździeckie.	2
Wy3	Przemiany broni w czasach nowożytnych.	2
Wy4	Rozwój broni strzeleckiej.	2
Wy5	Geneza i rozwój amunicji do broni strzeleckiej i broni ręcznej.	2
Wy6	Uzbrojenie ochronne od czasów historycznych po współczesność.	2
Wy7	Artyleria w czasach nowożytnych i współczesnych. Jej znaczenie na współczesnym polu walki i w przyszłych konfliktach zbrojnych.	2

Wy8	Wozy bojowe i ich znaczenie w perspektywie robotyzacji przyszłego pola walki.	2
Wy9	Ciężkie wozy bojowe – czołgi. Geneza i taktyka ich wykorzystania na tle minionego i współczesnego wieku.	2
Wy10	Środki napadu powietrznego na tle historycznym do współczesności.	2
Wy11	Broń rakietowa i hipersoniczna.	2
Wy12	Uzbrojenie morskie w rysie historycznym, współczesnym i kierunki rozwoju.	2
Wy13	Inne rodzaje broni konwencjonalnej (ładunki wybuchowe, miny, itp.).	2
Wy14	Kastomizacja techniki i uzbrojenia wojskowego wynikająca z potrzeb obronnych zmieniającej się sytuacji konfliktów zbrojnych.	2
Wy15	Sprawdzenie wiedzy. Kolokwium	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03.	Kolokwium
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

1. Encyklopedia wojskowa. Dowódcy i ich armie. Historia wojen i bitew. Technika wojskowa. T. 1 (A-M), Wyd. PWN, Bellona, Warszawa 2007.
2. Gwóźdź Z., Zarzycki P., Polskie konstrukcje broni strzeleckiej. SIGMA-NOT, Warszawa 1993.
3. Hogg I., Encyklopedia uzbrojenia. Rozwój uzbrojenia od prehistorii do XXI wieku. Warszawa 2009.
4. Kochański S., Małokalibrowa broń samoczynna. Wydawnictwo Politechniki Warszawskiej, Warszawa 1989.
5. Kwaśniewicz W., Encyklopedia dawnej broni i uzbrojenia ochronnego. Bellona, Warszawa 2022.
6. Weir W., 50 broni, które zmieniły sposób prowadzenia wojen. Warszawa 2005.
7. Wiśniewski A., Pancerze, budowa, projektowanie i badania. WNT, Warszawa 2001.
8. Włodarczyk E., Podstawy fizyki wybuchu. WNT, Warszawa 2012.
9. Zasieczny A., Broń Wojska Polskiego 1939-1945. Warszawa 2010.
10. Żygulski Z., Gradowski M., Słownik uzbrojenia historycznego. Warszawa 1998.

LITERATURA UZUPEŁNIAJĄCA

1. Ciepliński A., Woźniak R., Ilustrowana encyklopedia współczesnej broni palnej. Wydawnictwo Lampart, Warszawa 1997.
2. Hart R., Współczesne czołgi i pojazdy opancerzone od 1991 do dzisiaj. Wyd. 2, Alma-Press, Warszawa 2023.
3. Hazell P.J., Armour: Materials, Theory, and Design. CRC Press, Taylor & Francis Group, New York 2016.
4. Ius ad bellum versus ius in bello (Międzynarodowe Prawo Humanitarne. Tom IX). Praca zbiorowa, Wydawnictwo Marynarki Wojennej, Gdynia 2018.
5. Jamroziak K., Kędzia K., Śliwa Z., Standaryzacja amunicji strzeleckiej: budowa, znakowanie i przechowywanie. Skrypt. Wydawnictwo Wyższej Szkoły Oficerskiej Wojsk Lądowych. Wrocław 2003.
6. Puchała F., Budowa potencjału bojowego Wojska Polskiego 1945-1990. Bellona, Warszawa 2013.
7. Ustawa z dnia 21 maja 1999 r. o broni i amunicji (Dz.U. z 2022 r. poz. 2516).

OPIEKUN PRZEDMIOTU

dr hab. inż. Krzysztof Jamroziak tel.: 320 27 60 email: krzysztof.jamroziak@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Intellectual Property Law (Ochrona własności intelektualnej)**
Nazwa przedmiotu w języku angielskim: **Intellectual Property Law**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **wybieralny**
Kod przedmiotu: **W10MBM-SI3129**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	1				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.6				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ogólna wiedza w obszarze innowacji.
2. Podstawowa wiedza z obszaru rachunkowości i finansów.
3. Ogólna wiedza z prawa gospodarczego i marketingu.

CELE PRZEDMIOTU

C1. Poznanie podstawowych wiadomości o funkcjonującym systemie prawnym ochrony własności intelektualnych i różnych postaciach dóbr: prawo autorskie, prawo własności przemysłowej, patenty, wzory użytkowe, przemysłowe, itp.
C2. Nabycie elementarnych umiejętności przygotowania opisów zgłoszeniowych wynalazków i wzorów użytkowych oraz przemysłowych itp.
C3. Umiejętność korzystania z informacji patentowej.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Posiada wiedzę na temat informacji patentowej.
PEU_W02 - Potrafi objaśnić zdolność patentową.
PEU_W03 - Posiada wiedzę dotyczącą plagiatu.

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:
PEU_K01 - Rozumie potrzebę kształtowania świadomości działalności inżynierskiej w ujęciu ochrony własności intelektualnej.
PEU_K02 - Umiejętne weryfikowanie aspektów prawnych w zakresie prawa autorskiego i praw pokrewnych oraz prawa własności przemysłowej.
PEU_K03 - Umiejętność pracy w grupie.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Podstawowe pojęcia ochrony własności intelektualnej. Badania, nauka, wiedza, odkrycie, wynalazek, innowacje i innowacyjność, zastrzeżenie patentowe, wzory użytkowe, wzory przemysłowe, topografia obwodów scalonych.	2
Wy2	Procedura badania zgłoszeń wynalazków i wzorów użytkowych.	2
Wy3	Ocena zdolności patentowej. Opis zgłoszeniowy wynalazku.	2
Wy4	Informacja patentowa: źródła i zbiory dokumentacji i literatury patentowej, dostęp do informacji i baz danych Urzędu Patentowego RP.	2
Wy5	Znaki towarowe i ich ochrona prawna. Prawo autorskie i prawa pokrewne dzieł literackich i artystycznych.	2
Wy6	Ochrona własności intelektualnej oprogramowania. Organizacje zajmujące się zbiorowym zarządzaniem praw autorskich.	2
Wy7	Ochrona własności intelektualnej baz danych oraz domen.	2
Wy8	Plagiat a praca inżynierska.	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_W03.	Kolokwium
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
1. Michniewicz G. Ochrona własności intelektualnej. Podręczniki akademickie,. 5. Wydanie. C.H.Beck. Warszawa 2022.
2. Czub K. Prawo własności intelektualnej. Wolters Kluwer. Warszawa 2021.
3. Kostański P., Żelechowski Ł, Prawo własności przemysłowej. Podręcznik akademicki. Warszawa 2014.
4. Barta J., Markiewicz R. Prawo autorskie i prawa pokrewne. Wydanie 5. Warszawa 2011.
5. Adamczak A., Gedłek M. Znaki towarowe w działalności małych i średnich przedsiębiorstw. Krajowa Izba Gospodarcza. Warszawa 2009.
6. Adamczak A., Dobosz E., Gedłek M. Wzory przemysłowe w działalności małych i średnich przedsiębiorstw. Krajowa Izba Gospodarcza. Warszawa 2009.
7. Kondrat M., Dreszer-Lichańska H.Własność przemysłowa w UE. Gdańsk 2007.

LITERATURA UZUPEŁNIAJĄCA
1. Pawlik K., Zenderowski R. Dyplom z internetu. Jak korzystać z internetu pisząc prace dyplomowe? CeDeWu. Warszawa 2013.
2. Jeziorow J. Wrocławski kodeks dobrych praktyk w zakresie korzystania z wyników pracy intelektualnej. Urząd Marszałkowski Województwa Dolnośląskiego. Wrocław 2010.
3. Ustawa z dnia 30 czerwca 2000 r. Prawo własności przemysłowej (tj. Dz.U. 2003 nr 119, poz. 1117 z późn. zm.).
4. Ustawa z dnia 4 lutego 1994 r. o prawie autorskim i prawach pokrewnych (tj. Dz.U. 2006 nr 90, poz. 631 z późn. zm.).
5. Konwencja o udzielaniu patentów europejskich (Konwencja o patencie europejskim), sporządzona w Monachium dnia 5 października 1973 r. (Dz. U. z 2004 r. Nr 79, poz. 737), Akt z dnia 29 listopada 2000 r. rewidujący Konwencję o udzielaniu patentów europejskich, sporządzoną w Monachium dnia 5 października 1973 r. (Dz. U. z 2007 r. Nr 236, poz. 1736).
6. Konwencja paryska o ochronie własności przemysłowej z dnia 20 marca 1883 r. zmieniona w Brukseli dnia 14 grudnia 1900 r., w Waszyngtonie dnia 2 czerwca 1911 r., w Hadze dnia 6 listopada 1925 r., w Londynie dnia 2 czerwca 1934 r., w Lizbonie dnia 31 października 1958 r. i w Sztokholmie dnia 14 lipca 1967 r. - Akt sztokholmski z dnia 14 lipca 1967 r. (Dz. U. z 1975 r. Nr 9, poz. 51).
7. Podstawowe – obowiązujące akty prawne z zakresu ochrony własności przemysłowej na stronie Urzędu Patentowego RP: https://uprp.gov.pl/pl.

OPIEKUN PRZEDMIOTU

dr hab. inż. Krzysztof Jamroziak tel.: 320 27 60 email: krzysztof.jamroziak@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Solid and surface modeling in CATIA (Modelowanie bryłowe i powierzchniowe w systemie CATIA)**

Nazwa przedmiotu w języku angielskim: **Solid and surface modeling in CATIA**

Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**

Specjalność (jeśli dotyczy): **Mechanical engineering design**

Poziom i forma studiów: **I stopień, stacjonarne**

Rodzaj przedmiotu: **wybieralny**

Kod przedmiotu: **W10MBM-SI3134**

Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)				15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				30	
Forma zaliczenia				Zaliczenie na ocenę	
Grupa kursów					
Liczba punktów ECTS				1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)					

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Wiedza w zakresie geometrii wykreślnej.
2. Podstawy kształtowania ustrojów maszyn
3. Umiejętność posługiwania się programami CAD/CAE

CELE PRZEDMIOTU

C1. Zapoznanie się z metodami tworzenia modeli powierzchniowych i bryłowych
C2. Opanowanie metod tworzenia złożeń i zdefiniowania animacji mechanizmów.
C3. Zapoznanie z metodami kształtowania wytrzymałościowego struktur cienkościennych i bryłowych

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Potrafi opracować model bryłowy lub powierzchniowy w programie CATIA
PEU_U02 - Potrafi wykonać model złożeniowy i przeprowadzić animację ruchu mechanizmu w programie CATIA
PEU_U03 - Potrafi przeprowadzić analizę wytrzymałościową struktury bryłowej lub cienkościennej w programie CATIA

III. Z zakresu kompetencji społecznych:
PEU_K01 - Nabywa umiejętności ponoszenia odpowiedzialności za wykonaną pracę
PEU_K02 - Myśleć i działać w sposób kreatywny
PEU_K03 - Nabywa umiejętność pracy zespołowe

TREŚCI PROGRAMOWE

Forma zajęć – Projekt		Liczba godzin
Proj1	Wprowadzenie, zapoznanie się ze środowiskiem programu CATIA, praca ze szkicownikiem	1
Proj2	Podstawy modelowania bryłowego w programie CATIA	2
Proj3	Podstawy modelowania powierzchniowego w programie CATIA	2
Proj4	Tworzenie złożeń i animacji ruchu	2
Proj5	Przeprowadzenie analiz wytrzymałościowych dla struktur bryłowych	2
Proj6	Przeprowadzenie analiz wytrzymałościowych dla struktur cienkościennych	2
Proj7	Przygotowanie dokumentacji konstrukcyjnej	2
Proj8	Opracowanie sprawozdania z projektu	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. praca własna - przygotowanie do projektu N2. prezentacja multimedialna N3. prezentacja projektu N4. przygotowanie sprawozdania

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Projekt)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01 PEU_U02 PEU_U03 PEU_K01 PEU_K02	Evaluation of the completed project
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

Rusinski E., Czmochowski J., Smolnicki T. Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000
Rakowski G., Kacprzak Z.: Metoda elementów skończonych w mechanice konstrukcji, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2016
Wyleżoł M. CATIA. Podstawy modelowania powierzchniowego i hybrydowego, Helion, Gliwice 2003
Wełyczko A. CATIA V5. Sztuka modelowania powierzchniowego, Helion 2008
Sokół K. CATIA. Wykorzystanie metody elementów skończonych w obliczeniach inżynierskich, Helion 2014

LITERATURA UZUPEŁNIAJĄCA

Wyleżoł M. CATIA v5 Modelowanie i analiza układów kinematycznych, Helion 2007
Skarka W., Mazurek A. CATIA. Podstawy modelowania i zapisu konstrukcji, Helion 2005
Pieczonka K.: Inżynieria maszyn roboczych. Część I. Podstawy urabiania, jazdy, podnoszenia i obrotu, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2007
Dudczak A.: Koparki. Teoria i projektowanie, PWN, Warszawa 2000
Augustyn J., Śledziewski, Technologiczność stalowych konstrukcji spawanych, Arkady, Warszawa 1981
Ferenc K., Ferenc J.: Konstrukcje spawane. Projektowanie połączeń. WNT, Warszawa 2000

OPIEKUN PRZEDMIOTU
dr hab. inż. Jacek Karliński tel.: 71 320-29-46 email: jacek.karlinski@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Biomedical Engineering (Biomechanika inżynierska)**
Nazwa przedmiotu w języku angielskim: **Biomedical Engineering**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **wybieralny**
Kod przedmiotu: **W10MBM-SI3149**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	2				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Posiada wiedzę z zakresu podstaw mechaniki i wytrzymałości materiałów.
2. Posiada wiedzę z zakresu podstaw materiałoznawstwa.

CELE PRZEDMIOTU

C1. Opanowanie wiedzy na temat nowoczesnych technik stosowanych we wspomaganiu wybranych funkcji życiowych człowieka.
C2. Nabycie wiedzy z zakresu stosowanych biomateriałów i istniejących rozwiązań konstrukcyjnych implantów i sztucznych narządów.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Posiada wiedzę o mechanicznych i fizycznych właściwościach podstawowych elementów anatomicznych człowieka w aspekcie możliwości aplikacji sztucznych elementów zastępczych.
PEU_W02 - Ma uporządkowaną wiedzę z zakresu istniejących konstrukcji endoprotez stawowych i stabilizatorów oraz zasad ich projektowania z uwzględnieniem szczególnych wymagań materiałowych i wytrzymałościowych.

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Stan obecny i kierunki rozwoju inżynierii medycznej. Rola i funkcja inżyniera w medycynie.	2
Wy2	Ciało człowieka jako złożony układ mechaniczny. Biomechanika narządu ruchu człowieka. Modele obciążeń układu kostno-mięśniowego człowieka.	2
Wy3	Podstawy wytrzymałości materiałów tkankowych – biomechaniczne aspekty przeciążenia struktur tkankowych.	2
Wy4	Biomateriały, wymagania, ich własności mechaniczne i biofizyczne, modyfikacja powierzchni implantów. Zjawiska na granicy implant- tkanka.	2
Wy5	Endoprotezy stawowe kończyn dolnych (staw biodrowy, kolanowy, skokowy) i górnych (staw nadgarstka, łokciowy, barkowy). Biotribologia.	2
Wy6	Implanty i systemy stabilizujące uszkodzenia kręgosłupa. Protezy krążków międzykręgowych.	2
Wy7	Stabilizatory zewnętrzne i wewnętrzne kości długich. Skafoldy jako rusztowanie tkanki kostnej.	2
Wy8	Kolokwium	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. wykład informacyjny
N2. prezentacja multimedialna

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02	Kolokwium
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA 1. Biomechanika i Inżynieria Rehabilitacyjna T.V pod red. M. Nałęcza, Biocybernetyka i Inżynierii Biomedycznej, Warszawa 2003. 2. Bober T., Zawadzki J., Biomechanika układu ruchu człowieka, Wyd. BK, Wrocław 2001. 3. Tejszerska D., Świtoński E., Gzik M., Biomechanika narządu ruchu człowieka, Wydawnictwo Instytutu Technologii Eksploatacji – PIB, 2011. LITERATURA UZUPEŁNIAJĄCA

OPIEKUN PRZEDMIOTU
Prof. dr hab. inż. Celina Pezowicz tel.: 71 320-27-13 email: Celina.Pezowicz@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Technique in Medicine (Technika w medycynie)**
Nazwa przedmiotu w języku angielskim: **Technique in Medicine**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **wybieralny**
Kod przedmiotu: **W10MBM-SI3150**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	2				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Wiedza z zakresu mechaniki i wytrzymałości materiałów.
2. Wiedza z zakresu podstaw konstrukcji maszyn.
3. Wiedza z zakresu układów napędowych.

CELE PRZEDMIOTU

C1. Omówienie budowy i zasady działania urządzeń i systemów wspomagających zabiegi i operacje chirurgiczne.
C2. Omówienie budowy i zasady działania wybranych sztucznych narządów oraz sterowania ich pracą.
C3. Omówienie technicznych środków wspomagających lokomocję człowieka.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Formułuje i objaśnia wymagania stawiane urządzeniom wspomagającym funkcjonowanie człowieka oraz robotom i manipulatorom przeznaczonym do zastosowań medycznych.
PEU_W02 - Zana zasady doboru rozwiązań technicznych wspomagających funkcjonowanie narządów i układów człowieka.

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:
PEU_K01 - Ma świadomość ważności i rozumie pozatechniczne aspekty i skutki działalności inżyniera i rozumie związaną z tym odpowiedzialność za podejmowane decyzje.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wspomaganie lokomocji osób niepełnosprawnych (ON): wózki inwalidzkie, wózki z funkcją pionizacji, egzoszkielety. Normy dotyczące projektowania środków transportu dla ON, układy napędowe i sposoby sterowania, kierunki rozwoju konstrukcji wspomagających lokomocję ON.	2
Wy2	Protezy kończyn górnych i dolnych; funkcje, klasyfikacja, omówienie rozwiązań konstrukcyjnych stosowanych protez, układy napędowe w protezach, protezy bioniczne.	2
Wy3	Środki techniczne stosowane w rehabilitacji układu kostno-stawowego i mięśniowego, urządzenia do rehabilitacji czynnej i biernej kończyn, pionizatory i parapodia, egzoszkielety i systemy rehabilitacyjne wykorzystujące biologiczne sprzężenie zwrotne (biofeedback).	2
Wy4	Manipulatory i roboty medyczne, rozwiązania konstrukcyjne stosowane w manipulatorach medycznych, narzędzia do operacji laparoskopowych, kierunki rozwoju telemedycyny.	2
Wy5	Systemy nawigacji na sali operacyjnej, przeznaczenie, klasyfikacja, zasada funkcjonowania nawigacji optycznej i magnetycznej, przykłady rozwiązań konstrukcyjnych elementów mechanicznych systemów nawigacji, przykłady aplikacji w praktyce klinicznej.	2
Wy6	Obrazowanie w medycynie, budowa i zasada działania tomografów komputerowych, rodzaje konstrukcji, zakres stosowania, rezonans magnetyczny, ultrasonografia wewnątrznaczyniowa, algorytmy rekonstrukcji obrazów trójwymiarowych narządów wewnętrznych.	2
Wy7	Techniczne wspomaganie układu krążenia: sztuczne serce, idea budowy, stosowane rozwiązania, materiały, sterowanie, rozruszniki serca, układy krążenia pozaustrojowego, technika małoinwazyjnej angioplastyki naczyniowej; stenty naczyniowe, stengrafty, budowa, zasada działania, stosowane rozwiązania konstrukcyjne.	2
Wy8	Kolokwium zaliczeniowe.	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_W02, PEU_K01	Kolokwium
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA 1) Inżynieria Biomedyczna - podstawy i zastosowania (tomy: I - X); red. Władysław Torbicz, Akademicka Oficyna Wydawnicza EXIT, Warszawa 2013 LITERATURA UZUPEŁNIAJĄCA e-zasoby Biblioteki PWr.

OPIEKUN PRZEDMIOTU
dr hab. inż. Jarosław Filipiak tel.: 71 320-21-50 email: jaroslaw.filipiak@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Fizyka 1A**
Nazwa przedmiotu w języku angielskim: **Physics 1A**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W11MBM-SI0002**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30	15			
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	90	60			
Forma zaliczenia	Egzamin	Zaliczenie na ocenę			
Grupa kursów					
Liczba punktów ECTS	3	2			
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		2			
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.5	1.4			

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Wiedza i umiejętności z zakresu fizyki i matematyki ze szkoły średniej.

CELE PRZEDMIOTU

C1. Nabycie wiedzy, uwzględniającej jej aspekty aplikacyjne, z kinematyki oraz dynamiki, obejmujących zagadnienia pracy i energii mechanicznej, fal mechanicznych oraz zasad zachowania.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - ma ogólną wiedzę w zakresie podstawowych koncepcji i zasad dotyczącą kinematyki punktu materialnego, dynamiki punktu materialnego, ruchu układu punktów materialnych i bryły sztywnej, zasady zachowania pędu, momentu pędu, energii mechanicznej, pracy, energii kinetycznej i potencjalnej, fal mechanicznych pozwalającą na rozumienie zjawisk fizycznych.

II. Z zakresu umiejętności:
PEU_U01 - przeprowadzić analizę ilościową związaną z zagadnieniem fizycznym i sformułować wnioski jakościowe

III. Z zakresu kompetencji społecznych:
PEU_K01 - rozumie potrzebę i konieczność ciągłego zdobywania wiedzy (zarówno samodzielnie i w grupie)

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Sprawy organizacyjne. Metodologia fizyki. Wektory. Działania na wektorach	2
Wy2	Kinematyka punktu materialnego	2
Wy3	Dynamika punktu materialnego	4
Wy4	Praca, energia mechaniczna.	2
Wy5	Bryła sztywna – kinematyka, dynamika.	4
Wy6	Ruch drgający.	2
Wy7	Fale mechaniczne	2
Wy8	Wykłady rozszerzające dotychczasową wiedzę dotyczącą fizyki1.	12
		Suma: 30

Forma zajęć – Ćwiczenia		Liczba godzin
Ćw1	Sprawy organizacyjne.	1
Ćw2	Rozwiązywanie zadań rachunkowych dotyczących zagadnień omawianych na wykładzie.	12
Ćw3	Kolokwium zaliczeniowe.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. praca własna – samodzielne studia i przygotowanie do egzaminu N3. konsultacje N4. ćwiczenia rachunkowe

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_K01	Egzamin pisemny
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Ćwiczenia)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_K01	Test
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
[1] D. Halliday, R. Resnick, J. Walker, Podstawy fizyki, tomy 12., Wydawnictwo Naukowe PWN.
[2] J. Orear, Fizyka t.1 i 2, WNT, 1993, Warszawa 2003

LITERATURA UZUPEŁNIAJĄCA
[1] J. Massalski, M. Massalska, Fizyka dla inżynierów, cz. 1. i 2., WNT, Warszawa 2008.
[2] Fizyka dla szkół wyższych, https://openstax.org/books/

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Laboratorium podstaw fizyki**
Nazwa przedmiotu w języku angielskim: **Basic physics laboratory**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W11MBM-SI0003**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)			15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)			60		
Forma zaliczenia			Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS			2		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			2		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)			1.4		

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Wiedza i umiejętności z zakresu Fizyki 1A lub Fizyki 1B i matematyki.

CELE PRZEDMIOTU

C1. Opanowanie umiejętności korzystania z różnych urządzeń pomiarowych
C2. Opanowanie umiejętności przeprowadzenia prostego eksperymentu zgodnie z instrukcją
C3. Uzyskanie umiejętności opracowania wyników eksperymentu i prezentacji ich w postaci raportu
C4. Uzyskanie umiejętności szacowania niepewności uzyskanych rezultatów oraz wyznaczania niepewności pomiarowych

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Umie posługiwać się prostymi przyrządami pomiarowymi, potrafi wykonać pomiary podstawowych wielkości fizycznych z wykorzystaniem instrukcji stanowiska pomiarowego
PEU_U02 - potrafi opracować wyniki pomiarów oraz przeprowadzić analizę niepewności pomiarowych z wykorzystaniem narzędzi inżynierskich.
PEU_U03 - potrafi opracować raport podsumowujący wykonane ćwiczenie na podstawie uzyskanych wyników

III. Z zakresu kompetencji społecznych:
PEU_K01 - utrwala umiejętności pracy zespołowej
PEU_K02 - ma świadomość własnych ograniczeń i wie jak ważne jest dalsze samokształcenie
PEU_K03 - utrwala umiejętności rzetelnego i odpowiedzialnego wykonywania zadań

TREŚCI PROGRAMOWE

Forma zajęć – Laboratorium		Liczba godzin
Lab1	Sprawy organizacyjne, krótkie szkolenie BHP	1
Lab2	Przykładowe pomiary różnych wielkości fizycznych – zapoznanie się ze sposobami: wyznaczania niepewności pomiarowych; opracowania numerycznego i graficznego otrzymanych wyników; opracowania raportu. Omówienie pierwszych raportów	4
Lab3	Wykonanie w grupach ćwiczeniowych czterech doświadczeń z różnych działów fizyki zgodnie z harmonogramem	8
Lab4	Dyskusja na temat opracowania wyników i wykonania raportów. Weryfikacja znajomości zasad wyznaczania niepewności pomiarowych – kolokwium	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. praca własna – przygotowanie do laboratorium
N2. eksperyment laboratoryjny
N3. przygotowanie sprawozdania
N4. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01-PEU_U03, PEU_K01-PEU_K03	Ocena raportów z każdego wykonanego doświadczenia
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
[1] Opisy ćwiczeń, instrukcje, pomoce dydaktyczne, strona domowa LPF http://lpf.wppt.pwr.edu.pl
[2] Ćwiczenia Laboratoryjne z Fizyki, Tomy 1-4, Oficyna Wydawnicza Politechniki Wrocławskiej

LITERATURA UZUPEŁNIAJĄCA
[1] D. Halliday, R. Resnick, J.Walker: Podstawy Fizyki, tomy 1-2, 4, Wydawnictwa Naukowe PWN, Warszawa 2003.
[2] J. Massalski, M. Massalska, Fizyka dla inżynierów, cz. 1., WNT, Warszawa 2008.
[3] J.Orear , Fizyka, WNT, Warszawa 1990.
[4] I.W. Sawieliew, Wykłady z Fizyki tom1 i 2 , Wydawnictwa Naukowe PWN, Warszawa, 2003

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Physics 1A (Fizyka 1A)**
Nazwa przedmiotu w języku angielskim: **Physics 1A**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W11MBM-SI3002**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30	15			
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	90	60			
Forma zaliczenia	Egzamin	Zaliczenie na ocenę			
Grupa kursów					
Liczba punktów ECTS	3	2			
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		2			
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.5	1.4			

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Wiedza i umiejętności z zakresu fizyki i matematyki ze szkoły średniej.

CELE PRZEDMIOTU

C1. Nabycie wiedzy, uwzględniającej jej aspekty aplikacyjne, z kinematyki oraz dynamiki, obejmujących zagadnienia pracy i energii mechanicznej, fal mechanicznych oraz zasad zachowania.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - ma ogólną wiedzę w zakresie podstawowych koncepcji i zasad dotyczącą kinematyki punktu materialnego, dynamiki punktu materialnego, ruchu układu punktów materialnych i bryły sztywnej, zasady zachowania pędu, momentu pędu, energii mechanicznej, pracy, energii kinetycznej i potencjalnej, fal mechanicznych pozwalającą na rozumienie zjawisk fizycznych.

II. Z zakresu umiejętności:
PEU_U01 - przeprowadzić analizę ilościową związaną z zagadnieniem fizycznym i sformułować wnioski jakościowe

III. Z zakresu kompetencji społecznych:
PEU_K01 - rozumie potrzebę i konieczność ciągłego zdobywania wiedzy (zarówno samodzielnie i w grupie)

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Sprawy organizacyjne. Metodologia fizyki. Wektory. Działania na wektorach	2
Wy2	Kinematyka punktu materialnego	2
Wy3	Dynamika punktu materialnego	4
Wy4	Praca, energia mechaniczna.	2
Wy5	Bryła sztywna – kinematyka, dynamika.	4
Wy6	Ruch drgający.	2
Wy7	Fale mechaniczne	2
Wy8	Wykłady rozszerzające dotychczasową wiedzę dotyczącą fizyki1.	12
		Suma: 30

Forma zajęć – Ćwiczenia		Liczba godzin
Ćw1	Sprawy organizacyjne.	1
Ćw2	Rozwiązywanie zadań rachunkowych dotyczących zagadnień omawianych na wykładzie.	12
Ćw3	Kolokwium zaliczeniowe.	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. praca własna – samodzielne studia i przygotowanie do egzaminu N3. konsultacje N4. ćwiczenia rachunkowe

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01, PEU_K01	Egzamin pisemny
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Ćwiczenia)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01, PEU_K01	Test
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA [1] D. Halliday, R. Resnick, J. Walker, Podstawy fizyki, tomy 12., Wydawnictwo Naukowe PWN. [2] J. Orear, Fizyka t.1 i 2, WNT, 1993, Warszawa 2003 LITERATURA UZUPEŁNIAJĄCA [1] J. Massalski, M. Massalska, Fizyka dla inżynierów, cz. 1. i 2., WNT, Warszawa 2008. [2] Fizyka dla szkół wyższych, https://openstax.org/books/

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Basic physics laboratory (Laboratorium podstaw fizyki)**
Nazwa przedmiotu w języku angielskim: **Basic physics laboratory**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W11MBM-SI3003**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)			15		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)			60		
Forma zaliczenia			Zaliczenie na ocenę		
Grupa kursów					
Liczba punktów ECTS			2		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			2		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)					

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Wiedza i umiejętności z zakresu Fizyki 1A lub Fizyki 1B i matematyki.

CELE PRZEDMIOTU

C1. Opanowanie umiejętności korzystania z różnych urządzeń pomiarowych
C2. Opanowanie umiejętności przeprowadzenia prostego eksperymentu zgodnie z instrukcją
C3. Uzyskanie umiejętności opracowania wyników eksperymentu i prezentacji ich w postaci raportu
C4. Uzyskanie umiejętności szacowania niepewności uzyskanych rezultatów oraz wyznaczania niepewności pomiarowych

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:

II. Z zakresu umiejętności:
PEU_U01 - Umie posługiwać się prostymi przyrządami pomiarowymi, potrafi wykonać pomiary podstawowych wielkości fizycznych z wykorzystaniem instrukcji stanowiska pomiarowego
PEU_U02 - potrafi opracować wyniki pomiarów oraz przeprowadzić analizę niepewności pomiarowych z wykorzystaniem narzędzi inżynierskich.
PEU_U03 - potrafi opracować raport podsumowujący wykonane ćwiczenie na podstawie uzyskanych wyników

III. Z zakresu kompetencji społecznych:
PEU_K01 - utrwala umiejętności pracy zespołowej
PEU_K02 - ma świadomość własnych ograniczeń i wie jak ważne jest dalsze samokształcenie
PEU_K03 - utrwala umiejętności rzetelnego i odpowiedzialnego wykonywania zadań

TREŚCI PROGRAMOWE

Forma zajęć – Laboratorium		Liczba godzin
Lab1	Sprawy organizacyjne, krótkie szkolenie BHP	1
Lab2	Przykładowe pomiary różnych wielkości fizycznych – zapoznanie się ze sposobami: wyznaczania niepewności pomiarowych; opracowania numerycznego i graficznego otrzymanych wyników; opracowania raportu. Omówienie pierwszych raportów	4
Lab3	Wykonanie w grupach ćwiczeniowych czterech doświadczeń z różnych działów fizyki zgodnie z harmonogramem	8
Lab4	Dyskusja na temat opracowania wyników i wykonania raportów. Weryfikacja znajomości zasad wyznaczania niepewności pomiarowych – kolokwium	2
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. praca własna – przygotowanie do laboratorium
N2. eksperyment laboratoryjny
N3. przygotowanie sprawozdania
N4. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Laboratorium)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01-PEU_U03, PEU_K01-PEU_K03	Ocena raportów z każdego wykonanego doświadczenia
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

[1] Opisy ćwiczeń, instrukcje, pomoce dydaktyczne, strona domowa LPF http://lpf.wppt.pwr.edu.pl
[2] Ćwiczenia Laboratoryjne z Fizyki, Tomy 1-4, Oficyna Wydawnicza Politechniki Wrocławskiej

LITERATURA UZUPEŁNIAJĄCA

[1] D. Halliday, R. Resnick, J.Walker: Podstawy Fizyki, tomy 1-2, 4, Wydawnictwa Naukowe PWN, Warszawa 2003.
[2] J. Massalski, M. Massalska, Fizyka dla inżynierów, cz. 1., WNT, Warszawa 2008.
[3] J.Orear , Fizyka, WNT, Warszawa 1990.
[4] I.W. Sawieliew, Wykłady z Fizyki tom1 i 2 , Wydawnictwa Naukowe PWN, Warszawa, 2003

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Elektronika**
Nazwa przedmiotu w języku angielskim: **Electronics**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W12MBM-SI0002**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	2				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Podstawowa wiedza z fizyki, elektrotechniki i chemii w zakresie szkoły średniej

CELE PRZEDMIOTU

C1. Zrozumienie budowy zasady działania i zastosowania wybranych elementów/przyrządów półprzewodnikowych i układów scalonych (analogowych i cyfrowych).
C2. Poznanie zasady działania i zastosowania różnorodnych czujników wielkości fizycznych (temperatura, siła, przemieszczenie, światło, drgania)

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Student rozumie fizyczne podstawy funkcjonowania i zna zastosowanie elementów półprzewodnikowych
PEU_W02 - Student zna zasadę działania i zastosowanie różnorodnych czujników wielkości fizycznych

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:
PEU_K01 - Rozumie potrzebę wykorzystywania nowych technik i technologii w działalności inżynierskiej oraz potrafi określać cele i przewidywać skutki w podejmowanych pracach eksperymentalnych.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wstęp. Trendy rozwojowe w elektronice. Technika analogowa i cyfrowa.	2
Wy2	Sygnały w elektronice: analogowe, cyfrowe (opis natury tych sygnałów).	2
Wy3	Opis właściwości elementów elektronicznych RLC, prawo Ohma.	2
Wy4	Zarys technologii przyrządów półprzewodnikowych. Złącze p-n: mechanizm formowania się złącza, charakterystyka stałoprądowa I-U.	2
Wy5	Dioda półprzewodnikowa: rodzaje, zastosowania	2
Wy6	Tranzystory: bipolarne, unipolarne, polowe, złączowe - PNFET, unipolarne, polowe, z izolowaną bramką - MOSFET - budowa, zasada działania.	2
Wy7	Przyrządy półprzewodnikowe (tyrystor, triak, warystor, czujnik Halla)	2
Wy8	Układy pracy tranzystorów	2
Wy9	Klasy pracy wzmacniaczy	2
Wy10	Konstrukcja i integracja układów elektronicznych	2
Wy11	Wzmacniacze operacyjne: historia, zastosowania, podstawowe układy pracy	2
Wy12	Czujniki wielkości fizycznych: temperatura, światło, siła, naprężenie, ciśnienie	2
Wy13	Czujniki przemieszczenia, obrotów i drgań.	2
Wy14	Czujniki MEMS.	2
Wy15	Kolokwium zaliczające.	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01-PEU_W03	Kolokwium
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
<u>LITERATURA PODSTAWOWA</u> P. Hempowicz, R. Kiełsznia, A. Piłatowicz, J.Szymczyk i inni, Elektrotechnika i elektronika dla nieelektryków, WNT, 2004 A. Świt, J. Pułtorak, Przyrządy półprzewodnikowe, WNT, 1984 W. Marciniak, Przyrządy półprzewodnikowe i układy scalone, WNT, 1984 M. Polowczyk, A. Jurewicz, Elektronika dla mechaników, Wyd. Politechniki Gdańskiej, 2002 <u>LITERATURA UZUPEŁNIAJĄCA</u> M. Rusek, J. Pasierbiński, Elementy i układy elektroniczne w pytaniach i odpowiedziach, WNT, 1991 G. Rizzoni, Fundamentals of Electrical Engineering, McGraw-Hill, 2010 Ch. A. Schuler, Electronics. Principles & Applications, 2008

OPIEKUN PRZEDMIOTU
dr inż. Piotr Pruchnicki email: piotr.pruchnicki@pwr.edu.pl

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Electronics (Elektronika)**
Nazwa przedmiotu w języku angielskim: **Electronics**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Specjalność (jeśli dotyczy): **Mechanical engineering design**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W12MBM-SI3002**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60				
Forma zaliczenia	Zaliczenie na ocenę				
Grupa kursów					
Liczba punktów ECTS	2				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.2				

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Podstawowa wiedza z fizyki, elektrotechniki i chemii w zakresie szkoły średniej.

CELE PRZEDMIOTU

C1. Zrozumienie budowy zasady działania i zastosowania wybranych elementów/przyrządów półprzewodnikowych i układów scalonych (analogowych i cyfrowych).
C2. Poznanie zasady działania i zastosowania różnorodnych czujników wielkości fizycznych (temperatura, siła, przemieszczenie, światło, drgania)

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Student rozumie fizyczne podstawy funkcjonowania i zna zastosowanie elementów półprzewodnikowych
PEU_W02 - Student zna zasadę działania i zastosowanie różnorodnych czujników wielkości fizycznych

II. Z zakresu umiejętności:

III. Z zakresu kompetencji społecznych:
PEU_K01 - Rozumie potrzebę wykorzystywania nowych technik i technologii w działalności inżynierskiej oraz potrafi określać cele i przewidywać skutki w podejmowanych pracach eksperymentalnych.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Wstęp. Trendy rozwojowe w elektronice. Technika analogowa i cyfrowa.	2
Wy2	Sygnały w elektronice: analogowe, cyfrowe (opis natury tych sygnałów).	2
Wy3	Opis właściwości elementów elektronicznych RLC, prawo Ohma.	2
Wy4	Zarys technologii przyrządów półprzewodnikowych. Złącze p-n: mechanizm formowania się złącza, charakterystyka stałoprądowa I-U.	2
Wy5	Dioda półprzewodnikowa: rodzaje, zastosowania	2
Wy6	Tranzystory: bipolarne, unipolarne, polowe, złączowe - PNFET, unipolarne, polowe, z izolowaną bramką - MOSFET - budowa, zasada działania.	2
Wy7	Przyrządy półprzewodnikowe (tyrystor, triak, warystor, czujnik Halla)	2
Wy8	Układy pracy tranzystorów	2
Wy9	Klasy pracy wzmacniaczy	2
Wy10	Konstrukcja i integracja układów elektronicznych	2
Wy11	Wzmacniacze operacyjne: historia, zastosowania, podstawowe układy pracy	2
Wy12	Czujniki wielkości fizycznych: temperatura, światło, siła, naprężenie, ciśnienie	2
Wy13	Czujniki przemieszczenia, obrotów i drgań.	2
Wy14	Czujniki MEMS.	2
Wy15	Kolokwium zaliczające.	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01-PEU_W03	Kolokwium
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
<u>LITERATURA PODSTAWOWA</u> P. Hempowicz, R. Kiełsznia, A. Piłatowicz, J.Szymczyk i inni, Elektrotechnika i elektronika dla nieelektryków, WNT, 2004 A. Świt, J. Pułtorak, Przyrządy półprzewodnikowe, WNT, 1984 W. Marciniak, Przyrządy półprzewodnikowe i układy scalone, WNT, 1984 M. Polowczyk, A. Jurewicz, Elektronika dla mechaników, Wyd. Politechniki Gdańskiej, 2002 <u>LITERATURA UZUPEŁNIAJĄCA</u> M. Rusek, J. Pasierbiński, Elementy i układy elektroniczne w pytaniach i odpowiedziach, WNT, 1991 G. Rizzoni, Fundamentals of Electrical Engineering, McGraw-Hill, 2010 Ch. A. Schuler, Electronics. Principles & Applications, 2008

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Algebra liniowa z geometrią analityczną B**
Nazwa przedmiotu w języku angielskim: **LINEAR ALGEBRA WITH ANALITIC GEOMETRY B**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W13MBM-SI0004**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30	15			
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60	60			
Forma zaliczenia	Egzamin	Zaliczenie na ocenę			
Grupa kursów					
Liczba punktów ECTS	2	2			
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		2			
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.5	0.7			

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Student ma wiadomości wymagane przy egzaminie maturalnym z matematyki na poziomie co najmniej podstawowym.

CELE PRZEDMIOTU

C1. Zapoznanie z podstawowymi pojęciami algebry liniowej i geometrii analitycznej.
C2. Przedstawienie metod rozwiązywania podstawowych problemów związanych z liczbami zespolonymi, macierzami, układami równań oraz geometrią analityczną w przestrzeni euklidesowej R3

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Po ukończeniu przedmiotu student zna podstawowe własności liczb zespolonych.Po ukończeniu przedmiotu student zna podstawowe pojęcia i twierdzenia dotyczące macierzy.
PEU_W02 - Po ukończeniu przedmiotu student zna podstawowe pojęcia i twierdzenia dotyczące algebry wielomianów i zna podstawowe metody rozwiązywania równań liniowych
PEU_W03 - Po ukończeniu przedmiotu student zna sposoby opisu prostych, płaszczyzn i krzywych stożkowych.

II. Z zakresu umiejętności:
PEU_U01 - Po ukończeniu przedmiotu student potrafi wykonywać działania na liczbach zespolonych. Po ukończeniu przedmiotu student potrafi posługiwać się notacją macierzową i stosować przekształcenia właściwe dla algebry macierzy i wyznaczników
PEU_U02 - Po ukończeniu przedmiotu student potrafi rozkładać wielomian na czynniki liniowe i kwadratowe oraz ułamek wymierny na rzeczywiste ułamki proste. Po ukończeniu przedmiotu student potrafi efektywnie rozwiązywać układy równań liniowych.
PEU_U03 - Po ukończeniu przedmiotu student potrafi rozwiązywać problemy dotyczące wzajemnego położenia punktów, prostych oraz wektorów w przestrzeni euklidesowej.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Po ukończeniu przedmiotu student zna reguły zachowań w środowisku akademickim
PEU_K02 - Po ukończeniu przedmiotu student poprawia umiejętności komunikacyjne.
PEU_K03 - Po ukończeniu przedmiotu student potrafi korzystać z wiarygodnych źródeł informacji naukowej.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Macierz. Działania na macierzach. Macierz transponowana. Rodzaje macierzy (trójkątna, symetryczna, diagonalna etc.).	2
Wy2	Wyznacznik macierzy. Rozwinięcie Laplace'a. Dopełnienie algebraiczne elementu macierzy. Minor. Własności wyznaczników. Obliczanie wyznaczników. Twierdzenie Cauchy'ego o mnożeniu wyznaczników. Macierz nieosobliwa.	3
Wy3	Macierz odwrotna. Metoda dopełnień algebraicznych i przekształceń elementarnych. Własności macierzy odwrotnych. Równania macierzowe.	2
Wy4	Układ równań liniowych. Wzory Cramera. Metoda eliminacji Gaussa. Rozwiązywanie dowolnych układów równań liniowych.	3
Wy5	Liczba zespolona. Postać algebraiczna. Działania na liczbach zespolonych. Sprzężenie. Moduł. Argument.	2
Wy6	Interpretacja geometryczna liczby zespolonej. Postać trygonometryczna i postać wykładnicza. Wzór de Moivre'a. Pierwiastek n-tego stopnia z liczby zespolonej.	2
Wy7	Wielomian. Twierdzenie Bezout. Zasadnicze twierdzenie algebry. Pierwiastki wielomianów rzeczywistych.	2

Wy8	Dzielnik liniowy i kwadratowy wielomianu rzeczywistego. Rozkład wielomianu na czynniki. Funkcja wymierna. Rzeczywisty ułamek prosty. Rozkład funkcji wymiernej na rzeczywiste ułamki proste.	2
Wy9	Geometria analityczna w przestrzeni R3. Działania na wektorach. Długość wektora. Iloczyny: skalarny, wektorowy, mieszany. Zastosowanie do obliczania pól i objętości.	2
Wy10	Płaszczyzna. Wektor normalny. Równanie ogólne, parametryczne, wyznacznikowe. Wzajemne położenie płaszczyzn.	2
Wy11	Prosta. Równanie parametryczne, kierunkowe, krawędziowe. Odległość punktu od prostej i od płaszczyzny. Wzajemne położenie prostych. Wzajemne położenie prostej i płaszczyzny. Rzut punktu na prostą i płaszczyznę.	2
Wy12	Krzywe stożkowe. Okrąg. Elipsa. Hiperbola. Parabola	2
Wy13	Zastosowania algebry liniowej.	4
		Suma: 30
Forma zajęć – Ćwiczenia		Liczba godzin
Ćw1	Przekształcanie wyrażeń algebraicznych.	1
Ćw2	Rozwiązywanie zadań dotyczących tematów prezentowanych na wykładzie.	14
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. ćwiczenia rachunkowe N3. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01-PEU_W03	egzamin
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Ćwiczenia)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01-PEU_U03	kolokwia, odpowiedzi ustne, kartkówki
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

[1] T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna. Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław 2020.
[2] T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna. Definicje, twierdzenia, wzory. Oficyna Wydawnicza GiS, Wrocław 2022.
[3] P. Kajetanowicz, J. Wierzejewski, Algebra z geometrią analityczną, PWN 2008.
[4] M. Zakrzewski, Markowe wykłady z matematyki, Algebra z geometrią, Oficyna Wyd. GiS, Wrocław 2015.

LITERATURA UZUPEŁNIAJĄCA

[1] G. Banaszak, W. Gajda, Elementy algebry liniowej, cz.I, WNT, 2002.
[2] A. Mostowski, M. Stark, Elementy algebry wyższej, PWN, Warszawa 1963.
[3] W. Stankiewicz, Zadania z matematyki dla wyższych uczelni technicznych, Cz. A, PWN, Warszawa 2003.
[4] F. Leja, Geometria analityczna, PWN, Warszawa 1972.
[5] E. Kącki, D. Sadowska, L. Siewierski, Geometria analityczna w zadaniach, PWN, Warszawa 1993

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Analiza matematyczna 1A**
Nazwa przedmiotu w języku angielskim: **Mathematical analysis 1A**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W13MBM-SI0005**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30	30			
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	150	90			
Forma zaliczenia	Egzamin	Zaliczenie na ocenę			
Grupa kursów					
Liczba punktów ECTS	5	3			
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		3			
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.5	1.5			

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Wiedza z matematyki odpowiadająca maturze na poziomie podstawowym

CELE PRZEDMIOTU

C1. Zapoznanie z podstawowymi funkcjami elementarnymi i ich własnościami.
C2. Zapoznanie z podstawowymi pojęciami i twierdzeniami rachunku różniczkowego funkcji jednej zmiennej.
C3. Zapoznanie z pojęciem całki oznaczonej, jej podstawowymi własnościami oraz metodami obliczania.
C4. Przedstawienie przykładów praktycznych zastosowań metod analizy matematycznej funkcji jednej zmiennej rzeczywistej.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ
I. Z zakresu wiedzy: PEU_W01 - znajomość wykresów i własności podstawowych funkcji elementarnych, PEU_W02 - znajomość podstawowych pojęć i twierdzeń rachunku różniczkowego funkcji jednej zmiennej, PEU_W03 - znajomość pojęcia całki oznaczonej, jej własności i podstawowych zastosowań. **II. Z zakresu umiejętności:** PEU_U01 - umiejętność rozwiązywania typowych równań i nierówności z funkcjami elementarnymi, PEU_U02 - umiejętność stosowania elementów badania przebiegu zmienności funkcji do rozwiązywania typowych zadań oraz umiejętność stosowania rachunku różniczkowego do rozwiązywania wybranych zagadnień praktycznych, PEU_U03 - umiejętność obliczania typowych całek oznaczonych i nieoznaczonych oraz umiejętność stosowania rachunku całkowego do rozwiązywania wybranych zagadnień praktycznych. **III. Z zakresu kompetencji społecznych:** PEU_K01 - ma świadomość konieczności systematycznej i samodzielnej pracy w celu zdobycia wiedzy

TREŚCI PROGRAMOWE		
Forma zajęć – Wykład		Liczba godzin
Wy1	Powtórzenie i uzupełnienie wiadomości o funkcjach. Elementy logiki matematycznej. Definicja funkcji. Składanie funkcji. Przekształcanie wykresu. Funkcja monotoniczna, różnowartościowa. Funkcja liniowa, kwadratowa, wielomiany, funkcje wymierne. Funkcja odwrotna i jej wykres. Funkcje potęgowe i wykładnicze oraz odwrotne do nich. Koło trygonometryczne. Funkcje trygonometryczne i cyklometryczne.	8
Wy2	Ciągi liczbowe. Ciągi ograniczone, monotoniczne. Granice właściwe i niewłaściwe ciągów liczbowych. Twierdzenia o granicach ciągów. Wyrażenia nieoznaczone. Liczba e.	3
Wy3	Granice funkcji, asymptoty, funkcje ciągłe. Granice funkcji w punkcie i nieskończoności. Twierdzenia o granicach funkcji. Przykłady granic podstawowych wyrażeń nieoznaczonych. Asymptoty. Ciągłość funkcji w punkcie i na przedziale. Podstawowe własności funkcji ciągłych. Przybliżone rozwiązywanie równań.	4
Wy4	Rachunek różniczkowy. Definicja pochodnej funkcji. Interpretacja geometryczna i fizyczna. Pochodne podstawowych funkcji elementarnych. Reguły różniczkowania. Różniczka. Twierdzenie Lagrange’a. Przedziały monotoniczności funkcji. Reguła de l’Hospitala. Ekstrema lokalne i globalne. Przykłady zagadnień optymalizacyjnych.	7
Wy5	Całka nieoznaczona. Definicja całki nieoznaczonej i jej własności. Podstawowe wzory. Całkowanie przez części i podstawienie. Całkowanie funkcji wymiernych i trygonometrycznych.	4

Wy6	Całka oznaczona. Definicja całki oznaczonej i jej własności. Tw. Newtona-Leibniza. Przykłady zastosowań całki oznaczonej (np. średnia wartość funkcji na przedziale, pole obszaru, długość krzywej, objętość i pole powierzchni bocznej bryły obrotowej).	4
		Suma: 30

Forma zajęć – Ćwiczenia		Liczba godzin
Ćw1	Powtórzenie i uzupełnienie wiadomości o funkcjach. Elementy logiki matematycznej (spójniki, kwantyfikatory). Określanie dziedziny funkcji. Badanie parzystości. Składanie funkcji. Przekształcanie wykresów. Typowe równania i nierówności wykładnicze i logarytmiczne. Funkcja odwrotna. Funkcje trygonometryczne i cyklometryczne. Typowe równania i nierówności trygonometryczne.	8
Ćw2	Ciągi liczbowe. Badanie monotoniczności i ograniczoności ciągów. Obliczanie granic ciągów liczbowych.	2
Ćw3	Granice funkcji, asymptoty, funkcje ciągłe. Obliczanie granic funkcji w punkcie i w nieskończoności. Wyznaczanie asymptot. Badanie ciągłości funkcji. Przybliżone rozwiązywanie równań.	4
Ćw4	Rachunek różniczkowy. Definicja pochodnej. Reguły różniczkowania. Styczna. Różniczka. Reguła de l'Hospitala. Przedziały monotoniczności funkcji. Wyznaczanie ekstremów lokalnych i globalnych.	7
Ćw5	Całka nieoznaczona. Obliczanie całek nieoznaczonych. Całkowanie przez części i podstawienie. Całkowanie funkcji wymiernych i trygonometrycznych.	3
Ćw6	Całka oznaczona. Wzór Newtona-Leibniza. Pole obszaru. Długość krzywej. Objętość i pole powierzchni bryły obrotowej.	4
Ćw7	Kolokwium.	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. ćwiczenia rachunkowe N3. praca własna – samodzielne studia i przygotowanie do egzaminu N4. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się

F1	PEU_W01-PEU_W03	egzamin
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Ćwiczenia)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01-PEU_U03	kolokwia, odpowiedzi ustne, kartkówki
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA
[1] G. Decewicz, W. Żakowski, Matematyka, Cz.1, WNT, Warszawa 2007.
[2] M. Gewert, Z. Skoczylas, Analiza matematyczna 1. Definicje, twierdzenia, wzory, Oficyna Wydawnicza GiS, Wrocław 2021.
[3] M. Gewert, Z. Skoczylas, Analiza matematyczna 1. Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław 2021.
[4] W. Krysicki, L. Włodarski, Analiza matematyczna w zadaniach, Cz. I, PWN, Warszawa 2006

LITERATURA UZUPEŁNIAJĄCA
[5] F. Leja, Rachunek różniczkowy i całkowy, PWN, 2012.
[6] R. Leitner, Zarys matematyki wyższej dla studiów technicznych, cz.1-2, WNT, Warszawa 2006.
[7] M. Zakrzewski, Markowe wykłady z matematyki. Analiza, Oficyna Wydawnicza GiS, Wrocław 2013.

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Elementy analizy matematycznej 2**
Nazwa przedmiotu w języku angielskim: **Elements of mathematical analysis 2**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W13MBM-SI0006**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15	15			
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60	60			
Forma zaliczenia	Egzamin	Zaliczenie na ocenę			
Grupa kursów					
Liczba punktów ECTS	2	2			
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		2			
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.7	0.7			

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Znajomość rachunku różniczkowego i całkowego funkcji jednej zmiennej rzeczywistej potwierdzona zaliczeniem kursu Analizy Matematycznej 1A, 1B lub innego kursu zawierającego w programie rachunek różniczkowy i całkowy funkcji jednej zmiennej.

CELE PRZEDMIOTU

C1. Zapoznanie z podstawowymi pojęciami i twierdzeniami rachunku różniczkowego funkcji dwóch zmiennych.
C2. Zapoznanie z pojęciem całki podwójnej, metodami jej obliczania i przykładami zastosowań.
C3. Zapoznanie z podstawowymi kryteriami zbieżności szeregów liczbowych i własnościami szeregów potęgowych.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - znajomość podstawowych pojęć i twierdzeń rachunku różniczkowego funkcji dwóch zmiennych,
PEU_W02 - znajomość metod obliczania całek podwójnych,
PEU_W03 - znajomość podstawowych kryteriów zbieżności szeregów liczbowych i własności szeregów potęgowych,

II. Z zakresu umiejętności:
PEU_U01 - umiejętność obliczania pochodnych cząstkowych, kierunkowych i gradientu funkcji dwóch zmiennych oraz umiejętność interpretowania otrzymanych wielkości, umiejętność wyznaczania ekstremów lokalnych funkcji dwóch zmiennych
PEU_U02 - umiejętność obliczania całek podwójnych i wykorzystywania ich do obliczania pól i objętości;
PEU_U03 - umiejętność badania zbieżności szeregów liczbowych i rozwijania funkcji w szereg potęgowy przy wykorzystaniu rozwinięć funkcji elementarnych.

III. Z zakresu kompetencji społecznych:
PEU_K01 - świadomość konieczności systematycznej i samodzielnej pracy w celu zdobycia wiedzy

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Rachunek różniczkowy funkcji dwóch zmiennych. Funkcje dwóch zmiennych. Przykłady wykresów funkcji dwóch zmiennych. Definicja i interpretacja geometryczna pochodnych cząstkowych pierwszego rzędu. Płaszczyzna styczna do wykresu funkcji dwóch zmiennych. Różniczka. Pochodna kierunkowa. Gradient funkcji. Pochodne cząstkowe wyższych rzędów. Twierdzenie Schwarza. Ekstrema lokalne funkcji dwóch zmiennych. Warunki konieczne i wystarczające istnienia ekstremum.	6
Wy2	Całki podwójne. Definicja całki podwójnej. Interpretacja geometryczna. Obliczanie całek podwójnych po obszarach normalnych. Całka podwójna we współrzędnych biegunowych. Przykłady zastosowań całek podwójnych.	4
Wy3	Szeregi liczbowe i potęgowe. Definicja całki niewłaściwej pierwszego rodzaju. Definicja szeregu liczbowego. Podstawowe kryteria zbieżności. Zbieżność bezwzględna i warunkowa. Kryterium Leibniza. Definicja szeregu potęgowego. Przedział i promień zbieżności. Twierdzenie Cauchy‘ego-Hadamarda. Szeregi: Taylora i Maclaurina.	5
		Suma: 15
Forma zajęć – Ćwiczenia		Liczba godzin

Ćw1	Rachunek różniczkowy funkcji dwóch zmiennych. Wyznaczanie dziedziny. Szkicowanie wykresów funkcji dwóch zmiennych (powierzchnie obrotowe i walcowe). Obliczanie pochodnych cząstkowych. Wyznaczanie równania płaszczyzny stycznej. Zastosowanie różniczki do szacowania dokładności obliczeń. Wyznaczanie i interpretowanie gradientu funkcji i pochodnej kierunkowej. Wyznaczanie ekstremów lokalnych funkcji dwóch zmiennych.	6
Ćw2	Całki podwójne. Zamiana całki podwójnej na iterowane. Obliczanie całek po obszarach normalnych. Całka podwójna we współrzędnych biegunowych. Przykłady zastosowań całek podwójnych.	4
Ćw3	Szeregi liczbowe i potęgowe. Badanie zbieżności szeregów liczbowych. Wyznaczanie przedziału zbieżności szeregu potęgowego. Rozwijanie funkcji w szereg potęgowy przy wykorzystaniu rozwinięć podstawowych funkcji.	4
Ćw4	Kolokwium	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. ćwiczenia rachunkowe N3. praca własna – samodzielne studia i przygotowanie do egzaminu N4. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01-PEU_W03	egzemin
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Ćwiczenia)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01-PEU_U03, PEU_K01	kolokwia, odpowiedzi ustne, kartkówki

P = F1

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

[1] M. Gewert, Z. Skoczylas, Analiza Matematyczna 2. Definicje, twierdzenia, wzory. Oficyna Wydawnicza GiS, Wrocław 2016.
[2] M. Gewert, Z. Skoczylas, Analiza Matematyczna 2. Przykłady i Zadania, Oficyna Wydawnicza GiS, Wrocław 2016.
[3] R. Leitner, Zarys Matematyki Wyższej dla Studiów Technicznych, Cz. 1 - 2 WNT, Warszawa, 2006.

LITERATURA UZUPEŁNIAJĄCA

[1] W. Krysicki, L. Włodarski, Analiza Matematyczna w Zadaniach, Cz. II, PWN, Warszawa 2006.
[2] F. Leja, Rachunek Różniczkowy i Całkowy, Wydawnictwo Naukowe PWN, 2012.
[3] M.Zakrzewski, Markowe wykłady z matematyki. Analiza, geometria i świat fizyczny, Oficyna Wydawnicza GiS, Wrocław 2017.

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Linear algebra with analitic geometry B (Algebra liniowa z geometrią analityczną B)**

Nazwa przedmiotu w języku angielskim: **Linear algebra with analitic geometry B**

Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**

Poziom i forma studiów: **I stopień, stacjonarne**

Rodzaj przedmiotu: **obowiązkowy**

Kod przedmiotu: **W13MBM-SI3004**

Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30	15			
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60	60			
Forma zaliczenia	Egzamin	Zaliczenie na ocenę			
Grupa kursów					
Liczba punktów ECTS	2	2			
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		2			
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.5	0.7			

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Student ma wiadomości wymagane przy egzaminie maturalnym z matematyki na poziomie co najmniej podstawowym.

CELE PRZEDMIOTU

C1. Zapoznanie z podstawowymi pojęciami algebry liniowej i geometrii analitycznej.
C2. Przedstawienie metod rozwiązywania podstawowych problemów związanych z liczbami zespolonymi, macierzami, układami równań oraz geometrią analityczną w przestrzeni euklidesowej R3

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - Po ukończeniu przedmiotu student zna podstawowe własności liczb zespolonych.Po ukończeniu przedmiotu student zna podstawowe pojęcia i twierdzenia dotyczące macierzy.
PEU_W02 - Po ukończeniu przedmiotu student zna podstawowe pojęcia i twierdzenia dotyczące algebry wielomianów i zna podstawowe metody rozwiązywania równań liniowych
PEU_W03 - Po ukończeniu przedmiotu student zna sposoby opisu prostych, płaszczyzn i krzywych stożkowych.

II. Z zakresu umiejętności:
PEU_U01 - Po ukończeniu przedmiotu student potrafi wykonywać działania na liczbach zespolonych. Po ukończeniu przedmiotu student potrafi posługiwać się notacją macierzową i stosować przekształcenia właściwe dla algebry macierzy i wyznaczników
PEU_U02 - Po ukończeniu przedmiotu student potrafi rozkładać wielomian na czynniki liniowe i kwadratowe oraz ułamek wymierny na rzeczywiste ułamki proste. Po ukończeniu przedmiotu student potrafi efektywnie rozwiązywać układy równań liniowych.
PEU_U03 - Po ukończeniu przedmiotu student potrafi rozwiązywać problemy dotyczące wzajemnego położenia punktów, prostych oraz wektorów w przestrzeni euklidesowej.

III. Z zakresu kompetencji społecznych:
PEU_K01 - Po ukończeniu przedmiotu student zna reguły zachowań w środowisku akademickim
PEU_K02 - Po ukończeniu przedmiotu student poprawia umiejętności komunikacyjne.
PEU_K03 - Po ukończeniu przedmiotu student potrafi korzystać z wiarygodnych źródeł informacji naukowej.

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Macierz. Działania na macierzach. Macierz transponowana. Rodzaje macierzy (trójkątna, symetryczna, diagonalna etc.).	2
Wy2	Wyznacznik macierzy. Rozwinięcie Laplace'a. Dopełnienie algebraiczne elementu macierzy. Minor. Własności wyznaczników. Obliczanie wyznaczników. Twierdzenie Cauchy'ego o mnożeniu wyznaczników. Macierz nieosobliwa.	3
Wy3	Macierz odwrotna. Metoda dopełnień algebraicznych i przekształceń elementarnych. Własności macierzy odwrotnych. Równania macierzowe.	2
Wy4	Układ równań liniowych. Wzory Cramera. Metoda eliminacji Gaussa. Rozwiązywanie dowolnych układów równań liniowych.	3
Wy5	Liczba zespolona. Postać algebraiczna. Działania na liczbach zespolonych. Sprzężenie. Moduł. Argument.	2
Wy6	Interpretacja geometryczna liczby zespolonej. Postać trygonometryczna i postać wykładnicza. Wzór de Moivre'a. Pierwiastek n-tego stopnia z liczby zespolonej.	2
Wy7	Wielomian. Twierdzenie Bezout. Zasadnicze twierdzenie algebry. Pierwiastki wielomianów rzeczywistych.	2

Wy8	Dzielnik liniowy i kwadratowy wielomianu rzeczywistego. Rozkład wielomianu na czynniki. Funkcja wymierna. Rzeczywisty ułamek prosty. Rozkład funkcji wymiernej na rzeczywiste ułamki proste.	2
Wy9	Geometria analityczna w przestrzeni R3. Działania na wektorach. Długość wektora. Iloczyny: skalarny, wektorowy, mieszany. Zastosowanie do obliczania pól i objętości.	2
Wy10	Płaszczyzna. Wektor normalny. Równanie ogólne, parametryczne, wyznacznikowe. Wzajemne położenie płaszczyzn.	2
Wy11	Prosta. Równanie parametryczne, kierunkowe, krawędziowe. Odległość punktu od prostej i od płaszczyzny. Wzajemne położenie prostych. Wzajemne położenie prostej i płaszczyzny. Rzut punktu na prostą i płaszczyznę.	2
Wy12	Krzywe stożkowe. Okrąg. Elipsa. Hiperbola. Parabola	2
Wy13	Zastosowania algebry liniowej.	4
		Suma: 30
Forma zajęć – Ćwiczenia		Liczba godzin
Ćw1	Przekształcanie wyrażeń algebraicznych.	1
Ćw2	Rozwiązywanie zadań dotyczących tematów prezentowanych na wykładzie.	14
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. ćwiczenia rachunkowe N3. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01-PEU_W03	egzamin
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Ćwiczenia)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01-PEU_U03	kolokwia, odpowiedzi ustne, kartkówki
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

[1] T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna. Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław 2020.
[2] T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna. Definicje, twierdzenia, wzory. Oficyna Wydawnicza GiS, Wrocław 2022.
[3] P. Kajetanowicz, J. Wierzejewski, Algebra z geometrią analityczną, PWN 2008.
[4] M. Zakrzewski, Markowe wykłady z matematyki, Algebra z geometrią, Oficyna Wyd. GiS, Wrocław 2015.

LITERATURA UZUPEŁNIAJĄCA

[1] G. Banaszak, W. Gajda, Elementy algebry liniowej, cz.I, WNT, 2002.
[2] A. Mostowski, M. Stark, Elementy algebry wyższej, PWN, Warszawa 1963.
[3] W. Stankiewicz, Zadania z matematyki dla wyższych uczelni technicznych, Cz. A, PWN, Warszawa 2003.
[4] F. Leja, Geometria analityczna, PWN, Warszawa 1972.
[5] E. Kącki, D. Sadowska, L. Siewierski, Geometria analityczna w zadaniach, PWN, Warszawa 1993

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Mathematical analysis 1A (Analiza matematyczna 1A)**
Nazwa przedmiotu w języku angielskim: **Mathematical analysis 1A**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W13MBM-SI3005**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30	30			
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	150	90			
Forma zaliczenia	Egzamin	Zaliczenie na ocenę			
Grupa kursów					
Liczba punktów ECTS	5	3			
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		3			
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1.5	1.5			

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Wiedza z matematyki odpowiadająca maturze na poziomie podstawowym

CELE PRZEDMIOTU

C1. Zapoznanie z podstawowymi funkcjami elementarnymi i ich własnościami.
C2. Zapoznanie z podstawowymi pojęciami i twierdzeniami rachunku różniczkowego funkcji jednej zmiennej.
C3. Zapoznanie z pojęciem całki oznaczonej, jej podstawowymi własnościami oraz metodami obliczania.
C4. Przedstawienie przykładów praktycznych zastosowań metod analizy matematycznej funkcji jednej zmiennej rzeczywistej.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - znajomość wykresów i własności podstawowych funkcji elementarnych,
PEU_W02 - znajomość podstawowych pojęć i twierdzeń rachunku różniczkowego funkcji jednej zmiennej,
PEU_W03 - znajomość pojęcia całki oznaczonej, jej własności i podstawowych zastosowań.

II. Z zakresu umiejętności:
PEU_U01 - umiejętność rozwiązywania typowych równań i nierówności z funkcjami elementarnymi,
PEU_U02 - umiejętność stosowania elementów badania przebiegu zmienności funkcji do rozwiązywania typowych zadań oraz umiejętność stosowania rachunku różniczkowego do rozwiązywania wybranych zagadnień praktycznych,
PEU_U03 - umiejętność obliczania typowych całek oznaczonych i nieoznaczonych oraz umiejętność stosowania rachunku całkowego do rozwiązywania wybranych zagadnień praktycznych.

III. Z zakresu kompetencji społecznych:
PEU_K01 - ma świadomość konieczności systematycznej i samodzielnej pracy w celu zdobycia wiedzy

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Powtórzenie i uzupełnienie wiadomości o funkcjach. Elementy logiki matematycznej. Definicja funkcji. Składanie funkcji. Przekształcanie wykresu. Funkcja monotoniczna, różnowartościowa. Funkcja liniowa, kwadratowa, wielomiany, funkcje wymierne. Funkcja odwrotna i jej wykres. Funkcje potęgowe i wykładnicze oraz odwrotne do nich. Koło trygonometryczne. Funkcje trygonometryczne i cyklometryczne.	8
Wy2	Ciągi liczbowe. Ciągi ograniczone, monotoniczne. Granice właściwe i niewłaściwe ciągów liczbowych. Twierdzenia o granicach ciągów. Wyrażenia nieoznaczone. Liczba e.	3
Wy3	Granice funkcji, asymptoty, funkcje ciągłe. Granice funkcji w punkcie i nieskończoności. Twierdzenia o granicach funkcji. Przykłady granic podstawowych wyrażeń nieoznaczonych. Asymptoty. Ciągłość funkcji w punkcie i na przedziale. Podstawowe własności funkcji ciągłych. Przybliżone rozwiązywanie równań.	4
Wy4	Rachunek różniczkowy. Definicja pochodnej funkcji. Interpretacja geometryczna i fizyczna. Pochodne podstawowych funkcji elementarnych. Reguły różniczkowania. Różniczka. Twierdzenie Lagrange'a. Przedziały monotoniczności funkcji. Reguła de l'Hospitala. Ekstrema lokalne i globalne. Przykłady zagadnień optymalizacyjnych.	7
Wy5	Całka nieoznaczona. Definicja całki nieoznaczonej i jej własności. Podstawowe wzory. Całkowanie przez części i podstawienie. Całkowanie funkcji wymiernych i trygonometrycznych.	4

Wy6	Całka oznaczona. Definicja całki oznaczonej i jej własności. Tw. Newtona-Leibniza. Przykłady zastosowań całki oznaczonej (np. średnia wartość funkcji na przedziale, pole obszaru, długość krzywej, objętość i pole powierzchni bocznej bryły obrotowej).	4
		Suma: 30

Forma zajęć – Ćwiczenia		Liczba godzin
Ćw1	Powtórzenie i uzupełnienie wiadomości o funkcjach. Elementy logiki matematycznej (spójniki, kwantyfikatory). Określanie dziedziny funkcji. Badanie parzystości. Składanie funkcji. Przekształcanie wykresów. Typowe równania i nierówności wykładnicze i logarytmiczne. Funkcja odwrotna. Funkcje trygonometryczne i cyklometryczne. Typowe równania i nierówności trygonometryczne.	8
Ćw2	Ciągi liczbowe. Badanie monotoniczności i ograniczoności ciągów. Obliczanie granic ciągów liczbowych.	2
Ćw3	Granice funkcji, asymptoty, funkcje ciągłe. Obliczanie granic funkcji w punkcie i w nieskończoności. Wyznaczanie asymptot. Badanie ciągłości funkcji. Przybliżone rozwiązywanie równań.	4
Ćw4	Rachunek różniczkowy. Definicja pochodnej. Reguły różniczkowania. Styczna. Różniczka. Reguła de l'Hospitala. Przedziały monotoniczności funkcji. Wyznaczanie ekstremów lokalnych i globalnych.	7
Ćw5	Całka nieoznaczona. Obliczanie całek nieoznaczonych. Całkowanie przez części i podstawienie. Całkowanie funkcji wymiernych i trygonometrycznych.	3
Ćw6	Całka oznaczona. Wzór Newtona-Leibniza. Pole obszaru. Długość krzywej. Objętość i pole powierzchni bryły obrotowej.	4
Ćw7	Kolokwium.	2
		Suma: 30

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. ćwiczenia rachunkowe N3. praca własna – samodzielne studia i przygotowanie do egzaminu N4. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się

F1	PEU_W01-PEU_W03	egzamin
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Ćwiczenia)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01-PEU_U03	kolokwia, odpowiedzi ustne, kartkówki
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA

[1] G. Decewicz, W. Żakowski, Matematyka, Cz.1, WNT, Warszawa 2007.
[2] M. Gewert, Z. Skoczylas, Analiza matematyczna 1. Definicje, twierdzenia, wzory, Oficyna Wydawnicza GiS, Wrocław 2021.
[3] M. Gewert, Z. Skoczylas, Analiza matematyczna 1. Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław 2021.
[4] W. Krysicki, L. Włodarski, Analiza matematyczna w zadaniach, Cz. I, PWN, Warszawa 2006

LITERATURA UZUPEŁNIAJĄCA

[5] F. Leja, Rachunek różniczkowy i całkowy, PWN, 2012.
[6] R. Leitner, Zarys matematyki wyższej dla studiów technicznych, cz.1-2, WNT, Warszawa 2006.
[7] M. Zakrzewski, Markowe wykłady z matematyki. Analiza, Oficyna Wydawnicza GiS, Wrocław 2013.

Wydział Mechaniczny PWR Zał. nr 6 ZW121/2020

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: **Elements of mathematical analysis 2 (Elementy analizy matematycznej 2)**
Nazwa przedmiotu w języku angielskim: **Elements of mathematical analysis 2**
Kierunek studiów (jeśli dotyczy): **Mechanika i Budowa Maszyn**
Poziom i forma studiów: **I stopień, stacjonarne**
Rodzaj przedmiotu: **obowiązkowy**
Kod przedmiotu: **W13MBM-SI3006**
Grupa kursów: **nie**

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15	15			
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60	60			
Forma zaliczenia	Egzamin	Zaliczenie na ocenę			
Grupa kursów					
Liczba punktów ECTS	2	2			
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		2			
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	0.7	0.7			

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Znajomość rachunku różniczkowego i całkowego funkcji jednej zmiennej rzeczywistej potwierdzona zaliczeniem kursu Analizy Matematycznej 1A, 1B lub innego kursu zawierającego w programie rachunek różniczkowy i całkowy funkcji jednej zmiennej.

CELE PRZEDMIOTU

C1. Zapoznanie z podstawowymi pojęciami i twierdzeniami rachunku różniczkowego funkcji dwóch zmiennych.
C2. Zapoznanie z pojęciem całki podwójnej, metodami jej obliczania i przykładami zastosowań.
C3. Zapoznanie z podstawowymi kryteriami zbieżności szeregów liczbowych i własnościami szeregów potęgowych.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

I. Z zakresu wiedzy:
PEU_W01 - znajomość podstawowych pojęć i twierdzeń rachunku różniczkowego funkcji dwóch zmiennych,
PEU_W02 - znajomość metod obliczania całek podwójnych,
PEU_W03 - znajomość podstawowych kryteriów zbieżności szeregów liczbowych i własności szeregów potęgowych,

II. Z zakresu umiejętności:
PEU_U01 - umiejętność obliczania pochodnych cząstkowych, kierunkowych i gradientu funkcji dwóch zmiennych oraz umiejętność interpretowania otrzymanych wielkości, umiejętność wyznaczania ekstremów lokalnych funkcji dwóch zmiennych
PEU_U02 - umiejętność obliczania całek podwójnych i wykorzystywania ich do obliczania pól i objętości;
PEU_U03 - umiejętność badania zbieżności szeregów liczbowych i rozwijania funkcji w szereg potęgowy przy wykorzystaniu rozwinięć funkcji elementarnych.

III. Z zakresu kompetencji społecznych:
PEU_K01 - świadomość konieczności systematycznej i samodzielnej pracy w celu zdobycia wiedzy

TREŚCI PROGRAMOWE

Forma zajęć – Wykład		Liczba godzin
Wy1	Rachunek różniczkowy funkcji dwóch zmiennych. Funkcje dwóch zmiennych. Przykłady wykresów funkcji dwóch zmiennych. Definicja i interpretacja geometryczna pochodnych cząstkowych pierwszego rzędu. Płaszczyzna styczna do wykresu funkcji dwóch zmiennych. Różniczka. Pochodna kierunkowa. Gradient funkcji. Pochodne cząstkowe wyższych rzędów. Twierdzenie Schwarza. Ekstrema lokalne funkcji dwóch zmiennych. Warunki konieczne i wystarczające istnienia ekstremum.	6
Wy2	Całki podwójne. Definicja całki podwójnej. Interpretacja geometryczna. Obliczanie całek podwójnych po obszarach normalnych. Całka podwójna we współrzędnych biegunowych. Przykłady zastosowań całek podwójnych.	4
Wy3	Szeregi liczbowe i potęgowe. Definicja całki niewłaściwej pierwszego rodzaju. Definicja szeregu liczbowego. Podstawowe kryteria zbieżności. Zbieżność bezwzględna i warunkowa. Kryterium Leibniza. Definicja szeregu potęgowego. Przedział i promień zbieżności. Twierdzenie Cauchy‘ego-Hadamarda. Szeregi: Taylora i Maclaurina.	5
		Suma: 15
Forma zajęć – Ćwiczenia		Liczba godzin

Ćw1	Rachunek różniczkowy funkcji dwóch zmiennych. Wyznaczanie dziedziny. Szkicowanie wykresów funkcji dwóch zmiennych (powierzchnie obrotowe i walcowe). Obliczanie pochodnych cząstkowych. Wyznaczanie równania płaszczyzny stycznej. Zastosowanie różniczki do szacowania dokładności obliczeń. Wyznaczanie i interpretowanie gradientu funkcji i pochodnej kierunkowej. Wyznaczanie ekstremów lokalnych funkcji dwóch zmiennych.	6
Ćw2	Całki podwójne. Zamiana całki podwójnej na iterowane. Obliczanie całek po obszarach normalnych. Całka podwójna we współrzędnych biegunowych. Przykłady zastosowań całek podwójnych.	4
Ćw3	Szeregi liczbowe i potęgowe. Badanie zbieżności szeregów liczbowych. Wyznaczanie przedziału zbieżności szeregu potęgowego. Rozwijanie funkcji w szereg potęgowy przy wykorzystaniu rozwinięć podstawowych funkcji.	4
Ćw4	Kolokwium	1
		Suma: 15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. wykład tradycyjny z wykorzystaniem transparencji i slajdów N2. ćwiczenia rachunkowe N3. praca własna – samodzielne studia i przygotowanie do egzaminu N4. konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Wykład)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01-PEU_W03	egzamin
P = F1		

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ (Ćwiczenia)		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_U01-PEU_U03, PEU_K01	kolokwia, odpowiedzi ustne, kartkówki
P = F1		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA [1] M. Gewert, Z. Skoczylas, Analiza Matematyczna 2. Definicje, twierdzenia, wzory. Oficyna Wydawnicza GiS, Wrocław 2016. [2] M. Gewert, Z. Skoczylas, Analiza Matematyczna 2. Przykłady i Zadania, Oficyna Wydawnicza GiS, Wrocław 2016. [3] R. Leitner, Zarys Matematyki Wyższej dla Studiów Technicznych, Cz. 1 - 2 WNT, Warszawa, 2006. LITERATURA UZUPEŁNIAJĄCA [1] W. Krysicki, L. Włodarski, Analiza Matematyczna w Zadaniach, Cz. II, PWN, Warszawa 2006. [2] F. Leja, Rachunek Różniczkowy i Całkowy, Wydawnictwo Naukowe PWN, 2012. [3] M.Zakrzewski, Markowe wykłady z matematyki. Analiza, geometria i świat fizyczny, Oficyna Wydawnicza GiS, Wrocław 2017.