Załącznik nr 2 do ZW 121/2020

PROGRAM STUDIÓW

WYDZIAŁ: **Budownictwa Lądowego i Wodnego**
KIERUNEK STUDIÓW: **budownictwo**
Dyscypliny: **D1 inżynieria lądowa i transport (major discipline)**
~~D2* ……………………………~~
~~D3* ……………………………~~
~~D4* ……………………………~~

POZIOM KSZTAŁCENIA: **~~studia pierwszego stopnia (licencjackie / inżynierskie)~~ / drugiego stopnia / ~~jednolite magisterskie~~***
FORMA STUDIÓW: **stacjonarna / ~~niestacjonarna~~***
PROFIL: **ogólnoakademicki / ~~praktyczny~~ ***
JĘZYK PROWADZENIA STUDIÓW: **angielski**
OBOWIĄZUJE OD CYKLU KSZTAŁCENIA: **2022/2023**

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

Specjalność: Civil Engineering (CEB)

Wydział: Budownictwa Lądowego i Wodnego
Kierunek studiów: budownictwo
Poziom studiów: studia drugiego stopnia
Profil: ogólnoakademicki

<u>Umiejscowienie kierunku</u>

Dziedzina nauki: dziedzina nauk inżynieryjno-technicznych
Dyscyplina/dyscypliny w przypadku kilku dyscyplin proszę wskazać dyscyplinę wiodącą)
Inżynieria lądowa i transport

<u>Objaśnienie oznaczeń:</u>
P6U – charakterystyki uniwersalne odpowiadające kształceniu na studiach pierwszego stopnia - 6 poziom PRK*
P7U – charakterystyki uniwersalne odpowiadające kształceniu na studiach drugiego stopnia - 7 poziom PRK*

P6S – charakterystyki drugiego stopnia odpowiadające kształceniu na studiach pierwszego stopnia studiów - 6 poziom PRK *
P7S – charakterystyki drugiego stopnia odpowiadające kształceniu na studiach drugiego stopnia/ jednolitych magisterskich – 7 poziom PRK*
W – kategoria „wiedza"
U – kategoria „umiejętności"
K – kategoria „kompetencje społeczne"
K(*symbol kierunku*)_W1, K(*symbol kierunku*)_W2, K(*symbol kierunku*)_W3, …- efekty kierunkowe dot. kategorii „wiedza"
K(*symbol kierunku*)_U1, K(*symbol kierunku*)_U2, K(*symbol kierunku*)_U3, …- efekty kierunkowe dot. kategorii „umiejętności"
K(*symbol kierunku*)_K1, K(*symbol kierunku*)_K2, K(*symbol kierunku*)_K3, …- efekty kierunkowe dot. kategorii „kompetencje społeczne"
…._inż – efekty uczenia się umożliwiające uzyskanie kompetencji inżynierskich
Uwaga: efekty z kodem U są uzyskiwane wyłącznie na zajęciach o charakterze praktycznym.

Symbol kierunkowych efektów uczenia się	Opis efektów uczenia się dla kierunku studiów budownictwo Po ukończeniu kierunku studiów absolwent:	Odniesienie do charakterystyk PRK		
		Uniwersalne charakterystyki pierwszego stopnia (U)		
WIEDZA (W)				
K2_W01	ma niezbędną zaawansowaną wiedzę z zakresu wybranych działów matematyki i fizyki w zakresie stanowiącym podstawę dla wytrzymałości materiałów, mechaniki, w tym dynamiki oraz teorii konstrukcji budowlanych	**P7U_W**		**P7S_WG_INZ**
K2_W02	posiada poszerzoną wiedzę z zakresu zaawansowanych zagadnień wytrzymałości materiałów oraz modelowania materiałów	**P7U_W**	**P7S_WG,**	**P7S_WG_INZ**
K2_W03	ma odpowiednią, niezbędną wiedzę na temat podstaw teoretycznych metody elementów skończonych oraz ogólnych zasad prowadzenia nieliniowych obliczeń konstrukcji inżynierskich	**P7U_W**	**P7S_WG**	**P7S_WG_INZ**
K2_W04	zna, w niezbędnym zakresie, podstawy mechaniki ośrodków ciągłych; zna zasady analizy zagadnień statyki, stateczności złożonych konstrukcji prętowych, płytowych, tarczowych i powłokowych oraz bryłowych oraz dynamiki tego typu konstrukcji o wielu dynamicznych stopniach swobody tzn. układów dyskretnych lub zdyskretyzowanych	**P7U_W**	**P7S_WG**	**P7S_WG_INZ**
K2_W05	ma podstawowa wiedzę na temat podstaw teoretycznych analizy i optymalizacji konstrukcji oraz projektowania złożonych systemów konstrukcyjnych	**P7U_W**		**P7S_WG_INZ**
K2_W06	zna normy oraz wytyczne i przepisy dotyczące projektowania obiektów budowlanych i ich elementów	**P7U_W**		
K2_W07	zna zasady analizy, konstruowania i wymiarowania złożonych konstrukcji budowlanych: metalowych i żelbetowych	**P7U_W**	**P7S_WG**	**P7S_WG_INZ**
K2_W08	zna zasady fundamentowania złożonych obiektów budowlanych	**P7U_W**	**P7S_WG**	**P7S_WG_INZ**
K2_W09	zna klasyfikację i zakres stosowania programów komputerowych wspomagających analizę i projektowanie skomplikowanych konstrukcji budowlanych	**P7U_W**	**P7S_WG**	**P7S_WG_INZ**
K2_W10	zna aktualnie stosowane, współczesne materiały budowlane oraz podstawowe elementy technologii ich wytwarzania	**P7U_W**	**P7S_WK**	**P7S_WK_INZ**
K2_W11	zna zasady tworzenia procedur zarządzania jakością przedsięwzięć budowlanych; ma wiedzę na temat sposobu realizacji skomplikowanych robót i obiektów budowlanych; zna zasady normalizacji i standaryzacji w budownictwie; ma wiedzę na temat efektywności kosztu i czasu realizacji; zna programy przydatne do planowania przedsięwzięć budowlanych	**P7U_W**	**P7S_WG, P7S_WK**	**P7S_WG_INZ, P7S_WK_INZ**
K2_W12	ma ugruntowaną wiedzę na temat prowadzenia działalności gospodarczej w branży budowlanej; rozumie zasady i podstawy gospodarki finansowej przedsiębiorstw	**P7U_W**	**P7S_WK**	**P7S_WK_INZ**

K2_W13	ma wiedzę na temat wpływu realizacji inwestycji budowlanych na środowisko	**P7U_W**	**P7S_WK**	**P7S_WK_INZ**
K2_W14	zna przepisy prawa budowlanego oraz bezpieczeństwa pracy	**P7U_W**	**P7S_WK**	**P7S_WK_INZ**
K2_W15	zna elementy prawa dotyczącego patentów i ochrony wartości intelektualnych oraz zasady etyki zawodowej	**P7U_W**	**P7S_WG, P7S_WK**	**P7S_WG_INZ, P7S_WK_INZ**
UMIEJĘTNOŚCI (U)				
K2_U01	potrafi korzystać z zaawansowanych narzędzi specjalistycznych podczas przeszukiwania internetowych zasobów baz danych i innych źródeł do wyszukiwania informacji ogólnych i związanych z szeroko rozumianym budownictwem; potrafi stosować technologie informacyjne do komunikacji oraz umie pozyskiwać oprogramowanie wspomagające pracę projektanta i osoby organizującej i zarządzającej procesami budowlanymi	**P7U_U**	**P7S_UW, P7S_UU**	**P7S_UW_INZ**
K2_U02	posiada umiejętności językowe w zakresie zagadnień związanych z kierunkiem studiów, zgodnie z wymaganiami określonymi dla poziomu co najmniej B2+ według ESOKJ; ma umiejętność porozumiewania się w językach obcych, łącznie ze znajomością elementów języka technicznego z zakresu budownictwa	**P7U_U**	**P7S_UK**	
K2_U03	potrafi określić kierunki dalszego uczenia się i realizować proces samokształcenia	**P7U_U**	**P7S_UK**	
K2_U04	umie dokonać klasyfikacji prostych i złożonych obiektów budowlanych	**P7U_U**	**P7S_UW**	**P7S_UW_INZ**
K2_U05	potrafi dokonać oceny i zestawienia dowolnych obciążeń działających na obiekty budowlane wraz z odpowiednimi ich kombinacjami	**P7U_U**	**P7S_UW**	**P7S_UW_INZ**
K2_U06	potrafi wykonać klasyczną analizę statyczną i analizę stateczności ustrojów prętowych (kratownic, ram i cięgien) statycznie wyznaczalnych i niewyznaczalnych oraz konstrukcji powierzchniowych (tarcz, płyt, membran i powłok, elementów bryłowych) oraz analizę dynamiczna tego typu konstrukcji o wielu dynamicznych stopniach swobody jako układów dyskretnych lub zdyskretyzowanych	**P7U_U**	**P7S_UW**	**P7S_UW_INZ**
K2_U07	potrafi, w środowisku metody elementów skończonych, poprawnie zdefiniować model obliczeniowy i przeprowadzić zaawansowaną analizę w zakresie liniowym złożonych konstrukcji inżynierskich oraz stosować techniki obliczeń nieliniowych na poziomie podstawowym	**P7U_U**	**P7S_UW**	**P7S_UW_INZ**
K2_U08	potrafi rozwiązywać złożone zagadnienia z zakresu wybranych działów matematyki, stanowiących podstawę zaawansowanych metod analizy konstrukcji; potrafi wybrać narzędzia (analityczne bądź numeryczne) do rozwiązywania problemów inżynierskich; potrafi korzystać z wybranych programów komputerowych wspomagających modelowanie i procesy projektowe w budownictwie	**P7U_U**	**P7S_UW**	**P7S_UW_INZ**
K2_U09	potrafi krytycznie ocenić wyniki analizy numerycznej złożonych konstrukcji inżynierskich	**P7U_U**		**P7S_UW_INZ**
K2_U10	potrafi zaprojektować złożone fundamenty pod obiekty budowlane	**P7U_U**	**P7S_UW**	**P7S_UW_INZ**
K2_U11	potrafi zamodelować i zaprojektować skomplikowanie elementy i złożone konstrukcje metalowe i żelbetowe	**P7U_U**	**P7S_UW**	**P7S_UW_INZ**

K2_U12	potrafi sporządzić graficzną dokumentację projektową w środowisku wybranych programów graficznych	**P7U_U**	**P7S_UW**	**P7S_UW_INZ**
K2_U13	umie sporządzić harmonogram prac budowlanych i kosztorys przedsięwzięcia budowlanego oraz ocenić efektywność przedsięwzięć budowlanych w ramach prac zespołowych	**P7U_U**	**P7S_UO**	
K2_U14	potrafi ocenić zagrożenia przy realizacji przedsięwzięć budowlanych i wdrożyć odpowiednie zasady bezpieczeństwa; potrafi stosować normy i normatywy pracy oraz procedury zarządzania jakością w ramach prac zespołowych	**P7U_U**	**P7S_UW, P7S_UK, P7S_UO, P7S_UU**	**P7S_UW_INZ**
K2_U15	potrafi zaplanować i przeprowadzić eksperymenty laboratoryjne prowadzące do oceny jakości stosowanych materiałów oraz oceny wytrzymałości elementów konstrukcji budowlanych	**P7U_U**		
K2_U16	umie, zgodnie z zasadami naukowymi, wykorzystując warsztat naukowy sformułować i przeprowadzić wstępne prace o charakterze badawczym prowadzące do rozwiązania problemów inżynierskich, technologicznych i organizacyjnych występujących się w budownictwie	**P7U_U**	**P7S_UW, P7S_UU**	**P7S_UW_INZ**
K2_U17	potrafi zaplanować, przygotować i wykonać badania oraz sporządzać opracowania przygotowujące go do podjęcia pracy naukowej	**P7U_U**	**P7S_UW, P7S_UU**	**P7S_UW_INZ**
KOMPETENCJE SPOŁECZNE (K)				
K2_K01	ma świadomość konieczności ustawicznego podnoszenia kompetencji zawodowych i osobistych; w formie kształcenia formalnego lub nieformalnego uzupełnia i poszerza wiedzę w zakresie nowoczesnych procesów i technologii związanych z budownictwem	**P7U_K**	**P7S_KK**	
K2_K02	ma świadomość ważności i rozumie pozatechniczne aspekty i skutki działalności inżynierskiej, w tym jej wpływu na środowisko, i związanej z tym odpowiedzialność za podejmowane decyzje	**P7U_K**	**P7S_KK**	
K2_K03	potrafi pracować samodzielnie i współpracować w zespole nad wyznaczonym zadaniem; jest odpowiedzialny za bezpieczeństwo pracy własnej i podlegającego mu zespołu	**P7U_K**	**P7S_KK, P7S_KO**	
K2_K04	ma świadomość ważności zachowania w sposób profesjonalny i przestrzegania zasad etyki; prawidłowo identyfikuje i rozstrzyga dylematy związane z wykonywaniem zawodu; potrafi określić priorytety służące realizacji określonego przez siebie lub innych zadania	**P7U_K**	**P7S_KO, P7S_KR**	
K2_K05	potrafi myśleć i działać w sposób przedsiębiorczy	**P7U_K**	**P7S_KO**	
K2_K06	ma świadomość roli społecznej absolwenta uczelni technicznej, a zwłaszcza rozumie potrzebę formułowania i przekazywania społeczeństwu, w szczególności poprzez środki masowego przekazu, informacji i opinii dotyczących osiągnięć techniki i innych aspektów działalności inżynierskiej; podejmuje starania, aby przekazać takie informacje i opinie w sposób powszechnie zrozumiały, z uzasadnieniem różnych punktów widzenia	**P7U_K**	**P7S_KK, P7S_KO, P7S_KR**	

K2_K07	ma świadomość niezbędności aktywności indywidualnych i zespołowych wykraczających poza działalność inżynierską	**P7U_K**	**P7S_KK, P7S_KO, P7S_KR**	

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

OPIS PROGRAMU STUDIÓW

WYDZIAŁ: Budownictwa Lądowego i Wodnego

KIERUNEK: budownictwo

POZIOM KSZTAŁCENIA: II stopień, studia magisterskie

FORMA STUDIÓW: stacjonarna

PROFIL: ogólnoakademicki

SPECJALNOŚĆ: Civil Engineering

JĘZYK STUDIÓW: angielski

OBOWIĄZUJE OD CYKLU KSZTAŁCENIA: 2022/2023

1. Opis ogólny

1.1. Liczba semestrów:	***3***
1.2. Całkowita liczba punktów ECTS konieczna do ukończenia studiów na danym poziomie:	***90***
1.3. Łączna liczba godzin zajęć:	***1035***

1.4. Wymagania wstępne (w szczególności w przypadku studiów II stopnia):

Osoba ubiegająca się o przyjęcie na studia drugiego stopnia na kierunku budownictwo na WBLiW PWr musi posiadać kwalifikacje I stopnia oraz kompetencje do kontynuowania kształcenia na studiach drugiego stopnia na tym kierunku. Kandydaci ubiegający się o przyjęcie na studia drugiego stopnia na kierunku budownictwo na WBLiW PWr muszą posiadać w szczególności następujące kompetencje:

- posiada wiedzę z zakresu fizyki i matematyki, umożliwiającą zrozumienie podstaw fizycznych budownictwa oraz formułowanie i rozwiązywanie prostych zadań z zakresu budownictwa;

- posiada wiedzę z zakresu chemii, umożliwiającą zrozumienie podstaw chemicznych właściwości i budowy materiałów budowlanych;

- ma umiejętność odczytywania ze zrozumieniem rysunków architektonicznych, budowlanych i geodezyjnych oraz potrafi sporządzić odpowiednią projektową dokumentację graficzną w środowisku wybranych programów CAD;

- ma wiedzę i kompetencje z zakresu mechaniki ogólnej, wytrzymałości materiałów oraz zasad ogólnego kształtowania konstrukcji budowlanych;

- posiada znajomość i umiejętność stosowania zasad mechaniki i analizy konstrukcji prętowych w zakresie statyki, dynamiki i stateczności;

- potrafi przyjąć odpowiednie modele obliczeniowe i wykonać analizę statyczną prostych konstrukcji prętowych statycznie wyznaczalnych i niewyznaczalnych;

- posiada wiedzę i umiejętności z zakresu zaprojektowania wybranych elementów i prostych konstrukcji: metalowych, żelbetowych, drewnianych, murowych i zespolonych;

- ma wiedzę i podstawowe umiejętności z zakresu projektowania obiektów budownictwa hydrotechnicznego i mostowego oraz związanego z infrastrukturą transportową;

- zna podstawy mechaniki gruntów i zasady modelowania, wymiarowania i konstruowania fundamentów;

- zna podstawy fizyki budowli oraz rozumie zjawiska dotyczące transferu ciepła i dyfuzji wilgoci obiektach budowlanych;

- potrafi poprawnie wybrać i zastosować narzędzia do rozwiązywania problemów analizy i projektowania obiektów budowlanych oraz prowadzenia robót budowlanych;

- umie sporządzić kosztorys i harmonogram robót budowlanych, projekt zagospodarowania placu budowy oraz projekt wykonania robót budowlanych;

- ma umiejętności z zakresu interpretacji, prezentacji i dokumentacji wyników prostych eksperymentów oraz prezentacji i dokumentacji wyników realizacji zadań o charakterze projektowym.

Zasady weryfikacji kompetencji posiadanych przez kandydata określa odpowiednia uchwała Rady Wydziału.

1.5. Tytuł zawodowy nadawany po zakończeniu studiów:		***możliwość ubiegania się o przyjęcie do szkoły doktorskiej, studia podyplomowe***

1.6. Sylwetka absolwenta, możliwości zatrudnienia:

Po zakończaniu studiów drugiego stopnia na kierunku budownictwo, absolwent na podstawie zgromadzonej wiedzy i nabytych umiejętności jest przygotowany do podejmowania decyzji w zakresie prawidłowego stosowania materiałów, projektowania obiektów budowlanych i przedsięwzięć budowlanych. Zna aktualne trendy w projektowaniu i realizacji przedsięwzięć budowlanych. Stosuje zasady bezpieczeństwa i higieny pracy. Potrafi projektować obiekty budowlane, zna zasady mechaniki budowli, potrafi sformułować, utworzyć, a następnie zastosować właściwe modele obliczeniowe złożonych konstrukcji inżynierskich. Potrafi tworzyć i odczytać rysunki techniczne, rozpoznać opracowania kartograficzne i geodezyjne oraz kierować robotami budowlanymi. Potrafi sformułować i rozwiązywać nowe problemy inżynierskie, techniczne i organizacyjne związanych z budownictwem. Wykorzystuje nowoczesne techniki komputerowe wspomagające procesy projektowania obiektów i przedsięwzięć budowlanych. Potrafi krytycznie dobierać argumenty wspomagające kolektywne decyzje dotyczące realizacji zadań w budownictwie. Potrafi opracować i ewentualnie opublikować raporty dotyczące przebiegu wykonywanych prac. Ma umiejętności językowe w zakresie dziedzin nauki i dyscyplin naukowych, właściwych dla studiowanego kierunku studiów, zgodnie z wymaganiami określonymi dla poziomu B+ Europejskiego Systemu Kształcenia Językowego. Jest przygotowany do kontynuowania nauki na trzecim stopniu studiów. Absolwenci są przygotowani do: rozwiązywania złożonych problemów projektowych, organizacyjnych i technologicznych, opracowywania i realizacji programów badawczych, podejmowania przedsięwzięć o zasięgu międzynarodowym, uczestniczenia w marketingu i promocji wyrobów budowlanych, kontynuacji edukacji i uczestniczenia w badaniach i dziedzinach, związanych bezpośrednio z budownictwem i produkcją budowlaną, ustawicznego podnoszenia kwalifikacji i uzupełniania wiedzy, kierowania dużymi zespołami ludzkimi. Absolwenci mogą podjąć pracę w: biurach konstrukcyjno-projektowych, przedsiębiorstwach wykonawczych, instytucjach badawczych i ośrodkach badawczo-rozwojowych oraz instytucjach zajmujących się poradnictwem i upowszechnianiem wiedzy z zakresu budownictwa.

Specjalność Budownictwo Hydrotechniczne i Specjalne pozwala absolwentom zdobyć rozbudowane kompetencje w zakresie projektowania budowli hydrotechnicznych, stalowych konstrukcji hydrotechnicznych, specjalnego budownictwa betonowego i komunalnego, eksploatacji i regulacji rzek i dróg wodnych, siłowni wodnych, tuneli hydrotechnicznych, urządzeń wodno-kanalizacyjnych, renowacja budowli hydrotechnicznych oraz odwodnień stałych i tymczasowych. Rozszerzone kompetencje absolwentów specjalności Budownictwo Podziemne i Inżynieria Miejska wynikają z realizacji kursów podstawowych i specjalnościowych takich jak: roboty i budownictwo ziemne, budownictwo podziemne, inżynieria miejska, infrastruktura sieciowa, utrzymanie budowli podziemnych, fundamenty specjalne czy też fundamentowanie na terenach specjalnych. Specjalność Budowa Dróg i Lotnisk kształci absolwentów zdobywających rozbudowaną wiedzę i umiejętności z zakresu materiałów i nawierzchni drogowych, odwodnień budowli infrastruktury transportowej, teorii wymiarowania nawierzchni drogowych, komputerowego wspomaganie projektowania dróg i lotnisk, inżynierii miejskiej i komunikacji miejskich. Ponadto absolwenci zdobywają kompetencje w zakresie systemów transportowych.Specjalność Infrastruktura Transportu Szynowego pozwala absolwentom zdobyć rozbudowaną wiedzę i kompetencje w zakresie teorii nawierzchni szynowych, technologii robót kolejowych, projektowania stacji kolejowych, inżynierii ruchu kolejowego, sterowania ruchem kolejowym, eksploatacji kolei, inżynierii miejskiej, odwodnień budowli infrastruktury transportowej, diagnostyki nawierzchni szynowych, trwałości i niezawodności nawierzchni kolejowej oraz metod komputerowych w drogach kolejowych. Absolwent specjalności Inżynieria Mostowa ponad wiedzę, którą zdobywają absolwenci wszystkich specjalności, posiada rozszerzoną wiedzę i umiejętności z zakresu teorii konstrukcji mostowych, projektowania i wykonawstwa mostów betonowych, metalowych i mostów drewnianych, komputerowego wspomagania projektowania mostów, badania i rehabilitacji mostów i konstrukcji gruntowo-powłokowych. Absolwent ma też możliwość zapoznania się z komputerowymi systemami wspomagającymi gospodarkę mostową. Teoria Konstrukcji to specjalność dla szczególnie uzdolnionych studentów. Absolwenci tej specjalności są kompetentni w zakresie metod matematycznych w mechanice, teorii dźwigarów powierzchniowych, w rozwiązywaniu problemów niezawodności i stanów granicznych konstrukcji. Ponadto posiadają poszerzoną wiedzę i umiejętności z dynamiki układów ciągłych, reologii i komputerowego modelowania konstrukcji. Specjalność Civil Engeenering prowadzona w języku angielskim pozwala absolwentowi zdobyć rozbudowaną wiedzę i kompetencje w zakresie projektowania i wykonywania różnorodnych obiektów budowlanych, takich jak: złożone obiekty o konstrukcji żelbetowej lub metalowej, budynki mieszkalne, obiekty inżynierii miejskiej, drogi i autostrady, mosty, obiekty infrastruktury transportu szynowego. Ponadto absolwent ma poszerzoną wiedzę w zakresie zagadnień hydraulicznych oraz komputerowego wspomagania projektowania. Każdy z absolwentów ma poszerzoną swoją wiedzę o wybranych obiektach, w ramach szerokiej grupy modułów wybieralnych.

1.7. Możliwość kontynuacji studiów:	***3rd level studies***

1.8. Wskazanie związku z misja Uczelni mi strategia jej rozwoju:
Kierunek budownictwo na studiach drugiego stopnia wraz ze specjalnościami realizowanymi na studiach stacjonarnych: Konstrukcje Budowlane, Budowlano-Technologiczna, Budownictwo Hydrotechniczne i Specjalne, Budownictwo Podziemne i Inżynieria Miejska, Budowa Dróg i Lotnisk, Infrastruktura Transportu Szynowego, Inżynieria Mostowa, Teoria Konstrukcji oraz Civil Engineering (prowadzona w języku angielskim) jest wpisany w misję i strategię rozwoju Wydziału Budownictwa Lądowego i Wodnego Politechniki Wrocławskiej.
Studia na kierunku budownictwo są ściśle związane z realizowanymi na Wydziale Budownictwa Lądowego i Wodnego pracami naukowo-badawczymi prowadzonymi przez istniejące na Wydziale Katedry i Zakłady.

2. Opis szczegółowy

2.1. Całkowita liczba efektów uczenia się w programie studiów:	*kierunkowe*	*W (wiedza) =*	***15***
		U (umiejętności) =	***17***
		K (kompetencje) =	***7***
		W + U + K =	***39***

2.2. Dla kierunku studiów przyporządkowanego do więcej niż jednej dyscypliny – liczba efektów uczenia się przypisana do dyscypliny:	
D1 Inżynieria lądowa i transport (major), (this number must be greater than half the total number of learning outcomes)	***39***
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:*	***100***
D2 -		
D3 -		
D4 -		

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 - DN (musi być większa niż 50 % całkowitej liczby punktów ECTS z p. 2.1):	***81***
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. 2.1):	-

2.5. Zwięzła analiza zgodności zakładanych efektów kształcenia z potrzebami rynku pracy ***Program kształcenia jest ukierunkowany na kompleksowe przygotowanie wysokokwalifikowanej inżynierskiej kadry technicznej w szeroko rozumianym obszarze budownictwa. Absolwenci kierunku budownictwo o profilu ogólnoakademickim są przygotowani do samodzielnej pracy w zakresie organizacji i realizacji procesów budowlanych, zarządzania utrzymaniem i eksploatacją infrastruktury budowlanej, a także do udziału w procesie projektowania konstrukcji budowlanych. Absolwenci posiadają także wiedzę i umiejętności niezbędne do organizowania i kierowania pracą zespołów we wszystkich dziedzinach budownictwa. Profile kształcenia i specjalności dyplomowania przygotowują studentów do podjęcia pracy w najbardziej poszukiwanych na rynku obszarach: budownictwa kubaturowego i obiektów przemysłowych oraz zarządzania procesami budowlnymi (Konstrukcje Budowlane, Budowlano-technologiczna), budownictwa wodnego oraz ziemnego i podziemnego (Budownictwo Hydrotechniczne i Specjalne, Budownictwo Podziemne i Inżynieria Miejska) oraz w zakresie obiektów infrastruktury transportowej (Budowa Dróg i Lotnisk, Infrastruktura Transportu Szynowego, Inżynieria Mostowa),a uniwersalna wiedza podstawowa umożliwia elastyczne dostosowywanie się absolwentów do zmieniających się potrzeb rynku pracy. Specjalność Teoria Konstrukcji przygotowuje absolwentów do prac naukowo-badawczych, a specjalność Civil Engineering (prowadzona w języku angielskim) - daje możliwość nawiązania przez absolwentów współpracy z międzynarodowymi firmami budowlanymi. Wszystkie specjalności stanowią bazę wiedzy i kompetencji umożliwiającą uzyskiwanie przez absolwentów odpowiednich uprawnień zawodowych.***	
2.6. Łączna liczba punktów ECTS, którą student musi uzyskać na zajęciach wymagających bezpośredniego udziału nauczycieli akademickich lub innych osób prowadzących zajęcia i studentów (wpisać sumę punktów ECTS dla kursów/ grup kursów oznaczonych kodem BU1):	***48.2***
2.7. Łączna liczba punktów ECTS, którą student musi uzyskać w ramach zajęć z zakresu nauk podstawowych	
Liczba punktów ECTS z przedmiotów obowiązkowych:	***3***
Liczba punktów ECTS z przedmiotów wybieralnych:	***0***
Łączna liczba punktów ECTS:	***3***
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:	***42.4***
Liczba punktów ECTS z przedmiotów wybieralnych:	***8.5***
Łączna liczba punktów ECTS:	***50.9***
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):	***6***
2.10. Łączna liczba punktów ECTS, którą student może uzyskać, realizując bloki wybieralne (min. 30 % całkowitej liczby punktów ECTS):	***69***

3. Opis procesu prowadzącego do uzyskania efektów uczenia się:

W procesie uzyskania wymaganego zasobu wiedzy, umiejętności i kompetencji społecznych uzyskanych w procesie uczenia się uwzględnia się następujące elementy:
- różne przedmioty wraz z uwzględnieniem przypisanymi punktów ECTS dla różnych form dydaktycznych,
- przedmioty obejmują określone treści tematyczne, realizowane w formie zajęć dydaktycznych, w szczególności w formie wykładu, laboratorium, ćwiczeń, seminarium, praktyki określonych w programie studiów; w skład przedmiotu może wchodzić więcej niż jedna forma zajęć; przedmiot lub grupa przedmiotów może stanowić moduł, dla którego przypisano w programie studiów zakładane efekty uczenia się,
- efekty uczenia się w zakresie wiedzy, umiejętności i kompetencji społecznych z dostosowaniem kierunku budownictwo WBLiW PWr (dla profilu ogólnoakademickiego) do Charakterystyki Polskiej Ramy Kwalifikacji dla Szkolnictwa Wyższego,
- plan studiów uwzględniający różne specjalności oraz przedmioty obowiązkowe i wybieralne, a także przedmioty z zakresu kształcenia ogólnego, nauk podstawowych, kierunkowych i specjalnościowych,
- różne formy weryfikacji i oceny osiągania przez studenta zakładanych efektów uczenia się (egzaminy, zaliczenia).

Proces prowadzący do uzyskania efektów uczenia się obejmuje:
- uczestnictwo studentów w zajęciach zorganizowanych, które zgodnie z Regulaminem studiów jest obowiązkowe. Zajęcia mogą odbywać się w formie tradycyjnej, zdalnej-synchronicznej oraz mieszanej z wykorzystaniem zalecanych przez Uczelnię narzędzi elektronicznych do nauczania na odległość;
- korzystanie przez studentów z konsultacji z Prowadzącymi zajęcia, które są przeprowadzane poza terminami zajęć w formie tradycyjnej oraz zdalnej (nie przekraczającej 50% czasu przeznaczonego na konsultacje). Wymiar godzin konsultacji jest określany zgodnie z obowiązującym Zarządzeniem Wewnętrznym. Zestawienie terminów konsultacji są zamieszczane na stronie wydziałowej;
- pracę własną studentów, która obejmuje:
- studiowanie zaleconej przez Prowadzących literatury oraz udostępnionych materiałów dydaktycznych,
- opracowywanie projektów, sprawozdań i innych form wymaganych opracowań,
- przygotowywanie się do zajęć oraz do zaliczeń, kolokwiów i egzaminów;

Dla wszystkich przedmiotów (kursów) przypisanych do programu studiów zostały opracowane karty przedmiotu. W każdej z nich są podane efekty uczenia się właściwe dla tego przedmiotu (kursu). Studenci realizując i zaliczając kursy przypisane do programu studiów jednocześnie potwierdzają uzyskanie efektów uczenia się z zakresu nabytej wiedzy, umiejętności i kompetencji społecznych, przypisanych do danego przedmiotu (kursu). Realizacja przez studenta wszystkich przedmiotów (kursów) przypisanych do programu studiów oznacza osiągnięcie wszystkich efektów uczenia się określonych w programie studiów.

Karty przedmiotów, przypisane do nich efekty uczenia się oraz stosowane przez Prowadzących metody oceny ich osiągnięcia są kontrolowane, oceniane i weryfikowane przez:
- Wydziałową Komisję ds. Oceny i Zapewnienia Jakości Kształcenia,
- Wydziałowe Komisje Programowe,
- Prodziekana ds. Dydaktyki, przeprowadzającego w każdym semestrze ankietyzację Prowadzących w zakresie stosowanych metod i narzędzi weryfikacji osiągnięcia przez studentów efektów uczenia się.

4. Lista modułów kształcenia

Oznaczenia:

[1]BU – liczba punktów ECTS przypisanych zajęciom wymagającym 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, s, p)
[4]Kurs/ grupa kursów Ogólnouczelniany – O
[5]Kurs/ grupa kursów związany/-a z prowadzoną dział. 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

W – wybieralny, Ob – obowiązkowy
CNPS - calkowity nakład pracy studenta; ZZU - zajęcia zorganizowane; 1 ECTS = 30 h NPS
Uwaga: efekty z kodem U są uzyskiwane wyłącznie na zajęciach o charakterze praktycznym.

Specjalność: Civil Engineering

4.1. Lista bloków obowiązkowych
4.1.1. Lista bloków z zakresu kształcenia ogólnego
4.1.1.1. Blok Przedmioty humanistyczno-menedżerskie (min. 3 ECTS)

L.p.	Kod kursu / grupy kursów	Nazwa kursu / grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol kierunkowego 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]			ogólno-uczelniany[4]	zw. z dział. Nauk[5]	o char. praktycz. P[6]	rodzaj[7]	typ
1	**CEB008563**	Construction project management. Zarządzanie przedsięwzięciami budowlanymi	1					K2_W11, K2_W12, K2_W13, K2_W14, K2_W15, K2_U01, K2_U08, K2_U13, K2_U14, K2_K01, K2_K02, K2_K05	15	30	1	0	0.6	T, Z	Z		0		KO	Ob.
				1					15	60	2	0	0.6	T, Z	Z		0	1.5	KO	Ob.
		Razem	1	1	0	0	0		30	90	3	0	1.2				0	1.5		

4.1.1.2. Blok *Języki obce*
4.1.1.3. Blok *Zajęcia sportowe*
4.1.1.4. Blok *Technologie informacyjne*

Razem dla bloków obowiązkowych 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					
1	1	0	0	0	30	90	3	0	1.2

Liczba punktów ECTS zajęć P
1.5

4.1.2. Lista bloków z zakresu nauk podstawowych
4.1.2.1. Blok Matematyka
(min. 2 ECTS)

L.p.	Kod kursu / grupy kursów	Nazwa kursu / grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol kierunkowego 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]			ogólno-uczelniany[4]	zw. z dział. Nauk[5]	o char. praktycz. P[6]	rodzaj[7]	typ
1	**CEB008061**	Selected topics in mathematics. Matematyka - wybrane zagadnienia	1					K2_W01, K2_U08, K2_K01, K2_K02, K2_K03, K2_K06	15	30	1	1	0.6	T, Z	E		1		PD	Ob.
				1					15	30	1	1	0.6	T, Z	Z		1	0.6	PD	Ob.
		Razem	1	1	0	0	0		30	60	2	2	1.2				2	0.6		

4.1.2.2. Blok Fizyka

(min. 1 ECTS)

L.p.	Kod kursu / grupy kursów	Nazwa kursu / grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol kierunkowego 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]			ogólno-uczelniany[4]	zw. z dział. Nauk[5]	o char. praktycz. P[6]	rodzaj[7]	typ
1	**FZP007163**	Physics of modern materials. Fizyka nowoczesnych materiałów	1					K2_W01, K2_W02, K2_W04, K2_U03, K2_U08, K2_K01, K2_K02, K2_K06	15	30	1	1	0.5	T, Z	Z	O			PD	Ob.
		Razem	1	0	0	0	0		15	30	1	1	0.5					0.0		

4.1.2.3. Blok Chemia

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					
2	1	0	0	0	45	90	3	2	1.7

Liczba punktów ECTS zajęć P
0.6

4.1.3. Lista bloków kierunkowych

L.p.	Kod kursu / grupy kursów	Nazwa kursu / grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol kierunkowego 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]			ogólno-uczelniany[4]	zw. z dział. Nauk[5]	o char. praktycz. P[6]	rodzaj[7]	typ
1	**CEB007361**	Selected topics in geo-engineering - foundation. Fundamentowanie - wybrane zagadnienia	1					K2_W01, K2_W06, K2_W08, K2_U04, K2_U05, K2_U09, K2_U10, K2_U16, K2_U17, K2_K03, K2_K06	15	30	1	1	0.5	T, Z	Z		1		K	Ob.
						2			30	30	1	1	1.1	T, Z	Z		1	1.3	K	Ob.
2	**CEB008361**	Theory of elasticity and plasticity. Teoria sprężystości i plastyczności	2					K2_W01, K2_W02, K2_W04, K2_U02, K2_U04, K2_U08, K2_K01	30	30	1	1	1.1	T, Z	Z		1		K	Ob.
				1					15	30	1	1	0.6	T, Z	Z		1	0.4	K	Ob.
3	**CEB008461**	Selected topics in structural mechanics. Statyka budowli - wybrane zagadnienia	2					K2_W03, K2_W04, K2_W05, K2_U06, K2_U07, K2_U09, K2_K01, K2_K03	30	60	2	2	1.2	T, Z	E		2		K	Ob.
				1					15	30	1	1	0.6	T, Z	Z		1	0.7	K	Ob.
					1				15	30	1	1	0.6	T, Z	Z		1	0.7	K	Ob.
4	**CEB007962**	Dynamics. Dynamika budowli	1					K2_W01, K2_W03, K2_W04, K2_W05, K2_U03, K2_U05, K2_U06, K2_U07, K2_U09, K2_U16, K2_K01, K2_K02	15	60	2	2	0.7	T, Z	E		2		K	Ob.
					1				15	30	1	1	0.6	T, Z	Z		1	1.0	K	Ob.
5	**CEB005362**	Computational mechanics. Metody komputerowe	1					K2_W01, K2_W02, K2_W03, K2_W04, K2_W05, K2_W09, K2_U02, K2_U06, K2_U08, K2_U09, K2_U16, K2_K01, K2_K04	15	60	2	2	0.5	T, Z	Z		2		K	Ob.
					2				30	60	2	2	1.1	T, Z	Z		2	2.0	K	Ob.
		Razem	7	2	4	2	0		225	450	15	15	8.6				15	6.1		

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					
7	2	4	2	0	225	450	15	15	8.6

Liczba punktów ECTS zajęć P
6.1

4.1.4. Lista bloków specjalnościowych

L.p.	Kod kursu / grupy kursów	Nazwa kursu / grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol kierunkowego 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]			ogólno-uczelniany[4]	zw. z dział. Nauk[5]	o char. praktycz. P[6]	rodzaj[7]	typ
1	**CEB007561**	Concrete structures - objects. Konstrukcje betonowe - obiekty	2					K2_W04, K2_W06, K2_W07, K2_W08, K2_U09, K2_U11, K2_U12, K2_K01, K2_K02, K2_K03	30	60	2	2	1.1	T, Z	E		2		S	Ob.
						2			30	60	2	2	1.1	T, Z	Z		2	2.0	S	Ob.
2	**CEB007661**	Metal structures - objects. Konstrukcje metalowe - obiekty	2					K2_W01, K2_W02, K2_W04, K2_W05, K2_W06, K2_W07, K2_W09, K2_U01, K2_U02, K2_U04, K2_U05, K2_U06, K2_U07, K2_U08, K2_U09, K2_U11, K2_U12, K2_K01, K2_K02, K_K03	30	60	2	2	1.1	T, Z	E		2		S	Ob.
						2			30	60	2	2	1.1	T, Z	Z		2	2.0	S	Ob.
3	**CEB007761**	Advanced computer aided engineering. Zaawansowane komputerowe wspomaganie projektowania			2			K2_W03, K2_W04, K2_W05, K2_W06, K2_W07, K2_W09, K2_U04, K2_U05, K2_U06, K2_U07, K2_U08, K2_U09, K2_U11, K2_U12, K2_K01, K2_K02, K2_K03	30	60	2	2	1.2	T, Z	Z		2	2.0	S	Ob.
4	**CEB007861**	Hydraulics in civil engineering. Hydraulika w budownictwie	1					K2_W01, K2_W02, K2_W06, K2_W14, K2_U01, K2_U02, K2_U03, K2_U06, K2_U17, K2_U19, K2_U20, K2_K01, K2_K02, K2_K03	15	30	1	1	0.6	T, Z	Z		1		S	Ob.
						1			15	30	1	1	0.6	T, Z	Z		1	1.0	S	Ob.

5	**CEB007961**	BIM in Civil Engineering. BIM w inżynierii lądowej			4			K2_W03, K2_W06, K2_W14, K2_W15, K2_W06, K2_W03, K2_W06, K2_W10, K2_U04, K2_U01, K2_U12, K2_U17, K2_U04, K2_U01, K2_K03, K2_K04	60	120	4	4	3.3	T, Z	E		4	4	S	Ob.
6	**CEB008662**	Construction techniques and processes. Technologia robót budowlanych	1					K2_W10, K2_W11, K2_W13, K2_W14, K2_U01, K2_U13, K2_U14, K2_U16, K2_K01, K2_K02, K2_K04	15	30	1	1	0.7	T, Z	E		1		S	Ob.
						2			30	60	2	2	1.1	T, Z	Z		2	2.0	S	Ob.
7	**CEB004462**	Apartment building. Budownictwo mieszkaniowe	2					K2_W04, K2_W06, K2_W07, K2_W14, K2_U02, K2_U04, K2_U05, K2_U06, K2_U11, K2_K01, K2_K03, K2_K05, K2_K06	30	60	2	2	1.1	T, Z	Z		2		S	Ob.
						1			15	30	1	1	0.6	T, Z	Z		1	1.0	S	Ob.
8	**CEB003962**	Underground structures - urban infrastructure. Budownictwo podziemne - infrastruktura miejska	2					K2_W05, K2_W06, K2_W11, K2_W13, K2_U04, K2_U05, K2_U06, K2_U07, K2_U09, K2_U12, K2_K01, K2_K03	30	60	2	2	1.2	T, Z	E		2		S	Ob.
						2			30	60	2	2	1.2	T, Z	Z		2	2.0	S	Ob.
9	**CEB004062**	Railways. Koleje	2					K2_W06, K2_W07, K2_U04, K2_U05, K2_U12, K2_K01, K2_K03, K2_K06	30	30	1	1	1.1	T, Z	Z		1		S	Ob.
						2			30	60	2	2	1.1	T, Z	Z		2	1.7	S	Ob.

10	**CEB004162**	Roads, streets and airports. Drogi, ulice i lotniska	2					K2_W01, K2_W06, K2_W09, K2_U01, K2_U08, K2_U12, K2_U16, K2_K01, K2_K02, K2_K03	30	60	2	2	1.3	T, Z	Z		2		S	Ob.
						2			30	60	2	2	1.3	T, Z	Z		2	2.0	S	Ob.
11	**CEB008062**	Bridges. Mosty	2					K2_W03, K2_W04, K2_W05, K2_W06, K2_W07, K2_W10, K2_U02, K2_U04, K2_U05, K2_U07, K2_U08, K2_U11, K2_U12, K2_K01, K2_K02, K2_K03	30	60	2	2	1.3	T, Z	E		2		S	Ob.
						2			30	60	2	2	1.3	T, Z	Z		2	2.0	S	Ob.
12	**CEB009863**	Master thesis seminar. Seminarium dyplomowe					2	K2_W15, K2_U01, K2_U02, K2_U15, K2_U16, K2_U17, K2_K01, K2_K02, K2_K03, K2_K06	30	90	3	3	1.3	T, Z	Z		3	2.7	S	Ob.
13	**CEB099963**	Master thesis (MSc). Praca dyplomowa magisterska						K2_W02-K2_W05, K2_W07, K2_W09, K2_U01, K2_U06-K2_U09, K2_U15, K2_U16, K2_U17, K2_K01, K2_K02, K2_K04		540	18	18	7	T, Z	Z		18	18.0	S	Ob.
		Razem	16	0	6	16	2		600	1740	58	58	31.7				58	42.4		

4.2. Lista bloków wybieralnych
4.2.1. Lista bloków z zakresu KSztałcenia ogólnego
4.2.1.1. Blok Przedmioty humanistyczno-menedżerskie (min. 2 ECTS)

L.p.	Kod kursu / grupy kursów	Nazwa kursu / grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol kierunkowego 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]			ogólno-uczelniany[4]	zw. z dział. Nauk[5]	o char. praktycz. p[6]	rodzaj[7]	typ
1		**Lista z bloku A**					1		15	60	2	0	0.6	T, Z	Z	O	0	1.5	KO	W
	FLH020361	Ethics in engineering. Etyka inżynierska						K2_W13, K2_W14, K2_W15, K2_U01, K2_K01, K2_K02, K2_K04, K2_K06												
	FLH020461	Ethics in business. Etyka w biznesie																		
		Razem	0	0	0	0	1		15	60	2	0	0.6				0	1.5		

4.2.1.2. Blok Języki obce (min. 3 ECTS)

L.p.	Kod kursu / grupy kursów	Nazwa kursu / grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol kierunkowego 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]			ogólno-uczelniany[4]	zw. z dział. Nauk[5]	o char. praktycz. p[6]	rodzaj[7]	typ
1		**Lista z bloku B**		1					15	30	1	0	0.5	T, Z	Z	O	0	1.0	KO	W
	JZL100709BK	Foreign language I Język obcy I						K2_U01, K2_U02, K2_K01, K2_K06												
2		**List from optional block C**		3					45	60	2	0	1.5	T, Z	Z	O	0	2.0	KO	W
	JZL100710BK	Foreign language II Język obcy II						K2_U01, K2_U02, K2_K01, K2_K06												
		Razem	0	4	0	0	0		60	90	3	0	2.0				0	3.0		

4.2.1.3. Blok Zajęcia sportowe
4.2.1.4. Blok Technologie informacyjne

Łącznie dla wybieralnych 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]	Liczba punktów ECTS zajęć P
w	ć	l	p	s						
0	4	0	0	1	75	150	5	0	2.6	4.5

Łącznie 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]	Liczba punktów ECTS zajęć P
w	ć	l	p	s						
1	5	0	0	1	105	240	8	0	3.8	6.0

4.2.2. Lista bloków z zakresu nauk podstawowych
4.2.2.1. Blok Matematyka
4.2.2.2. Blok Fizyka
4.2.2.3. Blok Chemia

Razem dla bloków z zakresu nauk podstawowych:

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 DN[5]	Liczba punktów ECTS zajęć BU[1]	Liczba punktów ECTS zajęć P
0	0	0	0	0	0	0	0	0	0.0	0.0

Łącznie dla bloków z zakresu nauk podstawowych:

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 DN[5]	Liczba punktów ECTS zajęć BU[1]	Liczba punktów ECTS zajęć P
2	1	0	0	0	45	90	3	2	1.7	0.6

4.1.3. Lista bloków kierunkowych
4.2.3.1. Wybieralne bloki kierunkowe

L.p.	Kod kursu / grupy kursów	Nazwa kursu / grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin w	ć	l	p	s	Symbol kierunkowego 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 ogólno-uczelniany[4]	zw. z dział. Nauk[5]	o char. praktycz. P[6]	rodzaj[7]	typ
		Razem	0	0	0	0	0		0	0	0	0	0.0					0.0		

Razem dla bloków kierunkowych

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 DN[5]	Liczba punktów ECTS zajęć BU[1]	Liczba punktów ECTS zajęć P
0	0	0	0	0	0	0	0	0	0.0	0.0

4.1.4. Lista bloków specjalnościowych

Specjalność: Civil Engineering

L.p.	Kod kursu / grupy kursów	Nazwa kursu / grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol kierunkowego 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]			ogólno-uczelniany[4]	zw. z dział. Nauk[5]	o char. praktycz. p[6]	rodzaj[7]	typ
1		**Lista z bloku 1**	1						15	30	1	1	0.6	T, Z	Z		1		S	W
					1				15	60	2	2	0.6	T, Z	Z		2	2.0	S	W
	CEB006063	Artificial intelligence in civil engineering. Sztuczna inteligencja w budownictwie						K2_W11, K2_W12, K2_U16, K2_U17, K2_K01, K2_K03												
	CEB006163	Modern testing methods for non-destructive inspection of building structures. Nowoczesne metody badań nieniszczących konstrukcji budowlanych						K2_W06, K2_W10, K2_U04, K2_U15, K2_U16, K2_U17, K2_K01, K2_K03, K2_K05, K2_K06												
	CEB007063	Advanced building physics. Zaawansowana fizyka budowli						K2_W06, K2_W13, K2_U01, K2_U04, K2_U08, K2_K01, K2_K02, K2_K03												
	CEB006363	Hydrology for building engineers. Hydrologia dla inżynierów budowlanych						K2_W01, K2_W02, K2_W03, K2_W09, K2_CEB_W22, K2_U07, K2_U08, K2_CEB_U23, K2_K01, K2_K02, K2_K03, K2_K04, K2_K05, K2_K06												
	CEB006863	Effective properties of composites - introduction to micro-mechanics. Właściwości efektywne kompozytów - wprowadzenie do mikromodelowania						K2_W02, K2_W05, K2_U16, K2_K01, K2_K03												

2		**Lista z bloku 2**	1						15	30	1	1	0.6	T, Z	Z		1		S	W
						1			15	60	2	2	0.6	T, Z	Z		2	2.0	S	W
	CEB006563	Pre-stressed concrete structures. Betonowe konstrukcje sprężone						K2_W06, K2_W07, K2_W09, K2_W10, K2_U01, K2_U04, K2_U05, K2_U11, K2_U12, K2_U17, K2_K01, K2_K03												
	CEB006663	Timber structures. Konstrukcje drewniane						K2_W05, K2_W06, K2_W10, K2_U04, K2_U05, K2_U07, K2_U12, K2_K01, K2_K02												
	CEB006763	Conservation and strengthening of monumental heritage structures. Konserwacja i wzmacnianie konstrukcji zabytkowych						K2_W02, K2_W06, K2_W09, K2_W10, K2_U04, K2_U05, K2_U12, K2_K01, K2_K02, K2_K06												
	CEB006963	Methods of applied statistics (geo-statistics). Metody statystyki stosowanej (geostatystyka)						K2_W01, K2_W09, K2_U01, K2_U03, K2_U08, K2_U16, K2_U17, K2_K01, K2_K02, K2_K03, K2_K06												
	CEB008263	Sustainable housing. Budownictwo zrównoważone						K2_W06, K2_W13, K2_U01, K2_U04, K2_U08, K2_K01, K2_K02, K2_K03												
		Razem	2	0	1	1	0		60	180	6	6	2.4				6	4.0		

4.3. Blok praktyk

Nazwa praktyki	Praktyka kierunkowa. Industrial internship		
Liczba punktów ECTS	Liczba punktów ECTS zajęć BU[1]	Tryb zaliczenia praktyki	Kod
		W programie studiów II stopnia nie ma obowiązkowej praktyki zawodowej.	
Czas trwania praktyki	Cel praktyki		
-	-		

4.4. Blok praca dyplomowa

KSIĘGA PROCEDUR na Wydziale Budownictwa Lądowego i Wodnego Politechniki Wrocławskiej. Procedura dyplomowania Pr 8/4 zatwierdzona przez Dziekana Wydziału BLiW PWr w dniu 22.09.2020

Typ pracy dyplomowej	magisterska	
Liczba semestrów pracy dyplomowej	Liczba punktów ECTS	Kod
1	18	CEB099963
Charakter pracy dyplomowej		
Praca dyplomowa magisterska realizowana na studiach II stopnia może być studialna, studialno-projektowa lub eksperymentalno-projektowa. Powinna ona wykazać umiejętności dyplomanta nabyte w czasie studiów, jej zakres nie powinien wykraczać poza zagadnienia zawarte w programach poszczególnych przedmiotów, zarówno kierunkowych, jak i specjalnościowych z uwzględnieniem zagadnień zawartych w efektach kształcenia dla studiów I stopnia.		
Liczba punktów ECTS BU[1]	7	
Liczba punktów ECTS DN[5]	18	

5. Sposób weryfikacji zakładanych efektów kształcenia

Typ zajęć	Sposoby weryfikacji zakładanych efektów kształcenia
wykład	np. egzamin, kolokwium
ćwiczenia	np. test, kolokwium, prezentacja
laboratorium	np. wejściówka, sprawozdanie z laboratorium, prezentacja
projekt	np. obrona projektu
seminarium	np. udział w dyskusji, prezentacja tematu, esej
praktyka	np. raport z praktyki
praca dyplomowa	przygotowana praca dyplomowa, obrona, egzamin dyplomowy

6. Zakres egzaminu dyplomowego

Ogólne zasady organizowania i przebiegu egzaminu dyplomowego określa §25 Regulaminu studiów wyższych w Politechnice Wrocławskiej. Szczegółowe zasady dotyczące organizacji, przebiegu oraz zakresu egzaminu dyplomowego na kierunku budownictwo określa wydziałowa procedura dyplomowania zamieszczona na stronie wydziałowej.

Egzamin składa się z dwóch części:
a) przedstawienie tematyki pracy dyplomowej, metod jej realizacji i uzyskanych wyników oraz obrona pracy dyplomowej poprzez udzielenie przez studenta odpowiedzi (ustnej lub rysunkowej) na ustne pytania członków Komisji Egzaminów Dyplomowych zadawane w trakcie lub bezpośrednio po prezentacji pracy, a dotyczące wyłącznie treści pracy oraz zastosowanej metodyki;
b) egzamin ustny z zakresu przedmiotów kierunkowych i specjalnościowych, dotyczący sprawdzenia wiedzy studenta w zakresie podanym w programie nauczania danej specjalności studiów drugiego stopnia. Studentowi podczas egzaminu zadawane są co najmniej trzy pytania, z których dwa dotyczą przedmiotów kierunkowych, a co najmniej jedno z przedmiotów specjalizujących.

Zakres pytań egzaminacyjnych dotyczy wiedzy i umiejętności studenta z zakresu wszystkich przedmiotów objętych programem nauczania danej specjalności. W szczególności pytania egzaminacyjne mogą się odnosić do poszczególnych punktów treści programowych zamieszczonych na kartach przedmiotów danego programu nauczania. Program nauczania oraz zestaw kart przedmiotów są zamieszczone na stronie internetowej Wydziału. Pytania egzaminacyjne są formułowane przez członków komisji wskazanych przez przewodniczącego Komisji egzaminu dyplomowego. Egzamin nie może obejmować pytań z zagadnień, które nie znajdowały się w programie studiów kończonych przez egzaminowanego studenta.

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

Zgodnie z regulaminem studiów wyższych w Politechnice Wrocławskiej.

8. Plan studiów (załącznik nr 3)

Zaopiniowane przez właściwy organ uchwałodawczy Samorządu Studenckiego:

....	....
Data	Imię, nazwisko i podpis przedstawiciela studentów
....	....
Data	Podpis Dziekana Wydziału / Dyrektora Filii

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

PLAN STUDIÓW

WYDZIAŁ: Budownictwa Lądowego i Wodnego, Wydział Mechaniczny

KIERUNEK: budownictwo

POZIOM KSZTAŁCENIA: II stopień, studia magisterskie

FORMA STUDIÓW: stacjonarna

PROFIL: ogólnoakademicki

SPECJALNOŚĆ: Civil Engineering

JĘZYK STUDIÓW: angielski

OBOWIĄZUJE OD CYKLU KSZTAŁCENIA: 2022/2023

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

Oznaczenia:

[1]BU – liczba punktów ECTS przypisanych zajęciom wymagającym 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, s, p)
[4]Kurs/ grupa kursów Ogólnouczelniany – O
[5]Kurs/ grupa kursów związany/-a z prowadzoną dział. 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

W – wybieralny, Ob – obowiązkowy
CNPS - calkowity nakład pracy studenta; ZZU - zajęcia zorganizowane; 1 ECTS = 30 h NPS
Uwaga: efekty z kodem U są uzyskiwane wyłącznie na zajęciach o charakterze praktycznym.

Bloki dla specjalności: Civil Engineering CEB
Specialization: Civil Engineering (language of studies: English)

Semestr 1
Kursy obowiązkowe **liczba punktów ECTS 28**

L.p.		Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol kierunkowego 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]			ogólno-uczelniany[4]	zw. z dział. Nauk[5]	o char. praktycz. P[6]	rodzaj[7]	typ
1	**FZP007163**	Physics of modern materiale. Fizyka nowoczesnych materiałów	1					K2_W01, K2_W02, K2_W04, K2_U03, K2_U08, K2_K01, K2_K02, K2_K06	15	30	1	1	0.5	T, Z	Z	O	1		PD	Ob.
2	**CEB008061**	Selected topics in mathematics. Matematyka - wybrane zagadnienia	1					K2_W01, K2_U08, K2_K01, K2_K02, K2_K03, K2_K06	15	30	1	1	0.6	T, Z	E		1		PD	Ob.
				1					15	30	1	1	0.6	T, Z	Z		1	0.6	PD	Ob.
3	**CEB007361**	Selected topics in geo-engineering - foundation. Fundamentowanie - wybrane zagadnienia	1					K2_W01, K2_W06, K2_W08, K2_U04, K2_U05, K2_U09, K2_U10, K2_U16, K2_U17, K2_K03, K2_K06	15	30	1	1	0.5	T, Z	Z		1		K	Ob.
						2			30	30	1	1	1.1	T, Z	Z		1	1.3	K	Ob.
4	**CEB008361**	Theory of elasticity and plasticity. Teoria sprężystości i plastyczności	2					K2_W01, K2_W02, K2_W04, K2_U02, K2_U04, K2_U08, K2_K01	30	30	1	1	1.1	T, Z	Z		1		K	Ob.
				1					15	30	1	1	0.6	T, Z	Z		1	0.4	K	Ob.
5	**CEB008461**	Selected topics in structural mechanics. Statyka budowli - wybrane zagadnienia	2					K2_W03, K2_W04, K2_W05, K2_U06, K2_U07, K2_U09, K2_K01, K2_K03	30	60	2	2	1.2	T, Z	E		2		K	Ob.

				1					15	30	1	1	0.6	T, Z	Z		1	0.7	K	Ob.
					1				15	30	1	1	0.6	T, Z	Z		1	0.7	K	Ob.
6	**CEB007561**	Concrete structures - objects. Konstrukcje betonowe - obiekty	2					K2_W04, K2_W06, K2_W07, K2_W08, K2_U09, K2_U11, K2_U12, K2_K01, K2_K02, K2_K03	30	60	2	2	1.1	T, Z	E		2		S	Ob.
						2			30	60	2	2	1.1	T, Z	Z		2	2.0	S	Ob.
7	**CEB007661**	Metal structures - objects. Konstrukcje metalowe - obiekty	2					K2_W01, K2_W02, K2_W04, K2_W05, K2_W06, K2_W07, K2_W09, K2_U01, K2_U02, K2_U04, K2_U05, K2_U06, K2_U07, K2_U08, K2_U09, K2_U11, K2_U12, K2_K01, K2_K02, K_K03	30	60	2	2	1.1	T, Z	E		2		S	Ob.
						2			30	60	2	2	1.1	T, Z	Z		2	2.0	S	Ob.
8	**CEB007761**	Advanced computer aided engineering. Zaawansowane komputerowe spomaganie projektowania			2			K2_W03, K2_W04, K2_W05, K2_W06, K2_W07, K2_W09, K2_U04, K2_U05, K2_U06, K2_U07, K2_U08, K2_U09, K2_U11, K2_U12, K2_K01, K2_K02, K2_K03	30	60	2	2	1.2	T, Z	Z		2	2.0	S	Ob.
9	**CEB007861**	Hydraulics in civil engineering. Hydraulika w budownictwie	1					K2_W01, K2_W02, K2_W06, K2_W14, K2_U01, K2_U02, K2_U03, K2_U06, K2_U17, K2_U19, K2_U20, K2_K01, K2_K02, K2_K03	15	30	1	1	0.6	T, Z	Z		1		S	Ob.
						1			15	30	1	1	0.6	T, Z	Z		1	1.0	S	Ob.
10	**CEB007961**	BIM in Civil Engineering. BIM w inżynierii lądowej			4			K2_W03, K2_W06, K2_W14, K2_W15, K2_W06, K2_W03, K2_W06, K2_W10, K2_U04, K2_U01, K2_U12, K2_U17,	60	120	4	4	3.3	T, Z	Z		4	4	S	Ob.
		Lista z bloku A																		
1	**JZL100709BK**	Foreign language I Język obcy I		1				K2_U01, K2_U02, K2_K01, K2_K06	15	30	1	0	0.5	T, Z	Z	O	0	1.0	KO	W
		Razem	12	4	7	7	0		450	840	28	27	18				27	15.7		

Kursy wybieralne **liczba punktów ECTS 2**

L.p.		Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol kierunkowego 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]			ogólno-uczelniany[4]	zw. z dział. Nauk[5]	o char. praktycz. p[6]	rodzaj[7]	typ
1		**Lista z bloku B**					1		15	60	2	0	0.6	T, Z	Z	O	0	1.5	KO	W
	FLH020361	Ethics in engineering. Etyka inżynierska						K2_W13, K2_W14, K2_W15, K2_U01, K2_K01, K2_K02, K2_K04, K2_K06												
	FLH020461	Ethics in business. Etyka w biznesie																		
		Razem	0	0	0	0	1		15	60	2	0	0.6				0	1.5		

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 DN[5]	Liczba punktów ECTS zajęć BU[1]	Liczba punktów ECTS zajęć P
12	4	7	7	1	465	900	30	27	18.6	17.2

Semester 2

Kursy obowiązkowe **liczba punktów ECTS 30**

L.p.		Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin w	ć	l	p	s	Symbol kierunkowego 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 ogólno-uczelniany[4]	zw. z dział. Nauk[5]	o char. praktycz. P[6]	rodzaj[7]	typ
1	**CEB007962**	Dynamics. Dynamika budowli	1					K2_W01, K2_W03, K2_W04, K2_W05, K2_U03, K2_U05, K2_U06, K2_U07, K2_U09, K2_U16, K2_K01, K2_K02	15	60	2	2	0.7	T, Z	E		2		K	Ob.
					1				15	30	1	1	0.6	T, Z	Z		1	1.0	K	Ob.
2	**CEB005362**	Computational mechanics. Metody komputerowe	1					K2_W01, K2_W02, K2_W03, K2_W04, K2_W05, K2_W09, K2_U02, K2_U06, K2_U08, K2_U09, K2_U16, K2_K01, K2_K04	15	60	2	2	0.5	T, Z	Z		2		K	Ob.
					2				30	60	2	2	1.1	T, Z	Z		2	2.0	K	Ob.
3	**CEB008662**	Construction techniques and processes. Technologia robót budowlanych	1					K2_W10, K2_W11, K2_W13, K2_W14, K2_U01, K2_U13, K2_U14, K2_U16, K2_K01, K2_K02, K2_K04	15	30	1	1	0.7	T, Z	E		1		S	Ob.
						2			30	60	2	2	1.1	T, Z	Z		2	2.0	S	Ob.
4	**CEB004462**	Apartment building. Budownictwo mieszkaniowe	2					K2_W04, K2_W06, K2_W07, K2_W14, K2_U02, K2_U04, K2_U05, K2_U06, K2_U11, K2_K01, K2_K03, K2_K05, K2_K06	30	60	2	2	1.1	T, Z	Z		2		S	Ob.
						1			15	30	1	1	0.6	T, Z	Z		1	1.0	S	Ob.
5	**CEB003962**	Underground structures - urban infrastructure. Budownictwo podziemne - infrastruktura miejska	2					K2_W05, K2_W06, K2_W11, K2_W13, K2_U04, K2_U05, K2_U06, K2_U07, K2_U09, K2_U12, K2_K01, K2_K03	30	60	2	2	1.2	T, Z	E		2		S	Ob.
						2			30	60	2	2	1.2	T, Z	Z		2	2.0	S	Ob.

6	**CEB004062**	Railways. Koleje	2					K2_W06, K2_W07, K2_U04, K2_U05, K2_U12, K2_K01, K2_K03, K2_K06	30	30	1	1	1.1	T, Z	Z		1		S	Ob.
						2			30	60	2	2	1.1	T, Z	Z		2	1.7	S	Ob.
7	**CEB004162**	Roads, streets and airports. Drogi, ulice i lotniska	2					K2_W01, K2_W06, K2_W09, K2_U01, K2_U08, K2_U12, K2_U16, K2_K01, K2_K02, K2_K03	30	60	2	2	1.3	T, Z	Z		2		S	Ob.
						2			30	60	2	2	1.3	T, Z	Z		2	2.0	S	Ob.
8	**CEB008062**	Bridges. Mosty	2					K2_W03, K2_W04, K2_W05, K2_W06, K2_W07, K2_W10, K2_U02, K2_U04, K2_U05, K2_U07, K2_U08, K2_U11, K2_U12, K2_K01, K2_K02, K2_K03	30	60	2	2	1.3	T, Z	E		2		S	Ob.
						2			30	60	2	2	1.3	T, Z	Z		2	2.0	S	Ob.
		Lista z bloku C																		
9	**JZL100710BK**	Foreign language II Język obcy II		3				K2_U01, K2_U02, K2_K01, K2_K06	45	60	2	0	1.5	T, Z	Z	O	0	2.0	KO	W
		Razem	13	3	3	11	0		450	900	30	28	17.7				28	15.7		

Razem w semestrze:

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]	Liczba punktów ECTS zajęć P
w	ć	l	p	s						
13	3	3	11	0	450	900	30	28	17.7	15.7

Razem narastająco:

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]	Liczba punktów ECTS zajęć P
w	ć	l	p	s						
25	7	10	18	1	915	1800	60	55	36.3	32.9

Semester 3

Kursy obowiązkowe **liczba punktów ECTS 24**

L.p.		Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol kierunkowego 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]			ogólno-uczelniany[4]	zw. z dział. Nauk[5]	o char. praktycz. P[6]	rodzaj[7]	typ
1	**CEB008563**	Construction project management. Zarządzanie przedsięwzięciami budowlanymi	1					K2_W11, K2_W12, K2_W13, K2_W14, K2_W15, K2_U01, K2_U08, K2_U13, K2_U14, K2_K01, K2_K02, K2_K05	15	30	1	0	0.6	T, Z	Z		0		KO	Ob.
				1					15	60	2	0	0.6	T, Z	Z		0	1.5	KO	Ob.
2	**CEB009863**	Master thesis seminar. Seminarium dyplomowe					2	K2_W15, K2_U01, K2_U02, K2_U15, K2_U16, K2_U17, K2_K01, K2_K02, K2_K03, K2_K06	30	90	3	3	1.3	T, Z	Z		3	2.7	S	Ob.
3	**CEB099963**	Master thesis (MSc). Praca dyplomowa magisterska						K2_W02-K2_W05, K2_W07, K2_W09, K2_U01, K2_U06-K2_U09, K2_U15, K2_U16, K2_U17, K2_K01, K2_K02, K2_K04		540	18	18	7	T, Z	Z		18	18.0	S	Ob.
		Razem	1	1	0	0	2		60	720	24	21	9.5				21	22.2		

Kursy wybieralne **liczba punktów ECTS 6**

L.p.		Nazwa kursu/grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol kierunkowego 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]			ogólno-uczelniany[4]	zw. z dział. Nauk[5]	o char. praktycz. P[6]	rodzaj[7]	typ
1		**Lista z bloku 1**	1						15	30	1	1	0.6	T, Z	Z		1		S	W
					1				15	60	2	2	0.6	T, Z	Z		2	2.0	S	W
	CEB006063	Artificial intelligence in civil engineering. Sztuczna inteligencja w budownictwie						K2_W11, K2_W12, K2_U16, K2_U17, K2_K01, K2_K03												
	CEB006163	Modern testing methods for non- destructive inspection of building structures. Nowoczesne metody badań nieniszczących konstrukcji budowlanych						K2_W06, K2_W10, K2_U04, K2_U15, K2_U16, K2_U17, K2_K01, K2_K03, K2_K05, K2_K06												

	CEB007063	Adavnaced building physics. Zaawansowana fizyka budowli						K2_W06, K2_W13, K2_U01, K2_U04, K2_U08, K2_K01, K2_K02, K2_K03												
	CEB006363	Hydrology for building engineers. Hydrologia dla inżynierów budowlanych						K2_W01, K2_W02, K2_W03, K2_W09, K2_CEB_W22, K2_U07, K2_U08, K2_CEB_U23, K2_K01, K2_K02, K2_K03, K2_K04, K2_K05, K2_K06												
	CEB006863	Effective properties of composites - introduction to micro-mechanics. Właściwości efektywne kompozytów - wprowadzenie do mikromodelowania						K2_W02, K2_W05, K2_U16, K2_K01, K2_K03												
2		**List from optional block 2**	1						15	30	1	1	0.6	T, Z	Z		1		S	W
						1			15	60	2	2	0.6	T, Z	Z		2	2.0	S	W
	CEB006563	Pre-stressed concrete structures. Betonowe konstrukcje sprężone						K2_W06, K2_W07, K2_W09, K2_W10, K2_U01, K2_U04, K2_U05, K2_U11, K2_U12, K2_U17, K2_K01, K2_K03												
	CEB006663	Timber structures. Konstrukcje drewniane						K2_W05, K2_W06, K2_W10, K2_U04, K2_U05, K2_U07, K2_U12, K2_K01, K2_K02												
	CEB006763	Conservation and strengthening of monumental heritage structures. Konserwacja i wzmacnianie konstrukcji zabytkowych						K2_W02, K2_W06, K2_W09, K2_W10, K2_U04, K2_U05, K2_U12, K2_K01, K2_K02, K2_K06												
	CEB006963	Methods of applied statistics (geo-statistics). Metody statystyki stosowanej (geostatystyka)						K2_W01, K2_W09, K2_U01, K2_U03, K2_U08, K2_U16, K2_U17, K2_K01, K2_K02, K2_K03, K2_K06												
	CEB008263	Sustainable housing. Budownictwo zrównoważone						K2_W06, K2_W13, K2_U01, K2_U04, K2_U08, K2_K01, K2_K02, K2_K03												
		Razem	2	0	1	1	0		60	180	6	6	2.4				6	4.0		

Razem w semestrze:

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]	Liczba punktów ECTS zajęć P
w	ć	l	p	s						
3	1	1	1	2	120	900	30	27	11.9	26.2

Razem narastająco:

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]	Liczba punktów ECTS zajęć P
w	ć	l	p	s						
28	8	11	19	3	1035	2700	90	82	48.2	59.1

Razem godzin ZZU: **1035**
Godziny - wykłady: **40.6%**
Godziny - pozostałe zajęcia: **59.4%**
ECTS - BU: **53.6%**
ECTS - P: **65.7%**

2. Zestaw egzaminów w układzie semestralnym

Lp.	Kod kursu	Nazwa kursów kończących się egzaminem	Semestr
		Civil Engineering	
1	**CEB008061**	Selected topics in mathematics. Matematyka - wybrane zagadnienia	1
2	**CEB008461**	Selected topics in structural mechanics. Statyka budowli - wybrane zagadnienia	1
3	**CEB007561**	Concrete structures - objects. Konstrukcje betonowe - obiekty	1
4	**CEB007661**	Metal structures - objects. Konstrukcje metalowe - obiekty	1
5	**CEB007962**	Dynamics. Dynamika budowli	2
6	**CEB008662**	Construction techniques and processes. Technologia robót budowlanych	2
7	**CEB003962**	Underground structures - urban infrastructure. Budownictwo podziemne - infrastruktura miejska	2
8	**CEB008062**	Bridges. Mosty	2

3. Liczby dopuszczalnnego deficytu punktów ECTS po poszczególnych semestrach

Semestr	Dopuszczalny deficyt punktów ECTS po semestrze	Wymagana suma punktów do wpisu na kolejny semestr
1	15	15
2	13	47

Opinia właściwego organu Samorządu Studenckiego

Data Imię, nazwisko i podpis przedstawiciela studentów

Data Podpis Dziekana Wydziału / Dyrektora Filii

KATALOG KURSÓW

KARTY PRZEDMIOTÓW

PROGRAM KSZTAŁCENIA

WYDZIAŁ: Budownictwa Lądowego i Wodnego

KIERUNEK: budownictwo

z obszaru nauk technicznych

POZIOM KSZTAŁCENIA: ~~I /~~ II * stopień, studia ~~licencjackie /~~ ~~inżynierskie /~~ magisterskie*

FORMA STUDIÓW: stacjonarna ~~/ niestacjonarna~~*

PROFIL: ogólnoakademicki ~~/ praktyczny~~ *

SPECJALNOŚĆ*: Civil Engineering

JĘZYK STUDIÓW: angielski

Załącznik nr 6 do ZW 121/2020

WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO	
KARTA PRZEDMIOTU	
Nazwa w języku angielskim:	**Physics of modern materials**
Nazwa w języku polskim:	**Fizyka nowoczesnych materiałów**
Kierunek studiów (jeśli dotyczy):	*budownictwo*
Specjalność (jeśli dotyczy):	**Civil Engineering**
Stopień studiów i forma:	**~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu:	**obowiązkowy / wybieralny / ogólnouczelniany***
Kod przedmiotu:	**FZP007163**
Grupa kursów:	**~~TAK~~ / NIE***

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	**15**				
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	**30**				
Forma zaliczenia	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
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)	**0,5**				

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI
Competences at mathematical analysis and general physics confirmed by the completed 1st degree studies of technical major.

CELE PRZEDMIOTU	
C1	To posses the fundamental knowledge on physical effects determining the properties of modern materials and the knowledge necessary for proper understanding of the physical process in the nano-scale, and the applications of the modern materials.
C2	To posses fundamental skills of theoretical predictions, design and modelling of the physical properties of modern materials and nanomaterials.
C3	To posses and consolidate the competences allowing for the independent judgment on the influence of the discussed material technologies to the economy, social life and

ecology.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ	
Z zakresu wiedzy:	
PEU_W01	Possesses fundamental knowledge in quantum physics and physics of advanced materials and nanomaterials necessary to understand the physical processes determining the new properties of these systems.
Z zakresu umiejętności:	
PEU_U01	Can solve simple calculational tasks in quantum physics and physics of advanced materials and nanomaterials.
PEU_U02	Can apply practically and technically the acquired knowledge on the modern materials.
PEU_U03	Is able to extend the knowledge on the modern materials using the information available in nowadays scientific publications.
Z zakresu kompetencji społecznych:	
PEU_K01	Understands the social, informative and technical meaning of the learned processes regarding the modern materials
PEU_K02	Is aware of the wide interconnection between different branches of the modern material technologies and their relation to the currently conducted fundamental studies, and to respective physical sciences

TREŚCI PROGRAMOWE		
	Forma zajęć - wykład	**Liczba godzin**
Wy1	Modern materials – review, history, nano-scale, current challenges and application-related demands	1
Wy2	Elements of condensed matter theory and and its relationship to electrical conductivity and optical properties; basic concepts; band gap; electrical conductivity; doping; absorption and emission of light; band gap engineering; semiconductor multicomponent alloys; manufacturing techniques and types of nanomaterials.	2
Wy3	Techniques for testing the structural characteristics and morphology of materials at the nano scale (electron microscopy, scanning electron microscopy, X-ray diffraction, mass spectrometry, etc.).	2
Wy4	Artificially fabricated periodic structures; atomic crystals and photonics crystals; spatial limitation for light; photonic crystals and manufacturing techniques; sample applications of nanostructures and advanced materials (lasers, alternative sources of energy, optical sensors, fiber optic sensors, etc.)	2
Wy5	Heat transport phenomena in volume stable solids, multi-layered and quasi-cristals; heat transfer by radiation and convection; thermal radiation and its use; methods of measurement of thermal conductivity and temperature.	2
Wy6	Carbon nanomaterials – fabrication, physical properties and applications: a. carbon nanotubes; b. graphen – two-dimensional carbon crystal; c. two-dimensional crystals of other materials; d. other carbon-based structures.	2
Wy7	Nanometals and nanofibres:	2

	a. Fabrication technologies; b. Physical properties; c. Application.	
Wy8	Other modern materials: a. dielectrics of high and low dielectric permittivity; b. superconductors; c. composites; d. concretes modified. Crediting colloquy	2
	Suma godzin	**15**

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Informative lecture and multimedia presentation. N2. Consultations. N3. Independent student work and self-preparation to the course completion.

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
P (lecture)	PEU_W01, PEU_U01, PEU_U02, PEU_U03	Colloquy

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] Fundamentals of physics part 5, D. Halliday, R. Rescnick, J. Walker
[2] Low-dimensional semiconductor structures: Fundamentals and device applications, K. Bernham, D. Vvedensky

LITERATURA UZUPEŁNIAJĄCA:

[1] B. Bhushan (Ed.), Springer Handbook on Nanotechnology.
[2] M. F. Ashby, P. J. Ferreira, D. L. Schodek, Nanomaterials, Nanotechnologies and Design.
[3] R. Cotterill, The material world.
[4] D. Vollath, Nanoparticles – Nanocomposites – Nanomaterials. An Introduction for Beginners.
[5] Y. Gogotsi, V. Presser, Carbon Nanomaterials.
[6] Theodore L. Bergman, Frank P. Incropera, Adrienne S. Lavine, Fundamentals of Heat and Mass Transfer, John Wiley&Sons
[7] K. Saraswat, Lectures on Low-k dielectrics, Stanford University: http://web.stanford.edu/class/ee311/NOTES/Interconnect%20Lowk.pdf
[8] K. Kurzydłowski, M. Lewandowska, "Nanomateriały inżynierskie. Konstrukcyjne i funkcjonalne.

OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ZAKŁAD, INSTYTUT, ADRES E-MAIL)

Grzegorz Sek, grzegorz.sek@pwr.edu.pl, (Wojciech Rudno-Rudziński, wojciech.rudno-rudzinski@pwr.edu.pl)

Załącznik nr 6 do ZW 121/2020

STUDIUM NAUK HUMANISTYCZNYCH I SPOŁECZNYCH
KARTA PRZEDMIOTU
Nazwa w języku polskim: **Etyka w biznesie**
Kierunek studiów (jeśli dotyczy): ***budownictwo***
Specjalność (jeśli dotyczy): **Civil Engineering**
Stopień studiów i forma: **~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu: **~~obowiązkowy~~ ~~/~~ wybieralny ~~/~~ ~~ogólnouczelniany~~***
Kod przedmiotu: **FLH020461**
Grupa kursów: **~~TAK~~ / NIE***

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)					**15**
Liczba godzin całkowitego nakładu pracy studenta (CNPS)					**60**
Forma zaliczenia	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS					**2**
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					**1,5**
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)					**0,6**

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Text interpretation ability
2. Basic abilities in performing analysis and synthesis

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CELE PRZEDMIOTU

C1. Analysis of the significance and role of ethics in modern business
C2. Resolve problems relating to social responsibility to the surroundings
C3. The appearance and analysis of the situation in which ethical problems may arise
C4. Sensitize students to the ethical problems

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ	
Z zakresu wiedzy:	
PEU_HUM_W08	Student has knowledge necessary to understand economic, legal, social and beyond technical factors of engineering activities and their using in engineering practice
Z zakresu umiejętności:	
PEU_HUM_U01	Student is able to obtain information from the literature, databases and other carefully selected sources, also in English or another foreign language recognized as the language of international communication in the area studied direction; can integrate the information obtained, to make its interpretation, as well as to draw conclusions and formulate reasoned opinions.
Z zakresu kompetencji:	
PEU_HUM_K05	Student properly recognizes and settles dilemmas connected with professional activity.

Forma zajęć - seminarium		Liczba godzin
Se1	Introduction to business ethics	1
Se2	Ethics in economic activity	1
Se3	Protection of intellectual property versus ethics	1
Se4	Economic crises as a source of change in moral values	2
Se5	Ethical trade	1
Se6	Corporate Social Responsibility	2
Se7	Ecoethic	2
Se8	Ethics in Marketing	2
Se9	Areas of of modern ethical finance	1
Se10	Manipulation, corruption, lies and abuses in business	2
	Suma godzin	15

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1: Wykład informacyjny
N2: Wykład interaktywny
N3: Prezentacja multimedialna
N4: Dyskusja

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_HUM_W08 PEU_HUM_U01	Prezentacja, aktywność na zajęciach
F2	PEU_HUM_W08 PEU_HUM_K05	Prezentacja, aktywność na zajęciach
F3		

P=F1+F2

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
<u>LITERATURA PODSTAWOWA:</u> [1] B. Klimczak, Etyka gospodarcza, Wrocław 1996. [2] P. M. Minus, Etyka w biznesie, Warszawa 1995. [3] E. Sternberg, Czysty biznes. Etyka biznesu w działaniu, Warszawa 1998. **<u>LITERATURA UZUPEŁNIAJĄCA:</u>** [1] G. D. Chrissides, J. H. Kaler, Wprowadzenie do etyki biznesu, Warszawa 1999. [2] A. Chaufen, Kradzież a rozwój gospodarczy, Warszawa 2006. [3] C. Porębski, Czy etyka się opłaca, Kraków 1997. [4] Podstawy marketingu, pod red. J. Altkorna, Kraków 2004. [5] M. Bąk, P. Kulawczuk, A. Szcześniak, Strategia polskiego biznesu wobec korupcji, Warszawa 2001. [6] R. Morawski, Etyczne aspekty działalności badawczej w naukach empirycznych, Warszawa 2011.
OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ADRES E-MAIL)
Dr hab. Adriana Merta-Staszczak, prof. uczelni adriana.merta-staszczak@pwr.edu.pl; Studium Nauk Humanistycznych i Społecznych PWr

WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO

KARTA PRZEDMIOTU

Nazwa w języku angielskim: **Engineering Ethics**
Nazwa w języku polskim: **Etyka inżynierska**
Kierunek studiów (jeśli dotyczy): ***budownictwo***
Specjalność (jeśli dotyczy): **Civil Engineering**
Stopień studiów i forma: **~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu: **~~obowiązkowy~~ / wybieralny / ogólnouczelniany***
Kod przedmiotu: **FLH020361**
Grupa kursów: **~~TAK~~ / NIE***

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)					**15**
Liczba godzin całkowitego nakładu pracy studenta (CNPS)					**60**
Forma zaliczenia	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	~~Egzamin~~ / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS					**2**
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					**1,5**
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)					**0,6**

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI

Basic knowledge from the field of humanities and social sciences.

CELE PRZEDMIOTU

C1. Obtaining knowledge on general and professional ethics.
C2. Learning how to identify and analyze moral dilemmas related to engineering professions.
C3. Introducing and analyzing the content of professional codes of ethics for engineers.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ	
Z zakresu wiedzy:	
PEU_HUM W08	Students obtain knowledge on recognized standards of professional ethics and basic knowledge on the concept of intellectual property.
Z zakresu umiejętności:	
PEU_HUM U01, U02	The student is capable of using essential ethical literature independently and is able to work with normative texts on professional ethics, i.e. codes of ethics. Based on the knowledge of different ethical theories, the student is able to identify ethical dilemmas in engineering practice and use them as models helpful in indentifying patterns of ethical conduct.
Z zakresu kompetencji społecznych:	
PEU_HUM K01, K02, K05	The student is aware of the importance of non-technical aspects of engineering of a chosen specialty and understands the consequences of engineering activity in terms of its environmental and social impact as well as their responsibility for making decisions; the student understands the need for constant learning; the student correctly identifies and analyzes dilemmas related to their profession.

TREŚCI PROGRAMOWE		
	Forma zajęć - seminarium	**Liczba godzin**
Se1	Introduction: morality, ethics, law.	1
Se2	Main ethical theories: criteria for justification of moral judgments; the structure of a moral dilemma.	2
Se3	The status, goals and functions of professional engineering ethics.	2
Se4	Structure and functions of professional codes of ethics for engineering professions.	2
Se5	Professional obligations and responsibilities of engineers in ethical perspective.	2
Se6	Engineers responsibility toward society.	2
Se7	Ethical dilemmas in engineering professions: case study analyses.	2
Se8	Intellectual property; copyrights. Ethical and legal dilemmas, case study analyses.	2
	Suma godzin	**15**

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1: Multimedial presentation.
N2: Report.
N3: Discussion.

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_HUM W08 PEU_HUM U01 PEU_HUM K01, K05	Presentation in a multimedial or report form.
F2	PEU_HUM U01, U02 PEU_HUM K02, K05	Prepared participation in discussion.
P=F1+F2	PEU_HUM W08 PEU_HUM U01, U02 PEU_HUM K01, K02, K05	Weighted average of evaluation F1 (2/3 of concluding mark) and evaluation F2 (1/3 of concluding mark).

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] Chyrowicz B., O sytuacjach bez wyjścia w etyce, Kraków 2008

[2] Budinger T.F., Budinger M. D., Ethics of Emerging Technologies: Scientific Facts and Moral Challenges, Hoboken, New Jersey 2006.

[3] Galewicz W. [red.], Moralność i profesjonalizm. Spór o pozycję etyk zawodowych, Kraków 2010.

[4] Harris C., Pritchard M., Rabins M., Engineering Ethics. Concepts and Cases, Wadsworth 2009.

[5] Sieńczyło-Chlabicz J [red.], Prawo własności intelektualnej, Warszawa 2009.

LITERATURA UZUPEŁNIAJĄCA:

[1] Chyrowicz B. [red.], Etyka i technika w poszukiwaniu ludzkiej doskonałości, Lublin 2004.

[2] Jonas H., Zasada odpowiedzialności. Etyka dla cywilizacji technologicznej, tłum. M. Klimowicz, Kraków 1996.

[3] Małek M. Mazurek E., Serafin K., Etyka i technika. Etyczne, społeczne i edukacyjne aspekty działalności inżynierskiej, Wrocław 2014.

[4] Ossowska M., Normy moralne. Próba systematyzacji, Warszawa 2003.

OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ZAKŁAD, INSTYTUT, ADRES E-MAIL)

Dr Monika Małek-Orłowska monika.malek@pwr.edu.pl

Załącznik nr 6 do ZW 121/2020

WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO

KARTA PRZEDMIOTU

Nazwa w języku angielskim: **Praca dyplomowa**
Nazwa w języku polskim: **Master (MSc) thesis**
Kierunek studiów (jeśli dotyczy): ***budownictwo***
Specjalność (jeśli dotyczy): **Civil Engineering**
Stopień studiów i forma: **~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu: **obowiązkowy ~~/ wybieralny /~~ ~~ogólnouczelniany~~***
Kod przedmiotu: **CEB099963**
Grupa kursów: **~~TAK~~ / NIE***

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)					
Liczba godzin całkowitego nakładu pracy studenta (CNPS)				**540**	
Forma zaliczenia	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS				**18**	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				**18,0**	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				**7,0**	

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI

1. Has an advanced theoretical knowledge and skills in accordance with the requirements of the field of study *building* of the second cycle of the program, including Civil Engineering specialty.
2. Can shape, model, analyze, and measure complex structural components of buildings.
3. Knows the applicable standards, guidelines and regulations for the design of buildings, including the extended in the range of building structures.
4. Has the ability and computational efficiency in design, including computer-aided calculation and plotting.
5. Has the ability to independently acquire, use, and analysis of scientific and technical information.

CELE PRZEDMIOTU

C1. Synthesis of knowledge of the whole the second cycle studies and practical experience, especially in the chosen diploma specialty. C2. Getting knowledge of the planning and realization of a variety, complex technical, scientific and technical research. C3. Strengthening the knowledge of the principles of programming, modeling and solving complex engineering design tasks. C4. Learning students how to select and use advanced computational tools, including computer programs. C5. Strengthening skills of development the results and drawing conclusions. C6. Strengthening the ability to use and critical analysis of scientific and technical information.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ	
Z zakresu wiedzy:	
PEU_W01	Has a well-established and extended knowledge of the issues of the construction industry, particularly in the area of diploma specialization.
PEU_W02	Has a theoretically grounded knowledge of programming, modeling and solving complex design engineering tasks.
PEU_W03	Knows the rules for the application of advanced techniques and computer programs supporting the design and research processes.
Z zakresu umiejętności:	
PEU_U01	Has detailed, developed skills in solving problems in the construction industry, in particular of the studying specialty.
PEU_U02	Has the ability to collect and critically analyze, from a variety of sources, of information in the field of construction, especially of the studying specialty.
PEU_U03	Can select the methods and tools to solve complex engineering tasks and basic research problems.
PEU_U04	Has the ability to document the work or research projects done by himself and their presentation.
PEU_U05	Is able to establish directions of further education and follow the process of self learning.
Z zakresu kompetencji społecznych:	
PEU_K01	Is able to set priorities for implementation of specified by himself or the others tasks or research projects and is responsible for his decisions.
PEU_K02	Has an internal belief in the need for the continuous self-development, including related to his profession.

TREŚCI PROGRAMOWE		
Forma zajęć - wykład		**Liczba godzin**
Wy1		
…		
	Suma godzin	

Forma zajęć - ćwiczenia		**Liczba godzin**
Ćw1		
...		
	Suma godzin	

Forma zajęć - laboratorium		**Liczba godzin**
Lab1		
…		

	Suma godzin	

Forma zajęć - projekt		**Liczba godzin**
Pr1		
…		
	Suma godzin	

Forma zajęć - seminarium		**Liczba godzin**
Se1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Studies of literature and other sources of information. N2. Preparation and execution of calculations and / or experimental and / or case study analysis. N3. Analysis of the comparisons results, summary, formulation of conclusions, editorial preparation of the thesis. N4. Participation in consultations related to the thesis, summarizing discussions.

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
P1, P2, P3, P4	PEU_W01, PEU_W02, PEU_W03, PEU_U01, PEU_U02, PEU_U03, PEU_U04, PEU_U05, PEU_K01, PEU_K02	Ocena pracy przez promotora i recenzenta. Obrona pracy magisterskiej. Egzamin dyplomowy.
P1 – ocena pracy przez promotora i recenzenta P2 – obrona pracy magisterskiej P3 – ocena egzaminu dyplomowego		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
Literature depending on specialty in which the diploma is realized. Literature related to the thesis topic chosen independently by student and under the direction of the supervisor.
OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ZAKŁAD, INSTYTUT, ADRES E-MAIL)
Thesis supervisor.
CZŁONKOWIE ZESPOŁU DYDAKTYCZNEGO (IMIĘ, NAZWISKO, ADRES E-MAIL)
Thesis reviewer

Załącznik nr 6 do ZW 121/2020

WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO

KARTA PRZEDMIOTU

Nazwa w języku angielskim: **Master (MSc) thesis seminar**
Nazwa w języku polskim: **Seminarium dyplomowe**
Kierunek studiów (jeśli dotyczy): ***budownictwo***
Specjalność (jeśli dotyczy): **Civil Engineering**
Stopień studiów i forma: **~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu: **obowiązkowy ~~/ wybieralny / ogólnouczelniany~~***
Kod przedmiotu: **CEB009863**
Grupa kursów: **~~TAK~~ / NIE***

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)					**30**
Liczba godzin całkowitego nakładu pracy studenta (CNPS)					**90**
Forma zaliczenia	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	~~Egzamin~~ / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS					**3**
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)					**2,7**
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)					**1,3**

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Has basic theoretical knowledge and skills in accordance with the requirements of the field of study *building* of the second cycle program, including specialty Civil Engineering.
2. Can shape, model, analyze, and measure components of complex buildings.
3. Knows the applicable standards, guidelines and regulations of construction, including extended for studying a specialty.
4. Has abilities and computational efficiency in the design of building structures, including the use of advanced computer-aided techniques for the calculation and plotting.

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CELE PRZEDMIOTU

C1. Synthesis of knowledge from the completed studies and practical experience.
C2. Creation of education skills to assess the suitability and usability of various tools and

sources of information to solve engineering problems.
C3. Creation of education abilities of independent development and demonstration of technical issues in the construction industry, using multimedia techniques.
C4. Acquiring ability to develop a master thesis and a critical and comprehensive look at technological solutions.
C5. Learn how to prepare basic studies of a scientific or technical knowledge.
C6. Developing skills of preparation, critical evaluation and presentation of experimental results and evaluation studies.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

Z zakresu wiedzy:

PEU_W01 Has in-depth knowledge of issues related to the construction industry, in particular relating to diploma specialization.

PEU_W02 Has knowledge of the techniques and methods of guiding and participation in public discussion on the issue of the construction industry.

Z zakresu umiejętności:

PEU_U01 Has specific skills for solving problems in the construction industry, particularly in specialty Civil Engineering.

PEU_U02 Has the ability to collect and critically analyze, from a variety of sources, of information about the construction industry, in particular, of the realized diploma specialization.

PEU_U03 Is able to conduct properly design, implementation and make, using advanced multimedia technology, complex technical presentations in the area of construction, and in particularly of the specialty Civil Engineering.

PEU_U04 Has the ability, in accordance with scientific principles and using research techniques, to prepare and implement a preliminary work on a research leading to solutions of complex engineering problems that occur in the construction industry.

PEU_U05 Is able to prepare all the necessary information to present the essence of popular scientific or technical problems.

Z zakresu kompetencji społecznych:

PEU_K01 Is able to work independently over the implementation of the forthcoming thesis.

PEU_K02 Has the ability to prepare and execute complex presentation and the ability to participate in discussions in a public forum on topics related to construction.

PEU_K03 Is aware of the social role of technical college graduate in defining and delivering to public the information and opinions on the achievements of technology and other aspects of engineering.

TREŚCI PROGRAMOWE		
Forma zajęć - wykład		**Liczba godzin**
Wy1		
Wy2		
Wy3		
Wy4		
….		
	Suma godzin	

Forma zajęć - ćwiczenia		Liczba godzin
Ćw1		
Ćw2		
Ćw3		
Ćw4		
..		
	Suma godzin	

Forma zajęć - laboratorium		Liczba godzin
La1		
La2		
La3		
La4		
La5		
…		
	Suma godzin	

Forma zajęć - projekt		Liczba godzin
Pr1		
Pr2		
Pr3		
Pr4		
…		
	Suma godzin	

Forma zajęć - seminarium		Liczba godzin
Se1	Introduction to the course, range of subject, course organization, the principles of evaluation. Methodology for the design and development of complex multimedia presentations using computer tools. Sources of information and how to collect them and analyze.	2
Se2	Examples of the use of advanced software features in presentations related to the theme of the course - an analysis of the advantages and disadvantages of discussed presentations. Rules on technical presentation. Formulating questions and answers during the discussion in a public forum.	2
Se3	Presentation of the principles of preparation and implementation of issues related to the conduct of basic research. Examples.	2
Se4	Individual multimedia presentations related to the topic of theses (1^{st} series) and discussion.	2
Se5	Individual multimedia presentations related to the topic of theses (1^{st} series) and discussion.	2
Se6	Individual multimedia presentations related to the topic of theses (1^{st} series) and discussion.	2
Se7	Individual multimedia presentations related to the topic of theses (1^{st} series) and discussion.	2
Se8	Individual multimedia presentations related to the topic of theses (1^{st} series) and discussion.	2
Se9	Summary of the 1st series of presentations. Discussion.	2

Se10	Individual multimedia presentations related to the topic of theses (2nd series) and discussion.	2
Se11	Individual multimedia presentations related to the topic of theses (2nd series) and discussion.	2
Se12	Individual multimedia presentations related to the topic of theses (2nd series) and discussion.	2
Se13	Individual multimedia presentations related to the topic of theses (2nd series) and discussion.	2
Se14	Individual multimedia presentations related to the topic of theses (2nd series) and discussion.	2
Se15	Summary of the results of the seminar and credition.	2
	Suma godzin	**30**

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. Multimedia presentations - own and collegues.
N2. Discussion of problems among students.
N3. Evaluating of presentations - with justification.
N4. Contact hours

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1 (seminarium)	PEU_W01, PEU_W02, PEU_U01, PEU_U02, PEU_U03, PEU_U04, PEU_U05, PEU_K01, PEU_K02, PEU_K03	Prezentacja multimedialna serii 1
F2 (seminarium)	PEU_W01, PEU_W02, PEU_U01, PEU_U02, PEU_U03, PEU_U04, PEU_U05, PEU_K01, PEU_K02, PEU_K03	Prezentacja multimedialna serii 2
F3 (dyskusje techniczne)	PEU_W01, PEU_U01, PEU_U02, PEU_K02	Aktywność i wartość merytoryczna głosów w dyskusjach
P = 0,35 x F1+0,35 x F2+0,2 x F3 +0,1 x obecność		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

Literatura zależna od tematu dyplomowania.

LITERATURA UZUPEŁNIAJĄCA:

[1] Żurek E.: Sztuka prezentacji czyli jak przemawiać obrazem (Płyta CD). Wyd. Poltex, 2008.
[2] Grzybowski P., Sawicki K.: Pisanie prac i sztuka ich prezentacji. Wyd. Impuls, 2010.
[3] Blein B.: Sztuka prezentacji i wystąpień publicznych. Wyd. RM, 2010.
[4] Wiszniewski A.: Jak pisać skutecznie? Wyd. Videograf II, 2003.

OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ADRES E-MAIL)

prof. dr hab. inż. Jan Bień, jan.bien@pwr.edu.pl

Załącznik nr 6 do ZW 121/2020

WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO
KARTA PRZEDMIOTU
Nazwa w języku angielskim: **Construction techniques and processes**
Nazwa w języku polskim: **Technologia robót budowlanych**
Kierunek studiów (jeśli dotyczy): *budownictwo*
Specjalność (jeśli dotyczy): **Civil Engineering**
Stopień studiów i forma: **~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu: **obowiązkowy ~~/ wybieralny /~~ ~~ogólnouczelniany~~***
Kod przedmiotu: **CEB008662**
Grupa kursów: **~~TAK~~ / 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	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**1**			**2**	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				**2,0**	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	**0,7**			**1,2**	

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI
1. The student has knowledge on building materials and theory of structures.
2. The student is capable to design and elaborate structural analysis of basic building structures.
3. The student is familiar with organization of production processes in construction industry.

CELE PRZEDMIOTU	
C1.	to transfer the knowledge on construction techniques and processes
C2.	to train competencies for identification and resolving of considerable problems concerning execution of construction processes which are part of a complex construction project
C3.	the prepare the alumni for self-dependent managerial positions focused on construction works and supervision of teams in construction industry
C4.	to get the ability for self-study and continuous learning of new problems being permanently created in construction practice, corresponding to development of building materials and

building technology.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ	
Z zakresu wiedzy:	
PEU_W01	the student knows modern building materials and products as long as scope of their application on a construction site.
PEU_W02	the student has advanced knowledge on performing the main type of construction works (earthworks, concrete works, assembly of structure, finishing works).
PEU_W03	the student has advanced knowledge on production processes which are used in housing and industrial objects construction.
PEU_W04	the student has advanced knowledge on some selected types of complex construction works, which are specially demanded on a present building market (as: glazing facades, etc.).
Z zakresu umiejętności:	
PEU_U01	can plan and prepare the investment process for execution phase, including time planning of works, planning the machinery employment, programming of the site work brigades.
PEU_U02	can identify the technical risks which may the project be faced to during the execution of a given design specification and also can define the technical tools for reducing or eliminating the risk.
Z zakresu kompetencji społecznych:	
PEU_K01	the student is aware of need of permanent increasing of professional and personal competencies by means of formal and not formal training exercises on new construction technology problems.
PEU_K02	the student is aware about importance of technical and non-technical aspects and effects of engineering activities, like their influence on the environment and responsibility allocated to it.

TREŚCI PROGRAMOWE		
Forma zajęć - wykład		**Liczba godzin**
Wy1	Advanced problems on earthworks: protection of deep excavations, dewatering of excavations, construction of embankments, soil platforms for supporting foundations, quality control testing, machinery.	3
Wy2	Methods of construction the modern retaining structures in construction. Top-down method of construction the building structures with deep foundations.	2
Wy3	Advanced problems on concrete construction works: formworks, transportation placing the concrete-mix, compacting and curing technics, quality control.	2
Wy4	Industrial RC floor technology	2
Wy5	Advanced problems on structural assembly. Stability of structures during assembly phase.	2
Wy6	Technology of erection the structural glazed facades.	2
Wy7	General roles of fire protection in construction. Active and passive methods application in building construction.	2
	Suma godzin	**15**

	Forma zajęć - ćwiczenia	**Liczba godzin**
Cw1		
...		
	Suma godzin	

Forma zajęć - laboratorium	**Liczba godzin**

Lab1		
…		
	Suma godzin	

Forma zajęć - projekt		**Liczba godzin**
Pr1	Presentation of the overall scope of the project exercise which consist of: planning of all construction works / site processes needed to construct the building object defined individually for each student. Detailed guidance for all required parts of the project report content.	4
Pr2	Concept plan. Breakdown of the whole construction project into stages.	4
Pr3	Machinery and work brigades selection and allocation.	2
Pr4	Evaluation of time and cost of the planned works.	4
Pr5	Gantt chart of works. Critical activities.	2
Pr6	Detailed specification of particular site works operations, including specification of eventual temporary structures and scaffoldings needed for execution of planned operations.	4
Pr7	Detailed engineering drawings presenting all stages of the construction works execution. Text part of specification of the works.	4
Pr8	Presentation of reports with group discussion	2
Pr9	Final presentation of reports with final evaluating (final grades)	2
	Suma godzin	**30**

Forma zajęć - seminarium		**Liczba godzin**
Se1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE
WYKŁAD N1. Regular lecture with multi-media presentation. Possible distant “on-line” performing of the course. Presentation of construction site case studies. Presentation of selected data taken from real projects completed before. N2. Contact hours for students. **PROJEKT** N3. Presentation of the scope and step-by-step the whole process of elaborating the report. Possible distant “on-line” performing of the project course. N4. Presentation performed by students, demonstrating the intermediate project exercise results. N5. Contact hours for students.

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
P (lecture)	PEU_W01, PEU_W02, PEU_W03 PEU_W04	EXAMINATION
P (project)	PEU_U01	Check of the final report, considering as a

	PEU_U02	supplement, the student's verbal individual presentation of some report issues. Possible distant "on-line" quiz.

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
<u>LITERATURA PODSTAWOWA:</u> 1. Allen E., Fundamentals of building construction: materials and methods. John Willey&Sons Ltd., 2019. 2. Chudley R., Greeno R., Advanced Construction Technology, PEARSON, 2012. 3. Concrete construction engineering handbook (ed. Nawy G.) CRC Press, Taylor & Francis Group, 2008. 4. Du Preez A., Civil and Construction Technology, PEARSON, 2009. 5. Emmitt S., Gorse Ch.A., Barry's advanced construction of buildings. Wiley-Blackwell Publ. 2014. 6. Fleming E., Advanced Construction Technology. John Willey&Sons Ltd., 2014. 7. Illingworth J. R., Construction methods and planning. Chapman & Hall, 2000. 8. Temporary Works – Principles of Design and Construction. Ed.: Grant M., Pallett P.F..ICE Publ. 2012

OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ZAKŁAD, INSTYTUT, ADRES E-MAIL)
Andrzej Czemplik, PhD, CE, PE, Department of Building Engineering (K07W02D06), andrzej.czemplik@pwr.edu.pl
CZŁONKOWIE ZESPOŁU DYDAKTYCZNEGO (IMIĘ, NAZWISKO, ADRES E-MAIL)
Teachers from Department of Building Engineering (K07W02D06)

Załącznik nr 6 do ZW 121/2020

WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO

KARTA PRZEDMIOTU

Nazwa w języku angielskim: **Construction project management**
Nazwa w języku polskim: **Zarządzanie przedsięwzięciami budowlanymi**
Kierunek studiów (jeśli dotyczy): *budownictwo*
Specjalność (jeśli dotyczy): **Civil Engineering**
Stopień studiów i forma: **~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu: **obowiązkowy ~~/ wybieralny / ogólnouczelniany~~***
Kod przedmiotu: **CEB008563**
Grupa kursów: **~~TAK~~ / 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	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**1**	**2**			
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		**1,5**			
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	**0,6**	**0,6**			

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI

1. The student has the knowledge on construction technology and organization
2. The student is capable to elaborate the time schedule, bill of quantity and cost plan of construction projects.
3. The student knows the basic roles of structural design of construction objects

CELE PRZEDMIOTU

C1. to transfer the knowledge on construction project management
C2. to train competencies for identification and resolving of considerable problems concerning execution of construction processes
C3. the prepare the alumni for self-dependent managerial positions focused on construction works and supervision of teams in construction industry
C4. to get the ability for self-study and continuous learning of new problems solving.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ	
Z zakresu wiedzy:	
PEU_W01	the student knows procedures of construction projects management, has the knowledge on organization and management of complex construction projects, has the knowledge on evaluation of project economy, supervision of projects, and computer-aided planning of projects.
PEU_W02	the student has knowledge on performing the business in construction industry, does understand basic roles of company finance and knows cost control procedures as long as project time management
PEU_W03	the student knows basic role of construction law regulations and corresponding administration procedures, including environmental regulations, power energy regulations, waste management law, geological law and knows the basic roles of facility management.
Z zakresu umiejętności:	
PEU_U01	can plan and prepare the investment process for execution phase, including tendering, managing of construction project and fundaments facility management
PEU_U02	can use the advanced tools for internet and other sources searching the building information, can use the IT tools for interpersonal communication and can get and use the software needed for effective organization and management of construction projects.
PEU_U03	can elaborate the time schedule of works, as long as the bill of quantity; also, can evaluate the economy of construction project.
PEU_U04	can evaluate the risk allocated to execution of a construction project
Z zakresu kompetencji społecznych:	
PEU_K01	the student is aware of need of permanent increasing of professional and personal competencies by means of formal and not formal training exercises on new construction technology problems.
PEU_K02	the student can think and act in entrepreneurial way.

TREŚCI PROGRAMOWE		
Forma zajęć - wykład		**Liczba godzin**
Wy1	Management models of a construction process. Regulations and administrative procedures related to the construction process. Obligations and rights of project participants.	1
Wy2	The investment process: local urban plan, arrangements, documents, administrative decisions. Feasibility study for construction projects. Principles and scope of a feasibility study.	2
Wy3	Tender procedures. Types of tenders. Private and public orders. Management of a tender procedure. Insurance in the investment construction process. Commodity exchanges.	2
Wy4	Tenders and contracts in construction industry. FIDIC contract model.	2
Wy5	The use of scheduling and network planning in management of engineering investment.	2
Wy6	Evaluation of engineering projects effectiveness (NPV, IRR). Cost control of projects.	2
Wy7	Construction project progress analysis using Earned Value Method	2
Wy8	Crediting test.	2
	Suma godzin	**15**

Forma zajęć - ćwiczenia	Liczba godzin

Ćw1	Planning the organization of a construction project structure. Planning of the structure of a construction contracting company.	1
Ćw2	Selected administration procedures obligatory in the construction project management	2
Ćw3	Selected parts of the feasibility study of a construction investment project	2
Ćw4	Engineering clauses in contracts for works in construction.	2
Ćw5	Planning of works with application of critical paths and the cost plan ("S" curve).	2
Ćw6	Calculation of Net Present Value and Internal Rate of Return for construction investment projects.	2
Ćw7	Calculation of forecasted final date and final cost of construction projects with use of Earned Value Method.	2
Ćw8	Crediting test.	2
	Suma godzin	**15**

Forma zajęć - laboratorium		**Liczba godzin**
Lab1		
…		
	Suma godzin	

Forma zajęć - projekt		**Liczba godzin**
Pr1		
…		
	Suma godzin	

Forma zajęć - seminarium		**Liczba godzin**
Se1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Regular lecture with multi-media presentation. Possible on-line course with use of dedicated software packages. Presentation of construction case studies. Presentation of annual report data of real construction companies. N2. Demonstration of some recognizable software packages for project management. N3. Contact hours for students.

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
	PEU_W01	quiz semestralny: na zajęciach lub na odległość quiz „on-line”
	PEU_W02	
	PEU_W03	
	PEU_U01	
	PEU_U02	
	PEU_U03	
	PEU_U04	
	PEU_W01	

	PEU_W01	

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] A Guide to the Project Management Body of Knowledge, Project Management Institute, 2017.
[2] Code of Practice: Project Management for construction and development. Blackwell Publ. 2014
[3] Ferry D. J., Brandon P. S., Ferry J. D., Cost Planning of Buildings. Blackwelll Science, 2014.
[4] Fewings P., Construction Project Management – an integrated approach. Taylor&Francis, 2019.
[5] Harris F., McCaffer, Modern Construction Management. Blackwell Sci. Publ. 2013
[6] Sears S.K., Sears G.A., Clough R.H., Rounds J.L., Segner R.O., Project Management – A Practical Guide to Field Construction Management. Wiley, 2015.
[7] Walker A., Project Management in Construction. Wiley-Blackwell. 2015

LITERATURA UZUPEŁNIAJĄCA:

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[2] Gould F. E., Managing the construction process. Pearson 2012
[3] Kerzner H., Project Management – A Systems Approach to Planning, Scheduling and Controlling. Wiley, 2013.
[4] Winch G.M., Managing Construction Projects. Wiley-Blackwell. 2010.

OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ZAKŁAD, INSTYTUT, ADRES E-MAIL)
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CZŁONKOWIE ZESPOŁU DYDAKTYCZNEGO (IMIĘ, NAZWISKO, ADRES E-MAIL)
Teachers from Department of Building Engineering (K07W02D06)

Załącznik nr 6 do ZW 121/2020

WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO

KARTA PRZEDMIOTU

Nazwa w języku angielskim: **Selected topics in structural mechanics**
Nazwa w języku polskim: **Statyka budowli – wybrane zagadnienia**
Kierunek studiów (jeśli dotyczy): ***budownictwo***
Specjalność (jeśli dotyczy): **Civil Engineering**
Stopień studiów i forma: **~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu: **obowiązkowy ~~/ wybieralny /~~ ~~ogólnouczelniany~~***
Kod przedmiotu: **CEB008461**
Grupa kursów: **~~TAK~~ / NIE***

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	**30**	**15**	**15**		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	**60**	**30**	**30**		
Forma zaliczenia	Egzamin / ~~zaliczenie na ocenę~~*	~~Egzamin~~ / zaliczenie na ocenę*	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**2**	**1**	**1**		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		**0,7**	**0,7**		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	**1,2**	**0,6**	**0,6**		

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI

1. The student has knowledge and skills in the determination of internal forces (internal) and the rules for their labeling for plane rod systems statically determinate.
2. The student knows solving methods of statically determinate rod systems and can effectively determine the reactions and internal forces (internal) in the rod system.
3. The student has a theoretical basis and the ability to apply the principle of virtual work to determine static variables in statically determinate systems such as beams, frames and trusses.

CELE PRZEDMIOTU

C1. Learning the methodology of determining displacements in statically determinate systems and gaining the skills of displacement determination in plane rod systems from mechanical and non-mechanical loads.

C2.	Learning the methodology of solving of statically indeterminate systems by the force method and develop skills of determining internal forces (internal) in flat rod systems from mechanical and non-mechanical loads.
C3.	Learning the methodology of solving of geometrically indeterminate systems by the displacement method and gaining skills of determining internal forces (internal) in plane rod systems subjected to non-mechanical loads.
C4.	Learning the methods of determining the influence lines and gaining skills of their determination in the case of plane rod systems; statically determinate and indeterminate.
C5.	Gaining skills of solving simple rod structural systems using analytical methods as well as modeling, solving and verifying the results using computer computational software.
C6.	Gaining awareness of the continuing education need to improve own competences in the modern computer programs for structural analysis issues.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

Z zakresu wiedzy:

PEU_W01	The student has an in-depth knowledge of principles of structural mechanics with respect to statically determinate and indeterminate bar structures.
PEU_W02	The student knows solving methods of internal forces and displacements of statically determinate and indeterminate plane bar structures subjected to mechanical and not mechanical loads.
PEU_W03	The student knows methods of influence line determination for statically determinate and indeterminate bar systems

Z zakresu umiejętności:

PEU_U01	The student can perform static analysis of plane bar structures statically determinate and indeterminate which can be subjected to mechanical or non-mechanical loads.
PEU_U02	The student can determine influence lines of bar structures statically determinate and indeterminate.
PEU_U03	The student can properly define computational model of plane bar structures and their components, and carry out analysis of internal forces and displacements determination.

Z zakresu kompetencji społecznych:

PEU_K01	The student is able to work on the implementation of tasks independently or in a team (individual preparation of reports and cooperative problem solving in the classroom)
PEU_K02	The student is aware of the need to increase knowledge in the field of contemporary techniques and programs for calculation of building structures.

TREŚCI PROGRAMOWE

Forma zajęć - wykład		Liczba godzin
Wy1	Introduction. Discussion of the topic subject. Principles of virtual work for rod systems. Reciprocity theorems. Elastic constrains.	2
Wy2	Determination of displacement field in plane rod structures subjected to mechanical load. Methods for effective numerical integration of internal forces charts. Examples.	2
Wy3	Impact of support displacements and temperature variation on the movement of statically determinate systems. Examples.	2
Wy4	The force method for plane rod systems. Theoretical basis. Derivation of the canonical equations.	2

Wy5	Determination of the displacement field of the rod system using the method of forces. Examples.	2
Wy6	The force method. Determination of internal forces induced by mechanical loading. Verification of the correctness of the solution. Examples.	2
Wy7	Determination of the displacement field induced by support's displacement using the force method. Examples.	2
Wy8	Determination of the displacement field induced by temperature variation using the force method. Examples.	2
Wy9	Displacement method. Theoretical foundations.	2
Wy10	Displacement method. Transformation's rules according to the theory of first-order. Formulation of the canonical equations of displacement method. Verification of the correctness of the solution.	2
Wy11	Displacement method. Determination of internal forces induced by mechanical loads. Examples.	2
Wy12	Displacement method. Determination of internal forces induced by non-mechanical loads. Examples.	2
Wy13	Method of influence line determination in statically determinate and indeterminate rod structures. Theoretical foundations.	2
Wy14	Influence line determination using static approach. Examples.	2
Wy15	Influence line determination using kinematic approach. Examples.	2
	Suma godzin	**30**

Forma zajęć - ćwiczenia		Liczba godzin
Ćw1	Preliminary information. Introduction into force method. Solving a simple example presenting methodology of governing system of equations forming according to the force method.	2
Ćw2	The force method: determination of internal forces induced by mechanical loads. Computational examples.	2
Ćw3	The force method: determination of internal forces induced by non-mechanical loads. Computational examples.	2
Ćw4	Displacement method – introduction. Computational example presenting the main idea of the displacement method.	2
Ćw5	Displacement method: determination of internal forces induced by mechanical loads. Computational examples.	2
Ćw6	Displacement method: determination of internal forces induced by non-mechanical loads. Computational examples.	2
Ćw7	Influence lines: kinematic and static approach. Computational examples.	2
Ćw8	Influence lines. Further computational examples.	1
	Suma godzin	**15**

Forma zajęć - laboratorium		Liczba godzin
Lab1	Introductory information. The theme of the 1st laboratory exercise. The calculation example with presentation of the computer software. Performing own calculations with computer computational software and results discussion.	2
Lab2	Further calculations with the computational program based on the force method. Calculation example.	2
Lab3	The 1st laboratory exercise. The case of support displacement and temperaturę variation. Performing own numerical calculation.	2
Lab4	Test verifying the student knowledge regarding the 1st laboratory	2

	exercise. The theme of 2nd laboratory exercise. Displacement method. Calculation example. Performing own numerical calculation.	
Lab5	Numerical calculation of rod structure using the computer software based on the displacement method. The mechanical loading case.	2
Lab6	Numerical calculation of rod structure using the computer software based on the displacement method. The case of support displacement and temperaturę variation.	2
Lab7	The computer software of influence line determination. The final test.	2
Lab8	The final verification of laboratory reports.	1
	Suma godzin	**15**

Forma zajęć - projekt		**Liczba godzin**
Pr1		
…		
	Suma godzin	

Forma zajęć - seminarium		**Liczba godzin**
Se1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE	
N1.	Classic lecture. Multimedial presentation.
N2.	Laboratory: classic and multimedial presentation regarding laboratory, presentation of computer software, examples of problem solution with computer software..
N3.	Consulting. Teaching materials prepared by the teacher.
N4.	Class: classic and multimedial presentation, solving the examples.

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1(laboratory)	PEU_U01, PEU_U02, PEU_U03, PEU_K01	Test verifying knowledge regarding 1st laboratory exercise. Active participation during class.
F2(laboratory)	PEU_U01, PEU_U02, PEU_U03, PEU_K01	Test verifying knowledge regarding 2nd laboratory exercise. Active participation during class.
P (laboratory) = F1 x 1/2 + F2 x 1/2		
F1(class)	PEU_U01, PEU_U02, PEU_U03, PEU_K01	Test verifying student knowledge of force method. Active participation during class.
F2(class)	PEU_U01, PEU_U02, PEU_U03, PEU_K01	Test verifying student knowledge of displacement method. Active participation during class.

P (class) = F1 x 1/2 + F2 x 1/2		
P (lecture)	PEU_W01, PEU_W02, PEU_W03, PEU_K02	Final written exam – questions on theory and practical problems.

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] 1. Przemieniecki S., Theory of Structural Analysis, MacGraw-Hill, New York, 1968.

[2] Meller M., English through civil engineering, Politechnika Koszalińska – Wyd. Uczelniane, 1998.

[3] Mase G.E., Theory and problems of continuum mechanics, MacGraw-Hill, New York, 1970.

[4] Pilkey W.D., Wunderlich W., Mechanics of structures. Variational and computational methods, CRC Press, Boca Raton, 1994.

LITERATURA UZUPEŁNIAJĄCA:

[1] 1. Ross C.T.F., Finite element methods in structural mechanics, 1985.

[2] Reddy J.N., Applied functional analysis and variational methods in engineering, MacGraw-Hill, New York, 1986.

OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ZAKŁAD, INSTYTUT, ADRES E-MAIL)

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Załącznik nr 6 do ZW 121/2020

WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO

KARTA PRZEDMIOTU

Nazwa w języku angielskim: **Theory of elasticity and plasticity**
Nazwa w języku polskim: **Teoria sprężystości i plastyczności**
Kierunek studiów (jeśli dotyczy): *budownictwo*
Specjalność (jeśli dotyczy): **Civil Engineering**
Stopień studiów i forma: **~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu: **obowiązkowy ~~/ wybieralny /~~ ~~ogólnouczelniany~~***
Kod przedmiotu: **CEB008361**
Grupa kursów: **~~TAK~~ / NIE***

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	**30**	**15**			
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	**30**	**30**			
Forma zaliczenia	~~Egzamin~~ / zaliczenie na ocenę*	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**1**	**1**			
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		**0,4**			
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	**1,1**	**0,6**			

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI

1. The student has necessary knowledge of selected topics of mathematics and physics as a base of structural analysis.
2. The student has knowledge of structural mechanics and strength of materials.
3. The student has knowledge of partial differential equations and Fourier series.

CELE PRZEDMIOTU

C1. Introduction to three dimensional problem of theory of elasticity
C2. Presentation of physical basis and assumptions in plane problems.
C3. Presentation of assumptions, equations and analytical solutions in Kirchhoff theory of thin plates
C4. Presentation of assumptions, equations and analytical solutions in Kirchhoff-Love theory of thin shells

C5. Introduction to theory of plasticity. Presentation of limit load theory for thin plates. C6. To set a conviction about necessity of knowledge continuous extension in field of theory of elasticity and plasticity.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ
Z zakresu wiedzy: PEU_W01 The student knows and understands the equilibrium, geometrical and physical relations for linear-elastic, isotropic body. PEU_W02 The student knows and understands the differences between linear and nonlinear descriptions and isotropic anisotropic bodies. PEU_W03 The student knows and understands assumptions, internal forces definitions and boundary conditions in plates and shells. PEU_W04 The student knows and understands the differences between bending and membrane shells theories. PEU_W05 The student knows and understands basic terms of theory of plasticity, definitions and theorems of limit load theory. **Z zakresu umiejętności:** PEU_U01 The student recognizes properly plane problems and thin plates or shells issues. PEU_U02 The student is capable of use analytical solutions for selected discs, plates and membrane shells problems. PEU_U03 The student is capable of evaluate limit load for plates using kinematic approach. **Z zakresu kompetencji społecznych:** PEU_K01 The student has a conviction about necessity of knowledge continuous extension in field of theory of elasticity and plasticity.

TREŚCI PROGRAMOWE		
	Forma zajęć - wykład	**Liczba godzin**
Wy1	Introduction. Index notation. Stress tensor: differential equilibrium equation	2
Wy2	Stresses tensor (cont.): kinetic boundary conditions, transformation, invariants, principal stresses and directions.	2
Wy3	Continuous body motion: Lagrange and Euler description, strain tensors, compatibility equations. Linear elastic material models. General Hooke’s law. Theory of elasticity equations set. Lame and Beltrami-Mitchell equations.	2
Wy4	Elastic strain energy. Total potential energy. Virtual work principle. Lagrange theorem. Stable and unstable equilibrium.	2
Wy5	Plane problems. Airy stress function for plane stress.	2
Wy6	Plane problem in polar coordinates – application of Airy stress function, third order differential equation for axial symmetry case.	2
Wy7	Thin plates. Kirchhoff theory: assumptions, stresses and internal forces, equilibrium equations, boundary conditions.	2
Wy8	Analytical solutions for plates. Rectangular plate – Navier approach.	2
Wy9	Plate stability. Second order bending theory.	2
Wy10	Annular plates. Fourth and third order differential equations for axial symmetry case.	2
Wy11	Thin shells. Assumptions. Geometrical description. Stresses distribution and internal forces. Bending theory application for cylindrical container.	2
Wy12	Membrane theory for shells of revolution. Equilibrium equations. Analytical solutions for spherical and conical geometry and axis-symmetrical load.	2
Wy13	Basis of theory of plasticity: plastic body models, general plasticity conditions, plasticity conditions for plates, Definitions and theorems of limit	2

	load theory.	
Wy14	Lecture summary. Examples of test tasks.	2
Wy15	Test	2
	Suma godzin	**30**

Forma zajęć - ćwiczenia		**Liczba godzin**
Ćw1	Index notation – application examples.	1
Ćw2	Stress tensor components transformation. Invariants, principal stresses and directions calculation.	2
Ćw3	Application of Airy stress function in solution of plane stress problems.	2
Ćw4	Plane problem in polar coordinates – stress concentration caused by a circular hole.	2
Ćw5	Navier solution for plates.	2
Ćw6	Hyperboloid membrane shell – different geometry parameterization	2
Ćw7	Kinematic approach to limit load evaluation for rectangular and circular plates.	2
Ćw8	Test.	2
	Suma godzin	**15**

Forma zajęć - laboratorium		**Liczba godzin**
Lab1		
...		
	Suma godzin	

Forma zajęć - projekt		**Liczba godzin**
Pr1		
…		
	Suma godzin	

Forma zajęć - seminarium		**Liczba godzin**
Se1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Lecture: traditional form. N2. Classes: analytical solutions of lecture related problems. N3. Office hours.

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
P (classes)	PEU_W01, PEU_W03, PEU_W05, PEU_U01 PEU_U02, PEU_U03.	test
P (lecture)	PEU_W01,	test

	PEU_W03, PEU_W05, PEU_U01 PEU_U02, PEU_U03.	

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
<u>LITERATURA PODSTAWOWA:</u> 1. Stephen P. Timoshenko and J.N. Goodier, Theory of Elasticity, McGraw-Hill, 1970. 2. A.I. Lurie and A.K. Belyaev, Theory of Elasticity (Foundations of Engineering Mechanics), Springer, 2005. **<u>LITERATURA UZUPEŁNIAJĄCA:</u>** 1. Y. C. Fung, Foundation of Solid Mechanics, Prentice-Hall, New Jersey 1965. 2. Kyuichiro Washizu, Variational methods in elasticity and plasticity, Pergamon Press, 1982.

OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ZAKŁAD, INSTYTUT, ADRES E-MAIL)
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CZŁONKOWIE ZESPOŁU DYDAKTYCZNEGO (IMIĘ, NAZWISKO, ADRES E-MAIL)
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Załącznik nr 6 do ZW 121/2020

WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO

KARTA PRZEDMIOTU

Nazwa w języku angielskim:	**Sustainable housing**
Nazwa w języku polskim:	**Budownictwo zrównoważone**
Kierunek studiów (jeśli dotyczy):	***budownictwo***
Specjalność (jeśli dotyczy):	**Civil Engineering**
Stopień studiów i forma:	**~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu:	**obowiązkowy ~~/ wybieralny /~~ ~~ogólnouczelniany~~***
Kod przedmiotu:	**CEB008263**
Grupa kursów:	**~~TAK~~ / 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	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**1**			**2**	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				**2,0**	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	**0,6**			**0,6**	

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI

1. Graduation of civil engineering, environmental engineering architecture or city planning studies.
2. Has knowledge of building construction, technical drawings and general building design.
3. Knows standards, guidelines and regulations about construction and their detail design.
4. Has theoretical basis of detached house design and construction detail solutions.

CELE PRZEDMIOTU

C1. Gain knowledge about design rules of modern, low energy demand, ecological residential and commercial buildings and their details.
C2. Getting acquainted with renewable energy usage possibilities.
C3. Getting acquainted with regulations of rational energy preservation with taking thermal, visual and acoustic comfort of different rooms into consideration.
C4. Getting basis of design team cooperation to connect form and function with rational energy

usage in buildings.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ
Z zakresu wiedzy:
PEU_W01 knows the standards, guidelines and regulations referring to the design of buildings and their components
PEU_W02 possesses knowledge about the influence of building investments on the environment
PEU_W03 has extensive knowledge in the area of selected elements, constructions and building structures
Z zakresu umiejętności:
PEU_U01 is able to use advanced specialized tools when searching Internet databases and other sources which can be used to find both general information and other information related to civil engineering; is able to use information technology to communicate and know how to obtain software which is used to aid the work of a designer and the person organizing and managing building processes
PEU_U02 is able to choose a tool (analytical or numerical) in order to solve engineering issues; is able to use selected software which aid modeling and design processes in construction
PEU_U03 has skills to solve tasks referring to selected theoretical issues and also design elements, constructions and building structures
Z zakresu kompetencji społecznych:
PEU_K01 is aware of the need to constantly upgrade professional and personal competence in the form of formal or informal education and also improves and develops knowledge in the area of modern processes and technology, related to civil engineering
PEU_K02 is aware of the importance and also understands non-technical aspects and consequences of engineering activity, including influence on the environment and responsibility for implemented decisions
PEU_K03 is able to work independently and cooperate in a team on a specific task; is responsible for both the safety of his work and his subjected team's work

TREŚCI PROGRAMOWE		
	Forma zajęć - wykład	**Liczba godzin**
Wy1	Course subjects and passing regulations talk through. Sustainable building design basic information. LCA – building life cycle, total building costs. Environmental influence of buildings.	2
Wy2	Building environmental impact methods. Social, economical and environmental aspects of sustainable building design. Law regulations	2
Wy3	Global and local greenhouse gas emission. Carbon dioxide reduction strategies. Energy production from different fuels. Emission factors. Fuel equity. The primal energy conversion coefficients.	2
Wy4	Classification of low-energy buildings. Building shape coefficient. Basic and advanced building design methods. Heat flow through windows and glazed facades.	2
Wy5	Building thermal mass. Ventilation system, heat recovery, ground-coupled heat exchanger	2
Wy6	Renewable energy resources in global and local scale. Usage in low-energy and passive buildings.	2
Wy7	Examples of low-energy and passive buildings. Applied solutions. Possible solutions to carry in buildings in polish climate.	2
Wy8	Final test	1
	Suma godzin	**15**

Forma zajęć - ćwiczenia		Liczba godzin
Cl1		
…		
	Suma godzin	

Forma zajęć - laboratorium		Liczba godzin
Lab1		
…		
	Suma godzin	

Forma zajęć - projekt		Liczba godzin
Pr1	Project subjects and passing regulations talk through. Handing over design cases. Familiarize with work safety regulations.	1
Pr2	U-value calculations for building partition. Untypical cases	2
Pr3	Correct arrangement for rooms with different functions in horizontal and vertical plane. Daylight access.	2
Pr4	Building shape coefficient. Building thermal mass.	2
Pr5	Optimisation of heat gains and losses in buildings with different purpose.	2
Pr6	HVAC (heating, ventilation, air conditioning) and DHW (domestic hot water) systems	2
Pr7	Renewable energy sources. Usage possibilities in Poland and all over the world.	2
Pr8	Infrared thermography. Thermogram interpretation.	2
	Suma godzin	**15**

Form of classes - seminar		Number of hours
Se1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE	
N1.	Lecture: multimedia presentation of lecture material, share of teaching materials through e-learning platforms, use of remote learning platforms (Zoom, MS Teams)
N2.	Project: multimedia presentation of project material. Solving problem with use of MS Office software, , share of teaching materials through e-learning platforms, use of remote learning platforms (Zoom, MS Teams)

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
P1 (projekt)	PEU_U01 PEU_U02 PEU_U03 PEU_K01 PEU_K02 PEU_K03	Realizacja przypadku projektowego

P2 (wykład)	PEU_W01 PEU_W02 PEU_W03	Kolokwium - test pisemny lub test on-line

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA: [1] Beggs C., Energy Management, Supply and Conservation. Elsevier, 2002. [2] Clark J., Energy Simulation in Building Design. Wiley Company, 2001. [3] Gratia E., DeHerde A.: Passive Solar Architecture. BRE, 2006. [4] Hens H., Buildings Physics – Heat, Air and Moisture. Ernst & Sohn, 2007. [5] Moss K., Heat and Mass Transfer in Buildings. Elsevier, 2007. [6] Twidell J., Weir T., Renewable Energy Resources. Taylor & Francis, 2006. **LITERATURA UZUPEŁNIAJĄCA:**

OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ZAKŁAD, INSTYTUT, ADRES E-MAIL)
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Załącznik nr 6 do ZW 121/2020

WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO

KARTA PRZEDMIOTU

Nazwa w języku angielskim:	**Bridges**
Nazwa w języku polskim:	**Mosty**
Kierunek studiów (jeśli dotyczy):	***budownictwo***
Specjalność (jeśli dotyczy):	**Civil Engineering**
Profil:	**akademicki / ~~praktyczny~~***
Stopień studiów i forma:	**~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu:	**obowiązkowy ~~/ wybieralny / ogólnouczelniany~~***
Kod przedmiotu:	**CEB008062**
Grupa kursów:	**~~TAK~~ / 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*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**2**			**2**	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				**2.0**	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	**1.3**			**1.3**	

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI

1. Identifies structural elements
2. Identifies parameters of a structure
3. Identifies physical values used in mechanics

CELE PRZEDMIOTU

C1. Introduction to basic terms of bridge engineering
C2. Introduction to modern construction methods
C3. Introduction to structural analysis methods
C4. Strengthening of work in group

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ	
Z zakresu wiedzy:	
PEU_W01	Knows and understands basic ideas of bridge engineering
PEU_W02	Knows the layout of structural elements as well as non-structural elements
PEU_W03	Knows analysis methods and modelling of bridge structures
PEU_W04	Knows modern construction methods
PEU_W05	Knows selected methods of bridge testing
Z zakresu umiejętności:	
PEU_U01	Properly distinguishes bridge elements
PEU_U02	Is able to describe selected construction methods
PEU_U03	Properly describes selected methods of bridge testing and structural modelling
PEU_U04	Is able to do basic structural analysis
PEU_U05	Makes the drawings of bridge structures according to the rules
PEU_U06	Is able to design the superstructure of girder span in the field of main girders and slab
Z zakresu kompetencji społecznych:	
PEU_K01	Is able to work alone or in group
PEU_K02	Is aware of a need of updating the knowledge related to bridge testing

TREŚCI PROGRAMOWE		
	Forma zajęć - wykład	**Liczba godzin**
Wy1	Introduction, bridge infrastructure in Poland and Europe, basic terminology, bridge components.	2
Wy2	Bridge classification, static systems of bridges, case studies. Bridge supports.	2
Wy3	Bridge accessories, examples. Bridge bearings.	2
Wy4	General rules of structural analysis and dimensioning of bridge structures. Types of bridge loads, case studies.	2
Wy5	Numerical modelling and computer tools for structural analysis.	2
Wy6	Concrete bridges – classification and structural details.	2
Wy7	Concrete bridges – structural analysis, prefabricated bridges.	2
Wy8	Steel & composite bridges – classification and structural details.	2
Wy9	Steel & composite bridges – structural analysis.	2
Wy10	Masonry bridges – classification, structural details & analysis.	2
Wy11	Construction methods.	2
Wy12	Testing methods.	2
Wy13	Bridges defects, classification and case studies, causes of defect.	2
Wy14	Bridge exploitation and maintenance problems. Computer systems for management.	2
Wy15	Test.	2
	Suma godzin	**30**

	Forma zajęć – ćwiczenia	**Liczba godzin**
Ćw1		
...		
	Suma godzin	

	Forma zajęć - laboratorium	**Liczba godzin**
Lab1		
...		

	Suma godzin	

Forma zajęć – projekt		**Liczba godzin**
Pr1	Introduction, formal information, distribution of project subjects, description of the project's scope.	2
Pr2	Basic design rules for bridge substructure, shaping the bridge surroundings (typical sizes of piers and abutments according to formal requirements), description of basis terminology.	2
Pr3	Design rules for bridge superstructure, determination of bridge span lengths, selection of bridge girder's height, dimensions of main structural elements of a bridge (slab, transverse beams), bridge accessories (pavements, barriers, railings, drainage, expansion joints), examples.	2
Pr4	Description of conceptual drawings – rules for drawing, descriptions, scales, thickness of lines, scope of the conceptual design.	2
Pr5	Initial calculations – scope, basic assumptions, methods of analysis, collecting of dead and live loads.	2
Pr6	Initial calculations – load transverse distribution, finding internal forces with application of influence lines.	2
Pr7	Initial calculations – dimensioning of the main girders at bending. Basic rules for designing of reinforcement (choice of material, thickness of bars and cover, distances between bars).	2
Pr8	Detailed calculations – bridge superstructure modelling by means of FEM, presentation of exemplary models.	2
Pr9	Detailed calculations – analysis of bridge main girders by means of FEM method: collection and application of dead and live loads, finding the internal forces.	2
Pr10	Detailed calculations – creation of envelopes of internal forces (bending moments and shear forces), loading scenarios and combinations.	2
Pr11	Detailed calculations – ultimate limit state of bridge girder at bending and shearing, envelopes of resistance.	2
Pr12	Technical drawings of a bridge girder – scope and rules for drawing; details of reinforcement design (anchorage length, bending radius of bars, hooks, overlapping, joining of bars).	2
Pr13	Technical description of the designed bridges.	2
Pr14	Individual consultations of student projects.	2
Pr15	Passing the projects.	2
	Suma godzin	**30**

Forma zajęć - seminarium		**Liczba godzin**
Se1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Lecture: presentations, slides, making the drawings on the blackboard N2. Project: presentations, slides, ma king the drawings and schemes on the blackboard, examples of calculations N3. Individual meetings

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1 (proj)	PEU_U04	Individual task – conceptual drawings
F2 (proj)	PEU_U05	Individual task – first stage of calculations
F3 (proj)	PEU_U06 PEU_K01	Individual task – detailed design
P (projekt) =0.2xF1+0.1xF2+0.7xF3		
P (lect)	PEU_W01 PEU_W02 PEU_W03 PEU_W04 PEU_W05 PEU_K02	Test

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] 1 Parke G., Hewson N., *ICE manual of bridge engineering*, Thomas Telford Limited, 2008.
[2] Tonias D. E., Zhao J. J., *Bridge Engineering: Rehabilitation, and Maintenance of Modern Highway Bridges*. McGraw-Hill Professional. 2006.
[3] *Bridge engineering handbook* / ed. by Wai-Fah Chen and Lian Duan. 2000.
[4] Mondorf P., *Concrete Bridges*, Routledge, 2006.
[5] Ghosh U.K., *Design and Construction of Steel Bridges*, Taylor & Francis; 2006.
[6] Collings D., *Steel-Concrete Composite Bridges*, Thomas Telford, 2005.
[7] Hirt M., Lebet J.P. *Steel Bridges: Conceptual and Structural Design of Steel and Steel-Concrete Composite Bridges,* CRC Press, 2013.
[8] Hendy C.R., Smith D.A., *Designers' Guide to EN 1992 Eurocode 2: Design of Concrete Structures: Concrete bridges*, Thomas Telford, 2007.
[9] Hendy C. R., Murphy C. J., *Designers' Guide to EN 1993-2 Eurocode 3: Design of Steel Structures: Steel Bridges*, Thomas Telford, 2007.
[10] Hendy C.R., Johnson R.P., *Designers' Guide to EN 1994-2 Eurocode 4 : Design of Steel and Composite Structures: General Rules and Rules for Bridges*. Taylor & Francis; 2006.

LITERATURA UZUPEŁNIAJĄCA:

[1] David J., Brown, Bridges – Three thousand Years of Defying Nature, Mitchell Beazley, Octopus Publishing Group, London 1993-2005

OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ZAKŁAD, INSTYTUT, ADRES E-MAIL)

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PhD students of the Department of Bridges and Railways

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Nazwa w języku angielskim:	**Mathematics – selected topics**
Nazwa w języku polskim:	**Matematyka – wybrane zagadnienia**
Kierunek studiów (jeśli dotyczy):	***budownictwo***
Specjalność (jeśli dotyczy):	**Civil Engineering**
Stopień studiów i forma:	**~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu:	**obowiązkowy ~~/ wybieralny /~~ ~~ogólnouczelniany~~***
Kod przedmiotu:	**CEB008061**
Grupa kursów:	**~~TAK~~ / 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	Egzamin / ~~zaliczenie na ocenę~~*	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**1**	**1**			
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		**0,6**			
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	**0,6**	**0,6**			

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI

1. The student has knowledge of mathematical analysis in the following areas: basic concepts of topology, differential and integral calculus of functions of one variable, differential and integral calculus of functions of several variables.
2. Knows the basic types of ordinary differential equations and elementary methods of integration. From the first order equations - equation with separated variables, homogeneous equations, linear equations, Bernoulli equation. With a range of higher order differential equations - the theory of linear equations. Knows the basic methods of solving systems of ordinary differential equations - elimination method and the method of Euler.
3. Knows the basic concepts, theorems and methods of linear algebra, algebra of polynomials and analytic geometry.

CELE PRZEDMIOTU	
C1.	To familiarize students with the most common partial differential equations of second order used in mechanics.
C2.	The acquisition by students of elementary methods of solving partial differential equations.
C3.	Acquisition of intuition about the relationship of mathematically formulated boundary value problems with problems solved in structural mechanics.
C4.	To familiarize students with contemporary, based on the theorems of functional analysis, methods of formulation and solving boundary value problems.
C5.	To familiarize students with the mathematical foundations of the finite element method.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ	
Z zakresu wiedzy:	
PEU_W01	gain knowledge in the basics of the theory of partial differential equations
PEU_W02	recognize elements of contemporary mathematical analysis
PEU_W03	gaining knowledge about modern methods of solving boundary value problems
Z zakresu umiejętności:	
PEU_U01	properly distinguish between types of equations and boundary value problems
PEU_U02	has the ability to bring to a canonical form of linear equations of order 2, can use a Fourier method, correctly distinguishes between types of equations and boundary value problems
PEU_U03	gaining basic skills in differentiation distribution
PEU_U04	gaining basic skills in the formulation and numerical solution of complex boundary problems
Z zakresu kompetencji społecznych:	
PEU_K01	can work to resolve the tasks independently and in a team (participation in discussions on auditorium exercises in analyzing problems reported by other students)
PEU_K02	learn to think logically, clearly formulate issues and to resolve them within a specific theory and the specific assumptions

TREŚCI PROGRAMOWE		
	Forma zajęć - wykład	**Liczba godzin**
Wy1	Motto: "We will not talk unnecessary things" (Stanislaw Ignacy Witkiewicz Shoemakers) <u>Basic concepts:</u> guide to the basic concepts of topological conventions signs, basic definitions, classification - linear equations, half-linear quasi-linear examples.	1
Wy2	<u>Linear partial differential equations of second order on the plane</u> Classification, characteristic equation, performance, bringing hyperbolic, parabolic and elliptical to a canonical form.	2
Wy3	<u>The d'Alembert and Fourier</u> solution of the equation string by d'Alembert method, solution of the equation strings and heat flow equation Fourier method (separation of variables).	2
Wy4	<u>Laplace equation</u> physics issues leading to the Laplace equation, harmonic functions, removing the fundamental solution, maximum principle, uniqueness of	2

	solutions.	
Wy5	Normed spaces linear spaces, normed metric spaces, functional spaces, Banach space, unitary space, Hilbert space, the Pythagorean theorem, theorem on orthogonal projection.	2
Wy6	Sobolev spaces compactly supported functions, linear functionals, distribution, distribution derivatives, Sobolev space, spatial properties of H^1.	2
Wy7	Generalized solutions of elliptic equations II row Weak formulation of boundary value problems, Lax-Milgram theorem, application of Lax-Milgram theorem.	2
Wy8	Methods of variational equations The method of least squares orthogonal projection method, Galerkin method, Ritz method.	2
	Suma godzin	**15**

Forma zajęć - ćwiczenia		Liczba godzin
Ćw1	Solving problems of the simplest methods of integration of partial differential equations	1
Ćw2	Imports of second order linear equations to canonical form	2
Ćw3	Imports of second order linear equations to canonical form Solving boundary value problems by the method of separation of variables	2
Ćw4	Solving the boundary problems containing the Laplace equation	2
Ćw5	Solving the problems relating to properties of normed spaces	2
Ćw6	Solving the problems relating to properties of Sobolev space	2
Ćw7	Solving problems concerning the application of Lax-Milgram theorem (proof uniqueness of solutions). Solving problems using Galerkin and Ritz methods.	2
Ćw8	Solving problems using Galerkin and Ritz methods. Colloquium (45 minutes)	2
	Suma godzin	**15**

Forma zajęć - laboratorium		Liczba godzin
Lab1		
…		
	Suma godzin	

Forma zajęć - projekt		Liczba godzin
Pr1		
…		
	Suma godzin	

Forma zajęć - seminarium		Liczba godzin
Se1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Lecture: traditional form - definitions, theorems and proofs in all written on the blackboard. N2. Lectures and exercises: longer examples presented theorems and methods. N3. Classes: Discussion within a group of students of different abilities to solve problems. N4. Prepared lists and tasks on the website [2] for independent solution and opportunities for presentation and discussion exercises. The complete solution will be served at exercises, and some posted on the [2].

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1 (classes)	PEU_W01 PEU_W02 PEU_W03 PEU_U01 PEU_U02 PEU_U03 PEU_U04 PEU_K01 PEU_K02	assess the activities of students in solving problems formulated at the list of tasks
P1 (classes)	PEU_W01 PEU_W02 PEU_W03 PEU_U01 PEU_U02 PEU_U03 PEU_U04 PEU_K02	final assessment on the basis of the final test (45 minutes), including assessments for the activity
P2 (lecture)	PEU_W01 PEU_W02 PEU_W03 PEU_U01 PEU_U02 PEU_U03 PEU_U04 PEU_K02	Final Exam - tasks to solve

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

<u>LITERATURA PODSTAWOWA:</u>

[1] 1. R.V. Churchill, J.W.Brown, Fourier Series and Boundary Value Problems, McGraw-Hill Book Company, New York 1978.

[2] http://www.ib.pwr.wroc.pl/wpula

<u>LITERATURA UZUPEŁNIAJĄCA:</u>

[1] W. Puła, Mathematics. A Short introduction to Ordinary and Partial Differentia Equqtions, Politechnika Wrocławska, 2011.

OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ZAKŁAD, INSTYTUT, ADRES E-MAIL)

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Załącznik nr 6 do ZW 121/2020

WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO

KARTA PRZEDMIOTU

Nazwa w języku angielskim:	**Dynamika**
Nazwa w języku polskim:	**Dynamics**
Kierunek studiów (jeśli dotyczy):	***budownictwo***
Specjalność (jeśli dotyczy):	**Civil Engineering**
Stopień studiów i forma:	**~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu:	**obowiązkowy ~~/ wybieralny / ogólnouczelniany~~***
Kod przedmiotu:	**CEB007962**
Grupa kursów:	**~~TAK~~ / 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~~*	Egzamin / zaliczenie na ocenę*	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**2**		**1**		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			**1,0**		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	**0,7**		**0,6**		

* niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI

1. The student possesses knowledge of the areas of mathematics and physics necessary for the analysis of dynamics of structures.
2. The student knows the principles of analysis of bar structures statics.
3. The student has the necessary knowledge of structure designing and strength of materials.
4. The student has the necessary knowledge of the dynamics of one-degree-of-freedom systems (ones consisting of mass points, stiff discs and/or deformable bars).

CELE PRZEDMIOTU

C1. Gaining an in-depth knowledge of dynamic loads and the evaluation of civil engineering structures' vibrations.
C2. Learning the principles of solving the eigenproblem for multiple-degree-of-freedom systems (discrete or discretized).
C3. Learning the principles of solving the problem of harmonic forced vibration for multiple-degree-

of-freedom systems(discrete or discretized). C4. Gaining basic knowledge of designing dynamically loaded structures.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ	
Z zakresu wiedzy:	
PEU_W01	The student has an in-depth knowledge of engineering problems in structure dynamics.
PEU_W02	The student knows the principles of analysis of natural vibration of discrete systems and discretized bar structures.
PEU_W03	The student knows the principles of harmonically forced vibrations analysis, using both the direct method and the modal transformation method.
PEU_W04	The student has knowledge of the basic types of exciting vibration of civil engineering structures
Z zakresu umiejętności:	
PEU_U01	The student can create a discrete dynamic computation model of a bar system.
PEU_U02	The student can formulate equations of motion of discrete bar systems using the Force Method and Displacement Method
PEU_U03	The student can solve eigenproblems of discrete dynamic systems.
PEU_U04	The student can determine the full dynamic load of the structure.
PEU_U05	The student can determine the envelopes of the dynamic cross-section forces under harmonic excitation.
PEU_U06	The student can determine the analytical solution of an equation of motion of a one-degree-of-freedom system in special cases of excitation.
Z zakresu kompetencji społecznych:	
PEU_K01	The student is conscious of the need for furthering their knowledge of the dynamics of civil engineering structures through ongoing self-study.
PEU_K02	The student is conscious of the possibility that vibration of the designed structures can have negative effects.

TREŚCI PROGRAMOWE		
	Forma zajęć - wykład	**Liczba godzin**
Lec1	Aims, scope and plan of the subject. Overview of the engineering problems in structural dynamics.	1
Lec2	Dynamic degrees of freedom and generalized coordinates. Continuous and discrete dynamic models of deformable bar structures. Examples of determining the number of dynamic degrees of freedom of discrete bar systems, the degree of static and geometric (kinematic) indeterminacy. Geometric indeterminacy in the dynamic sense.	2
Lec3	Second order Lagrange's equations. Systems of coordinates and their transformations. The energetic balance and the matrix equation of motion of a discrete system. Elastic bonds in discrete bar systems, the definition of the displacement and stiffness matrices. Examples of calculating the displacement matrix in statically determinate and indeterminate systems.	2
Lec4	Examples of calculating the stiffness matrices in geometrically determinate and indeterminate systems. Examples of forming an equation of motion of a discrete system: a beam supporting structure for a rotating motor. Examples of determining the mass matrix and the generalized vector of the exciting forces in discrete bar systems.	2
Lec5	The eigenproblem of a discrete system. Example of analysis of the natural vibration of a simply supported beam with three dynamic degrees of freedom, the eigenforms of the vibration. Free vibration of the discrete system. Damping in civil engineering structures. Models of damping and the force transferred to foundations in discrete systems.	2
Lec6	The kinetostatic method. The principles of designing dynamically excited	2

	structures. The state of strain and state of strength. The idea of dynamic envelopes of cross-section forces . Harmonically excited steady-state vibration in discrete systems (direct method). Example of determining the dynamic envelopes of cross-section forces for a bar system with a discrete mass distribution.	
Lec7	The Orthogonality Priniple of natural vibration, the modal transformation method. Harmonic excitation in a one-degree-of-freedom system. The use of the modal transformation method for analysing harmonically excited steady-state vibration in multi-degree-of-freedom systems. The dynamics of a stiff solid on elastic ground.	2
Lec8	The use of the modal transformation method for analysing harmonic vibration of a block foundation. Special cases of excitation in a one-degree-of-freedom system: inertial excitation and kinematic excitation.	2
	Suma godzin	**15**

Forma zajęć - ćwiczenia		Liczba godzin
Ćw1		
...		
	Suma godzin	

Forma zajęć - laboratorium		Liczba godzin
Lab1	Aims, scope and plan of the subject.	1
Lab2	Elements of the matrix and vector calculus.	2
Lab3	One-degree-of-freedom systems.	2
Lab4	Arranging the elastic and damping bonds (in parallel, in series and mixed).	2
Lab5	Superposition of vibration. Beat.	2
Lab6	Discrete systems – beams and frames. The force method and the displacement method. Eigenproblem – eigenfrequency and eigenforms. Harmonically forced vibrations. Dynamic envelopes of the cross-section forces.	2
	Suma godzin	**15**

Forma zajęć - projekt		Liczba godzin
Pr1		
…		
	Suma godzin	

Forma zajęć - seminarium		Liczba godzin
Se1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE	
N1.	classic lecture
N2.	multimedial presentation
N3.	Examples of problem solution with the use of computer programs.

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F (laboratorium komputerowe)	PEU_U01 PEU_U02 PEU_U03 PEU_U04 PEU_U05 PEU_U06	aktywny udział podczas ćwiczeń
P (wykład)	PEU_W01-PEU_W04 PEU_U01- PEU_U06 PEU_K01, PEU_K02	kolokwium pisemne – pytania dotyczące teorii i problemów praktycznych

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] Z. WÓJCICKI, J. GROSEL, Structural Dynamics, WUT (PRINTAP Łódź, Wrocław 2012, Structural dynamics | Grosel, Jacek; Wójcicki, Zbigniew - Europeana Collections http://www.studia.pwr.wroc.pl/materialy/526/civil_engineering.html

[2] Teaching materials, http://www.studies.pwr.wroc.pl/teaching_materials/448/civil_engineering.html

LITERATURA UZUPEŁNIAJĄCA:

[1] J. LANGER, Dynamika budowli, Oficyna Wydawnicza PWr, Wrocław, 1980

[2] T. CHMIELEWSKI, Z. ZEMBATY, Podstawy dynamiki budowli, ARKADY, Warszawa, 1998

[3] M. KLASZTORNY, Mechanika. Statyka. Kinematyka. Dynamika., DWE, Wrocław 2000.

[4] R. LEWANDOWSKI, Dynamika konstrukcji budowlanych, Wyd. Polit. Poznańskiej, Poznań 2006.

[5] Z. OSIŃSKI, Tłumienie drgań, PWN, Warszawa, 1997.

[6] S. KALISKI, Mechanika techniczna, drgania i fale, PWN, Warszawa,1986.

[7] R. GUTOWSKI, W.A. SWIETLICKI, Dynamika i drgania układów dynamicznych, PWN, Warszawa, 1986.

[8] G. RAKOWSKI i in., Mechanika Budowli – ujęcie komputerowe, t.2, Arkady 1992.

OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ZAKŁAD, INSTYTUT, ADRES E-MAIL)

dr inż. Jacek Grosel, K11, jacek.grosel@pwr.wroc.pl

CZŁONKOWIE ZESPOŁU DYDAKTYCZNEGO (IMIĘ, NAZWISKO, ADRES E-MAIL)

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Załącznik nr 6 do ZW 121/2020

WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO

KARTA PRZEDMIOTU

Nazwa w języku angielskim:	**BIM in Civil Engineering**
Nazwa w języku polskim:	**BIM w konstrukcjach budowlanych**
Kierunek studiów (jeśli dotyczy):	***budownictwo***
Specjalność (jeśli dotyczy):	**Civil Engineering**
Stopień studiów i forma:	**~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu:	**obowiązkowy ~~/ wybieralny / ogólnouczelniany~~***
Kod przedmiotu:	**CEB007961**
Grupa kursów:	**~~TAK~~ / NIE***

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)			**60**		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)			**120**		
Forma zaliczenia	Examination / crediting with grade *	Examination / crediting with grade *	~~Examination /~~ crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS			**4**		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			**4,0**		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)			**3,3**		

*delete if applicable

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI

1. Knowledge of design principles, in particular in hydro- and geotechnics.
2. Knowledge of materials and technologies used in construction, in particular in hydro- and geotechnics.
3. Knowledge of assessment methods for the maintenance of earth hydrotechnical structures.
4. Knowledge of design supporting software as well as basics of CAD tools.

CELE PRZEDMIOTU

C1. Acquiring knowledge of basic computer methods in hydro and geotechnics and the use of BIM.
C2. Gaining knowledge in the field of three-dimensional soil reconstruction.
C3. Acquiring knowledge in design and modeling of geometry in 2D and 3D.
C4. Acquiring knowledge in the field of parametric modeling.
C5. Ability to work in team.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ
Z zakresu wiedzy: PEU_W01 One knows and is able to use computer software in hydro and geotechnical design. PEU_W02 One knows the theoretical basis for creating a 3D reconstruction of a substrate. PEU_W03 One knows the methods of design and modeling of hydrotechnical and special earth structures. **Z zakresu umiejętności:** PEU_U01 One is able to use computer software to support design process. PEU_U02 One is able to model, design and characterize selected constructions. **Z zakresu kompetencji społecznych:** PEU_K01 One is able to work individually and in a team on a project.

TREŚCI PROGRAMOWE		
Forma zajęć - wykład		**Liczba godzin**
Lec1		
…		
	Suma godzin	

Forma zajęć - ćwiczenia		**Liczba godzin**
Cl1		
...		
	Suma godzin	

Forma zajęć - laboratorium		**Liczba godzin**
Lab1	Introduction (course credit rules, office hours, literature). Discussion of BIM principles in historical context, in particular in hydrotechnics, geotechnics and special construction. Discussion of the design methods available for the engineers.	4
Lab2	History of CAD to BIM transition. Benefits of using BIM. Communication and data exchange in the investment process.	4
Lab3	Overview of available computer software. Problems of multidimensionality in design, normalization and standardization problems.	4
Lab4	Tools and functions supporting design. Introduction to software in hydro- and geotechnics. Basics of work in a selected program (menu overview, presentation of examples). Configuration.	4
Lab5	Introduction to the geographical information system. Basics of the selected GIS software.	4
Lab6	Introduction of theoretical foundations for modeling a substrate (reconstruction based on point information -wells). Theoretical basics of the kriging technique. Rules or selection of correlation radius and semi-variogram functions.	4
Lab7	Creating probable layer systems in the subsoil - 2D problem.	4
Lab8	Creating probable layer systems in the subsoil - 3D problem.	4
Lab9	Modeling of 3D geotechnical structures.	4
Lab10	Modeling of 3D geotechnical structures.	4
Lab11	Performing numerical calculations on the prepared model. Analysis of results. Attempt to optimize the original solution.	4
Lab12	Performing numerical calculations on the prepared model. Analysis of results. Attempt to optimize the original solution.	4
Lab13	Preparation of electronic project documentation. BIM elements in the scope of investment life cycle. Investment cost optimization analysis.	4
Lab14	Visualization and animation of the results.	4

Lab15	Summary and evaluation of the students.	4
	Suma godzin	**60**

Forma zajęć - projekt		Liczba godzin
Proj1		
…		
	Suma godzin	

Forma zajęć - seminarium		Liczba godzin
Sem1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE	
N1.	multimedia presentation
N2.	personal computer, interactive whiteboard (calculations, drawings, descriptions)

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F (laboratory)	PEU_W01, PEU_W02, PEU_W03, PEU_U01, PEU_U02, PEU_K01.	report
L (laboratory) = 0,9xF+0,1x PRESENCE		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] Kasznia, D., Magiera, J., & Wierzowiecki, P. (2018). BIM w praktyce: standardy, wdrożenie, case study. Wydawnictwo Naukowe PWN.
[2] Gwóźdź, R., Gwóźdź-Lasoń, M., Lach, K., & Urbański, A. (2016). „Podstawy projektowania geotechnicznego: wprowadzenie do nowych technologii w geotechnice praca zbiorowa”. „The Geotechnical Design: an introduction to new technologies in geotechnics: collective work”.
[3] Zimmermann, T., Truty, A., Urbański, A., & Podleś, K. (2008). Z-Soil user manual. Zace Services, Switzerland.
[4] GEO5 User’s manual. Fine Ltd. Prague 2016.
[5] Team, Q. D. (2016). QGIS geographic information system. Open source geospatial foundation project.

LITERATURA UZUPEŁNIAJĄCA:

[6] Barvashov, V. A. Information Systems in Geotechnics-BIM Geotechnics Boldyrev GG, Doctor of Technical Sciences, Director for Research and Innovation, NPP Geotek LLC, Penza, Russia, g-boldyrev@ geoteck.ru Barvashov VA Ph. D., Leading Researcher, NIIOSP named after NM Gersevanova, Moscow.
[7] Graser, A. (2013). Learning QGIS 2.0. Packt Publishing Ltd.

OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ZAKŁAD, INSTYTUT, ADRES E-MAIL)

Katedra Geotechniki, Hydrotechniki, Budownictwa Podziemnego i Wodnego dr hab. inż. Adrian Różański, adrian.rozanski@pwr.edu.pl

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Załącznik nr 6 do ZW 121/2020

WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO

KARTA PRZEDMIOTU

Nazwa w języku angielskim:	**Hydraulics in Civil Engineering**
Nazwa w języku polskim:	**Hydraulika w budownictwie**
Kierunek studiów (jeśli dotyczy):	*budownictwo*
Specjalność (jeśli dotyczy):	**Civil Engineering**
Stopień studiów i forma:	**~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu:	**obowiązkowy ~~/ wybieralny / ogólnouczelniany~~***
Kod przedmiotu:	**CEB007861**
Grupa kursów:	**~~TAK~~ / 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	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	~~Examination~~ / crediting with grade *	Examination / crediting with grade *
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**1**			**1**	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				**1,0**	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	**1,0**			**0,6**	

*delete as applicable

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI

1. Student possesses knowledge of the areas of mathematics and physics, basic hydraulics, geology and hydrogeology.
2. Student possesses knowledge of the basic property of the solid body and liquids.

CELE PRZEDMIOTU

C1. Gaining knowledge in the range of hydraulics laws, with hydrostatics and hydrodynamics
C2. Gaining knowledge in the range of pressure pipe flow and open channel flow, in steady and unsteady movement.
C3. Gaining knowledge in the range of porous media water flow.
C4. Gaining knowledge in the range of hydraulic calculations including: hydrostatic force acting on the flat and curved surfaces, simple hydraulic systems calculation, open channel designing, determining of bridges and culverts cross-sections, designing of solid and temporary

	dewatering systems,.
C5.	Gaining knowledge of realizing laboratory measurements in the range of hydrostatics and hydrodynamics.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ	
Z zakresu wiedzy:	
PEU_W01	Knows and understands the basic hydraulics laws in the range of hydrostatics and hydrodynamics, with the equations describing laminar and turbulent flows of compressible and non compressible fluid (Navier-Stokes and Reynolds equations)
PEU_W02	Knows theory of laminar and turbulent flow in pressured pipes, with Bernoulli's equation, equations for friction and local loss of head calculation.
PEU_W03	Gaining knowledge in range of open channel flow calculations, with Chezy equation, calculations principles of most hydraulically efficient cross-section, knows theory of critical movements.
PEU_W04	Knows theory of porous media flow and gaining knowledge in range of simplified hydraulic filtration model.
PEU_W05	Gaining knowledge in range of hydro-engineering structures, with siphons and syphons, bridges and culverts.
Z zakresu umiejętności:	
PEU_U01	Gaining skills of hydrostatic force calculation on flat and curved surfaces, buoyancy force of submerged solid body.
PEU_U02	Gaining skills of orifices outflow and weir discharge calculation.
PEU_U03	Gaining skills of simple water system calculation, consists of series or parallel pipes.
PEU_U04	Gaining skills of open channel project.
PEU_U05	Gaining skills of horizontal or vertical drainage system calculation of building trench.
PEU_U06	Gaining skills of small bridge or culvert cross-section calculation.
PEU_U07	Gaining skills of laboratory and ground measurements in the range of flow velocity and discharge, stage or depth of water flow
Z zakresu kompetencji społecznych:	
PEU_K01	Is able to work individually on the realization of strict designing problem or in the team during realizing of ground or laboratory measurements.
PEU_K02	Is conscious of necessity knowledge widening in the range of contemporary technologies in hydraulics and computer programs for designing of hydro-engineering structures.

TREŚCI PROGRAMOWE		
Forma zajęć - wykład		**Liczba godzin**
Lec1	Short history of hydraulics as the science. Fundamental physical properties of water. Newton' law. Forces in fluid field. Pressure definition and its properties. Hydrostatics force on flat and curved surfaces. Buoyancy – Archimedes's law.	2
Lec2	Principles of fluid flow. Types of fluid motion in pipes and open channels. Basic hydraulics equations – continuity equation, energy equation, and momentum equation. Reynold's experiment. Water flow in pipes. Friction factor for laminar and turbulent flow.	2
Lec3	Water flow in closed conduits or pipes, local head losses. Designing of simple pressured pipes. Designing of siphons and syphons – calculating examples. Partially full closed conduits.	2
Lec4	Designing of the most hydraulically efficient open channels. Calculating of stage – discharge relation for natural river cross-section. Numerical models of open channel flow. Specific energy definition with open channel flow. Critical water flow in open channels. Calculating examples.	2

Lec5	Gradually and rapidly varied flow. Hydraulic jump as the example of rapidly varied flow. Differential equation of gradually varied flow in open channels – artificial and natural ones. Unsteady water flow in closed conduits and in open channels.	2

Lec6	Water outflow through orifices. Weirs and their classification in the range of constructional solutions and hydraulics of the water flow. The principles of weirs calculations. Calculation of road culverts. Spillways and stilling basins of the dams creating storage reservoirs. Control cross-sections of hydro-engineering structures.	2
Lec7	Ground and laboratory measurements, of pressure, water stages, water depths, velocity or flow discharge. The principles of ground water flow. Darcy's and Dupuit's Law. Laminar and turbulent ground water flow.	2
Lec8	Class test	1
	Suma godzin	**15**

Forma zajęć - ćwiczenia		Liczba godzin
Cl1		
...		
	Suma godzin	

Forma zajęć - laboratorium		Liczba godzin
Lab1		
...		
	Suma godzin	

Forma zajęć - projekt		Liczba godzin
Proj1	Hydrostatic force calculation on flat and curved surfaces, determining of direction of acting and point of force imposing.	2
Proj2	Project of water supply system of construction site, with determining of water requirement, the choice of source of water uptake, the choice of diameter of supply pipe.	2
Proj3	Project of sewage system, with waste water balance, choice of waste water receipt, the choice of diameter of sewage conduit.	2
Proj4	Discharge calculation in open channels. Project of optimal cross-section of an open channel.	2
Proj5	Determining of flow condition on the chosen length of natural river, with water passing through bridge or culvert cross-section with HEC-RAS numerical model.	7
	Suma godzin	**15**

Forma zajęć - seminarium		Liczba godzin
Sem1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Laptop with Power Point for multimedia presentation. N2. Computer programs in computer laboratory of Institute of Geotechnics and Hydrotechnics, for realizing of project exercises.

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1 (lecture)	PEU_W01 ÷ PEU_W05	
P = F1 (lecture)		Written test – questions on theory and practical problems.
E2 (project)	PEU_U01 ÷ PEU_U07	
P = F2 (project)		Customize of the multi elemental project.

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

1. A. Chadwick, J. Morfett, M. Borthwick. Hydraulics in Civil and Environmental Engineering. Taylor & Francis Group – Spon Press. London 2004.
2. M. Kay. Practical Hydraulics. Taylor & Francis Group – Routledge. New York 2008.
3. R.J. Houghtalen, N.F.C. Hwang, A. Akan Osman. Fundamentals of Hydraulic Engineering Systems. Pearson Education, Inc. New Jersey 2010.

LITERATURA UZUPEŁNIAJĄCA:

1. A. Prakash. Water resources engineering kandbook of essential methods and design. ASCE Press 2004.
2. R.M. Khatsuria. Hydraulics of Spillway and Energy Dissipators. Marcel Dekker 2005.

OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ZAKŁAD, INSTYTUT, ADRES E-MAIL)

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Zał. nr 6 do ZW 121/2020

WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO

KARTA PRZEDMIOTU

Nazwa w języku angielskim:	**Advanced computer aided engineering**
Nazwa w języku polskim:	**Zaawansowane komputerowe wspomaganie Projektowania**
Kierunek studiów (jeśli dotyczy):	***budownictwo***
Specjalność (jeśli dotyczy):	**Civil Engineering**
Stopień studiów i forma:	**~~I /~~ II stopień*, stacjonarna ~~/ niestacjonarna~~***
Rodzaj przedmiotu:	**obowiązkowy /~~ wybieralny / ogólnouczelniany~~***
Kod przedmiotu:	**CEB007761**
Grupa kursów:	**~~TAK /~~ NIE***

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)			**30**		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)			**60**		
Forma zaliczenia	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	~~Egzamin /~~ zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS			**2**		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			**2,0**		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)			**1,2**		

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Able to identify and to define loads acting on complex building structures.
2. Knows standards and the guidelines and regulations for the design of buildings and their components.
3. Has a developed theoretical knowledge and skills for dimensioning and construction of elements and complex building structures.
4. Has the ability to model complex 2D and 3D structures using FEM.

CELE PRZEDMIOTU

C1. Developing and strengthening ability of applying methods of modeling and design of complex, spatial constructions using computer programs.
C2. Understanding the theoretical foundations of computer modeling of complex buildings

and the interpretation and verification of results, including the issues of non-linearity and dynamic range. C3. Acquiring the ability to select and use the software used in design practice for solving spatial complex buildings.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ	
Z zakresu wiedzy:	
PEU_W01	Knows and understands the principles of computer-aided modeling, calculation and dimensioning of complicated spatial structures and solving mechanics and structural analysis of 2D and 3D in the linear and non-linear statics, dynamics and stability.
Z zakresu umiejętności:	
PEU_U01	Can select and use computer programs for analysis and design of complex structures.
PEU_U02	Can model in the environment of the finite element method, defines calculation model; can define and perform advanced linear and non-linear analysis of complex 2D and 3D engineering structures.
PEU_U03	Can properly interpret and critically evaluate the results of numerical analysis of complex engineering structures.
Z zakresu kompetencji społecznych:	
PEU_K01	Able to work on the implementation of tasks independently or in a team project (team preparation and presentations, giving classes, reports from projects); is responsible for the accuracy of the results of the work and its correct interpretation.
PEU_K02	Is aware of the need to increase knowledge in the field of contemporary techniques and software for the design of building structures.

TREŚCI PROGRAMOWE		
	Forma zajęć - wykład	**Liczba godzin**
Wy1		
…		
	Suma godzin	

	Forma zajęć - ćwiczenia	**Liczba godzin**
Ćw1		
...		
	Suma godzin	

	Forma zajęć - laboratorium	**Liczba godzin**
La1	Introduction: Training on health and safety rules. Discussion of the completion rules. Set a schedule of classes. Overview and introduction to computational programs used in relation to the 2D and 3D problems.	1
La1	Analysis of the possibilities of using engineering design software to support the verification of the results of laboratory tests.	1
La2	Presentation of the principles of computer modeling using FEM of complex engineering structures – examples for 3D bar structures, plates and shields.	2
La3	Presentation of the principles of computer modeling using FEM of complex engineering structures – examples for shells and solid	2

	structures.	
La4	Modelling and analysis of complex building and engineering structures – examples prepared and presented by students – 3D bar structures.	2
La5	Modelling and analysis of complex building and engineering structures – examples prepared and presented by students – plate structures.	2
La6	Modelling and analysis of complex building and engineering structures – examples prepared and presented by students – shell structures.	2
La7	Modelling and analysis of complex building and engineering structures – examples prepared and presented by students – solid structures.	2
La8	Solving examples of complex building and engineering structures – verification test.	2
La9	Modeling and solving examples of complex constructions in terms of research - design of plates and shields (eg. Lusas, Robot).	2
La10	Modeling and solving examples of complex constructions in terms of research - design of shells and solids (eg. Lusas, Robot).	2
La11	Construction optimization problems – introduction to modeling (eg. Solver, Robot).	2
La12	Construction optimization problems of bar structures – solving examples (eg. Solver, Robot).	2
La13	Construction optimization problems of bar structures – solving examples (eg. Solver, Robot).	2
La14	Shape and topology optimization problems (eg. ESO).	2
La15	Summary. Discussion. Final verification. Completion.	2
	Suma godzin	**30**

Forma zajęć - projekt		Liczba godzin
Pr1		
…		
	Suma godzin	

Forma zajęć - seminarium		Liczba godzin
Se1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Laboratory: student teams multimedia presentations: defining and solving of problems using software; analysis and discussion of results. N2. Common solving of design problems. N3. Contact hours.
Stationary or on-line teaching.

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ		
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_U02, PEU_U03	Testy weryfikacyjne – rozwiązanie przykładó w podczas laboratorium oraz w domu.
F2	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02	Prezentacja zespołowa i raport z rozwiązania własnego, grupowego lub indywidualnego zagadnienia projektowego.
P = 0,4xF1+0,55xF2+0,05xOBECNOŚĆ		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] Zienkiewicz O. C., Taylor R. L., Zhu J. Z., The Finite Element Method, Sixth Edition, McGraw-Hill, 2005.
[2] McCormack J., Structural Analysis Using Classical and Matrix Methods, John Wiley & Sons, 2007.
[3] Rombach G. A., Finite-element design of concrete structures, Practical problems and their solutions, ICE publishing, 2011.
[4] Arora J. S., Optimum design, McGraw-Hill, Inc., 1989 (ex.).
[5] Xie**,** Yi Min, Steven**,** Grant P., Evolutionary Structural Optimization, Springer, 1997.
[6] Muñoz-Rojas**,** Pablo Andrés (Ed.), Optimization of Structures and Components, Springer, 2013.
[7] Program manuals (Robot, Lusas, Advanceed Steel, Tekla, etc.).
[8] https://www.autodesk.pl/

LITERATURA UZUPEŁNIAJĄCA:

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http://www.solid.lth.se/research/structural-optimization/
[10] *Elsevier*; http://www.elsevier.com
https://www.journals.elsevier.com/computers-and-structures
https://www.journals.elsevier.com/case-studies-in-structural-engineering
https://www.journals.elsevier.com/engineering-structures
https://www.journals.elsevier.com/finite-elements-in-analysis-and-design
https://www.journals.elsevier.com/automation-in-construction
https://www.journals.elsevier.com/advances-in-engineering-software
https://www.journals.elsevier.com/computer-methods-in-applied-mechanics-and-engineering
https://www.journals.elsevier.com/structures
https://www.journals.elsevier.com/journal-of-building-engineering
https://www.journals.elsevier.com/archives-of-civil-and-mechanical-engineering
[11] *Springer*; https://www.springer.com/gp
https://link.springer.com/journal/158
(Structural and Multidisciplinary Optimization)
https://www.springer.com/new+%26+forthcoming+titles+%28default%29/journal/11527
(Materials and Structures)

OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ZAKŁAD, ADRES E-MAIL)

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Załącznik nr 6 do ZW 121/2020

WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO

KARTA PRZEDMIOTU

Nazwa w języku angielskim:	**Metal structures - objects**
Nazwa w języku polskim:	**Konstrukcje metalowe - obiekty**
Kierunek studiów (jeśli dotyczy):	***budownictwo***
Specjalność (jeśli dotyczy):	**Civil Engineering**
Stopień studiów i forma:	**~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu:	**obowiązkowy ~~/ wybieralny / ogólnouczelniany~~***
Kod przedmiotu:	**CEB007661**
Grupa kursów:	**~~TAK~~ / 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	Examination ~~/ crediting with grade~~ *	Examination / crediting with grade *	Examination ~~-~~/ crediting with grade *	~~Examination~~ / crediting with grade *	Examination ~~-~~/ crediting with grade *
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**2**			**2**	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				**2,0**	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	**1,1**			**1,1**	

*delete as applicable

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI

1. Is able to determine: the cases of actions, calculation of their intensity, making of their right combination for an individual building systems.
2. Has a knowledge of the mechanics of buildings, strength of materials, shaping of elements and connections used in metal structures.
3. Is able to design and calculate connections according to PN-EN 1993-1-1, PN-EN 1993-1-5, PN-EN 1993-1-8.
4. Has a knowledge of the modelling of structures in MES and the ability to use computer software.

CELE PRZEDMIOTU

C1. To acquaint students with primary structure and the skeleton of industrial buildings, long span coverings, typical structures of tanks, siloses for bulk materials, chimneys, towers masts and

multi-storey buildings, and English appropriate terminology. C2. To acquaint students with the rules of setting the static schemes for mentioned above systems regarding their specify of actions, determining the internal forces by simplified and accurate methods of static calculations. C3. Training of dimensioning of steel cross-sections and members. C4. Developing of skills of the rational shaping of different steel structural members, division on field components, calculation of shop and site connections. C5. Developing of skills of description of building design and executive design, descriptive part, calculation and graphical part for different steel structures based on the example of the space regular structure. C6. Training of the cooperation and integration of Polish and foreign students in exchange of experience, knowledge and team work. C7. To deepen and strengthen the knowledge of the English terminology appropriate for different types of steel structures.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ
Z zakresu wiedzy: PEU_W01 Has an enlarged knowledge of: advanced topics of the strength of materials, analysis and shaping of complex steel structures, calculation of adequacy of connections of different types. PEU_W02 Knows and understands the rules of analysis of static schemes and stability for complex strut and skin structures by simplified methods (substitutional simple schemes) and accurate methods (computer programs). **Z zakresu umiejętności:** PEU_U01 Is able to shape the overall geometry and the cross-sections for different types of steel structures and to set their assembling components based on the static and strength analysis. PEU_U02 Has the ability to model and design the complex structural elements in the building and executive design. PEU_U03 Develop the skills of designing steel structures according to Eurocode3 in English. **Z zakresu kompetencji społecznych:** PEU_K01 Shows a willingness to improve professional and personal skills, extends the knowledge of technical English language. PEU_K02 Appreciates the importance of mutual support and teamwork skills, communicates effectively in technical English vocabulary related to civil engineering.

TREŚCI PROGRAMOWE		
Forma zajęć - wykład		**Liczba godzin**
Lec1	Primary structure of industrial buildings	2
Lec2	Skeleton members and cladding	2
Lec3	Bracings of industrial buildings - types and geometry	2
Lec4	Dead and imposed loads	2
Lec5	Dimensioning of main members of industrial buildings	2
Lec6	Dimensioning of main members of industrial buildings (continuation)	2
Lec7	Anchorage of main and secondary columns in the foundations	2
Lec8	Construction of long - span coverings – flat and barrel structures	2
Lec9	Construction of long - span coverings – domes	2
Lec10	Construction of long - span coverings – cable structures	2
Lec11	Tangs for liquids and silos for bulk materials	2
Lec12	Chimneys – actions, construction, design	2
Lec13	Towers – actions, construction, design	2

Lec14	Masts – actions, construction, design	2
Lec15	Skeletons of multi – storey buildings	2
	Suma godzin	**30**

Forma zajęć - ćwiczenia		**Liczba godzin**
Cl1		
...		
	Suma godzin	

Forma zajęć - laboratorium		**Liczba godzin**
Lab1		
…		
	Suma godzin	

Forma zajęć - projekt		**Liczba godzin**
Proj1	Edition of tasks related to the space covering – discussion of rules and conditions of gaining the credit- general characteristics of steel space structures	2
Proj2	Discussion of static schemes of space structures	2
Proj3	Discussion and presentation of geometry of the space structures	2
Proj4	Dead and imposed loads acting on roof coverings	2
Proj5	Simplified calculations of space structures based on the beam and plate analogy	2
Proj6	Simplified calculations of space structures based on the beam and plate analogy (continuation)	2
Proj7	Accurate static computation based on computer programs (creation of models)	2
Proj8	Dimensioning of strut elements under axial or/and axial and bending – creation of zones	2
Proj9	Types of joints used in space structures – patent and other constructions	2
Proj10	Options of joints related to the overall geometry and assembly concept	2
Proj11	Presentation and analyses of existing student works	2
Proj12	Discussion of general rules related to the executive design for steel structures	2
Proj13	Discussion of general rules of execution of assembling and shop drawings for steel structures	2
Proj14	Discussion of current issues related with the points (proj6 - proj13)	2
Proj15	Successive testing of students' skills and the level of progress in the execution of the given task (proj6 – proj13)	2
	Suma godzin	**30**

Forma zajęć - seminarium		**Liczba godzin**
Sem1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Lecture: informative lecture, problem lectures, multimedia presentation N2. Project: traditional and multimedia presentation, consultations

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1 (project)	PEU_U01	Evaluation of calculation and graphical parts of the design
	PEU_U02	
	PEU_U03	
F2 (project)	PEU_W02	Activity during problem discussions
P=0,6xF1+0,4xF2 (project)		
P (lecture)	PEU_W01	Examination
	PEU_W02	

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] Gaylord E.H.,Gaylord Ch.N., Stallmeyr J.E., Design of steel structures, Mc Graw-Hill, Inc., 1992
[2] Newman A., Metal building systems, design and specifications, Mc Graw-Hill., New York 1997
[3] Łubiński M., Żółtowski W., Konstrukcje metalowe, część 2, Arkady, Warszawa 2004
[4] Biegus A., Stalowe budynki halowe, Arkady, Warszawa 2003
[5] Rykaluk K., Konstrukcje stalowe. Kominy, wieże, maszty, Oficyna Wydawnicza PWr, Wrocław 2005
[6] Trahair N.S. and others, The behaviour and design of steel structures to EC3, Fourth edition, Taylor & Francis Group, London and New York 2008
[7] Makowski Z.S., Analysis, Design and Construction of braced Barrel Vaults, Elsevier Applied Science Publishers, London 1985

LITERATURA UZUPEŁNIAJĄCA:

[1] Bródka J. I inni., Przekrycia strukturalne, Arkady, Warszawa 1985
[2] Nooshin H., Third International Conference on Space Structures, London 1984

OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ZAKŁAD, INSTYTUT, ADRES E-MAIL)

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Załącznik nr 6 do ZW 121/2020

WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO

KARTA PRZEDMIOTU

Nazwa w języku angielskim:	**Concrete Structures - objects**
Nazwa w języku polskim:	**Konstrukcje betonowe – obiekty**
Kierunek studiów (jeśli dotyczy):	***budownictwo***
Specjalność (jeśli dotyczy):	**Civil Engineering**
Stopień studiów i forma:	**~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu:	**obowiązkowy ~~/ wybieralny /~~ ~~ogólnouczelniany~~***
Kod przedmiotu:	**CEB007561**
Grupa kursów:	**~~TAK~~ / 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	Examination / ~~crediting with grade~~ *	Examination / crediting with grade *	Examination / crediting with grade *	~~Examination~~ / crediting with grade *	Examination / crediting with grade *
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**2**			**2**	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				**2,0**	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	**1,1**			**1,1**	

*delete as applicable

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI

1. Student possesses the knowledge of general mechanics, mechanics (strength) of materials and the rules of general designing of building constructions.
2. Student is able to define correctly the construction and their elements calculation models, that are used for analytical and computer analysis of complex constructions.
3. He knows the principles of forming, dimensioning and constructing complex reinforced concrete structur of the building and engineering objects.
4. He is able to use selected computer software that enables to design selected complex reinforced concrete constructions.

CELE PRZEDMIOTU

C1. Familiarizing students with the rules of designing complex reinforced concrete constructions as a rational joint of beams, columns, shells, plates and beam-walls.

C2.	Forming the ability of independent modelling and analyzing complex, diversified reinforced concrete structures using analytical and computer calculations.
C3.	Familiarizing students with the principles of forming, calculating and constructing main reinforced concrete elements forming up: the supporting construction of volume general building and engineering building objects such as industrial buildings and multi-storey framework buildings as well as roofs, walls, bottoms and foundation of liquids tanks, silos and reinforced concrete tower buildings.
C4.	Reaffirming the ability of an effective cooperation in a project team including the multi-field character of project process.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

Z zakresu wiedzy:

PEU_W01 Student knows and comprehends the rules of idealizing, numerical modelling and analyzing the complex reinforced concrete structures.

PEU_W02 Student possesses profoundly wide knowledge of analysis, dimensioning and constructing the complex reinforced concrete structures.

PEU_W03 Student is familiar with the principles of static work under the influence of diversified loads over the beam and column reinforced concrete constructions, slab reinforced concrete constructions, beam-walls reinforced concrete constructions and shell reinforced concrete constructions.

Z zakresu umiejętności:

PEU_U01 Student is able to classify and analyze analytically or numerically the complex reinforced concrete structures in relation to varied forces, and consequently, to critically assess the obtained results.

PEU_U02 Student is able to design the complex reinforced concrete constructions and prepare a necessary project documentation.

Z zakresu kompetencji społecznych:

PEU_K01 Student is aware of importance of non-technical aspects in an engineer's work as well as of indispensability of continuous learning.

PEU_K02 Student effectively cooperates with a project team and respects the safety regulations to protect himself and the project team members during work.

TREŚCI PROGRAMOWE

Forma zajęć - wykład		Liczba godzin
Lec1	Forming principles and outline of the analysis of a column-and-girder-frame construction of the industrial buildings with overhead traveling cranes.	2
Lec2	Forming, analyzing and constructing reinforced and prestressed single- and multi-span two-way reinforced concrete slabs.	2
Lec3	Forming, analyzing and constructing solid web girders and prestressed roof trusses.	2
Lec4	Designing overhead crane girders and single- or double-tee columns in industrial reinforced concrete buildings.	2
Lec5	Forming and designing the construction of the multi-storey framework reinforced concrete buildings.	2
Lec6	Designing column-and-girder constructions. Reinforcing the slab floor against punching.	2
Lec7	Forming, analyzing and constructing reinforced concrete beam- walls; designing folded plate covers.	2
Lec8	Outline of the principles of forming and usage of the reinforced concrete shells as the thin-walled constructions, used in volume general building and industrial building objects.	2
Lec9	General rules of forming the thin-walled covers. Designing monolithic and prefabricated reinforced concrete domes.	2
Lec10	Designing underground, on-the-ground and tower reinforced concrete tanks	2

	for liquids.	
Lec11	Designing the underground and on-the-ground box-shaped (rectangular shaped) tanks for liquids used in municipal and industrial building	2
Lec12	An outline of forming and designing cooling towers, reinforced concrete chimneys and other reinforced concrete tower objects. Technological background of thin-walled reinforced concrete constructions' erection.	2
Lec13	Forming slender and corpulent silo bins as well as silo batteries in corn elevators. Principles of setting loads in silos and the outline of studies on the influence of loose materials on the silo's construction elements.	2
Lec14	Designing silos and bunkers with the diversified heights, detached and blocked ones.	2
Lec15	Technological aspects of designing thin-walled constructions made of concrete; the rules of performing proofed expansion joints and working joints.	2
	Suma godzin	**30**

Forma zajęć - ćwiczenia		Liczba godzin
Cl1		
...		
	Suma godzin	

Forma zajęć - laboratorium		Liczba godzin
Lab1		
…		
	Suma godzin	

Forma zajęć - projekt		Liczba godzin
Proj1	Handing out the project topics in a field of complex reinforced concrete constructions in the form of domes and cylindrical and rectangular shaped tanks for liquids.	2
Proj2	Conditions for preparation of two initial geometrical construction variants; talking over a choice of construction materials and technological background of discussed construction variants.	2
Proj3	Approval of variant choice for a project use; talking over the rules of creating calculation models used for static analysis performed with the help of the following methods: analytical, Finite Element Method (FEM) or simplified methods	2
Proj4	Presenting the rules of compiling loads in a construction and defining the extreme inner forces. Describing the characteristics of defining the loads in tanks for liquids.	2
Proj5	Talking over static calculations with the use of analytical methods and FEM for the selected construction variant. Checking up the results applying the simplified methods.	2
Proj6	Selection of the parts of the analysed constructions for further analysis and dimensioning. Discussion over the rules of preparing building and working drawings of thin-walled reinforced concrete structures.	2
Proj7	Taking over the results of statical analysis and characteristics of thin-walled elements' dimensioning, taking into consideration ultimate and serviceability limit states	2
Proj8	Discussion over the typical mistakes and faults in analysis and preparation of the construction drawings.	2
Proj9	Discussion over the dimensioning results of the selected parts of a	2

	construction.	
Proj10	Initial evaluation of the submitted drafts of reinforcement members.	2
Proj11	Discussion over the characteristics of outlining the thin-walled cross-sections and forming trusses and connection zones of construction component elements.	2
Proj12	Evaluation of cross-section geometry, insert placement and submitted assembly and working drawings	2
Proj13	Talking over the rules of applying technical characteristics and guidelines on gathering the final project documentation.	2
Proj14	Final evaluation of submitted working drawings.	2
Proj15	Collection of the projects. Crediting with notes. Final summing-up.	2
	Suma godzin	**30**

Forma zajęć - seminarium		Liczba godzin
Sem1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Lecture – Informative lecture, problem-solving lecture, multimedia presentations. N2. Project – Discussing over the project requirements, overview of possible solutions , consultations

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
P (project)	PEU_W01 PEU_W02 PEU_W03 PEU_U01 PEU_U02 PEU_K02	Completion of a project and its presentation
P (lecture)	PEU_W01 PEU_W02 PEU_W03 PEU_U01 PEU_U02	Exam
P (laboratory etc.) =		
P (lecture) =		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

<u>**LITERATURA PODSTAWOWA:**</u>

[1] Nawy E., Concrete Construction Engineering. Handbook. CRC Press, New York 2008.
[2] Limbrunner G. F., Agdhayere A. O., Reinforced Concrete Design. Prentice Hall, New Jersey 2010.
[3] Kobiak J., Stachurski W., Konstrukcje żelbetowe, t. 2, t. 4. Arkady, Warszawa 1987, 1991.
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LITERATURA UZUPEŁNIAJĄCA:

[1 Budownictwo Przemysłowe, t. XIII. Zbiorniki, zasobniki, silosy, kominy i maszty. Arkady, Warszawa 1966.
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[5] Satereh M., Darvas R., Concrete Structures, Prentice Hall, New Jersey 2007.

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CZŁONKOWIE ZESPOŁU DYDAKTYCZNEGO (IMIĘ, NAZWISKO, ADRES E-MAIL)
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Załącznik nr 6 do ZW 121/2020

WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO	
KARTA PRZEDMIOTU	
Nazwa w języku angielskim:	**Selected topics in geo-engineering – Foundations**
Nazwa w języku polskim:	**Wybrane zagadnienia geoinżynierii – Fundamenty**
Kierunek studiów (jeśli dotyczy):	***budownictwo***
Specjalność (jeśli dotyczy):	**Civil Engineering**
Stopień studiów i forma:	**~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu:	**obowiązkowy ~~/ wybieralny /~~ ~~ogólnouczelniany~~***
Kod przedmiotu:	**CEB007361**
Grupa kursów:	**~~TAK~~ / NIE***

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	**15**			**30**	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	**30**			**30**	
Forma zaliczenia	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	~~Examination~~ / crediting with grade *	Examination / crediting with grade *
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**1**			**1**	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				**1,3**	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	**0,5**			**1,1**	

*delete as applicable

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI

P1. Fundamentals of bearing constructions in civil engineering, fundamentals of strength of materials and soil mechanics.
P2. Basic types of foundations for different simple geoengineering conditions, geotechnical categories GC1 and GC2, construction processes of foundations, functional and environmental aspects of foundations depending on the type of object, loadings, soil conditions and water in soils.
P3. Principles of soil-structure interacion for undeformable foundations, embedded walls, retaining structures; calculation of the bearing capacity, stability of slopes, calculation of soil and water pressure.
P4. Design of basic concrete elements, like beams, footings and columns; reinforcement calculation.

P5. Solving of the simplest linear ordinary differential equations with constant coefficients.

CELE PRZEDMIOTU
C1. Ability in modelling of the soil-structure interaction for deformable foundations on deformable subsoil; contact stresses redistribution, changes of internal forces, mining influences as a static excitation. C2. Knowledge of mathematical solutions to simple deformable foundations on the elastic subsoil, the Winkler model and the elastic halfspace; application of differential equations. C3. Building an engineering intuition in prediction of internal forces in foundations, non-uniform settlements and rational analysis of structures interacting with the subsoil. C4. Gaining knowledge in more complex problems of the earth pressure prediction, generalizations of the Coulomb solution. C5. Developing knowledge and ability of application of methods of the earth pressure reduction, stability improvement, shaping of retaining walls. C6. Understanding necessity of safety in geotechnical design – design approaches with partial safety factors due to the Eurocode EC7-1. C7. Developing skills in design of foundations.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ	
Z zakresu wiedzy:	
PEU_W01	student gains a theoretical knowledge in applications of ordinary differential equations towards calculation of deformable foundation beams, as well as piles and walls embedded in soils, a better understanding of the method of virtual forces (the Bleich method) - being a prototype for the boundary element method,
PEU_W02	understands a theoretical background of the method of partial safety factors in geoengineering, uses the design approaches required by the Eurocode EC7-1 – the GEO stability criteria in this group,
PEU_W03	understands problems of soil-structure interaction on the example of elastic subsoils, knows how to design retaining constructions transmitting large loadings on the soil – particularly non-vertical forces, gets a background to identify poor engineering solutions,
Z zakresu umiejętności:	
PEU_U01	student can define and apply appropriate calculation models for deformable foundations and deformable soils, analyses internal forces in foundations and combinations of such actions (also for mining excitations),
PEU_U02	can interpret the special role played by elastic fixities of constructions in the soil, is aware of fundamental shortcomings in commercial codes of CAD for CE designers,
PEU_U03	becomes skillful in modelling of the soil-structure interaction problems, can calculate more complex foundations within the geotechnical category 2 and 3,
Z zakresu kompetencji społecznych:	
PEU_K01	student improves the ability to work alone and in a group of designers (due to discussions with other students during class-projects and with the teacher),
PEU_K02	drills in logical thinking, clear formulation of theses and requirements, concentration on given tasks – within a given theory and set margins of assumptions.

TREŚCI PROGRAMOWE		
	Forma zajęć - wykład	**Liczba godzin**
Lec1	<u>Examples of the soil-foundations interaction</u>: Role of the foundation stiffness, influence of a superstructure stiffness and the subsoil compressibility on contact forces and structural behaviour	1
Lec2	<u>Linear calculation models of the subsoil compressibility</u>: Global models – the Winkler subsoil, the Pasternaka one, the Kerr one *etc.*, local models – the elastic halfspace, finite elastic layers;	2

	rational selection of the most adequate linear model, real-soil behaviour and application limits of the linear models; values of parameters of the models	
Lec3	Calculation of simple foundations resting on the linear elastic subsoil: Foundation beams – the fundamenal solution, the basic solutions, boundary conditions, the metod of Bleich (virtual forces applied outside the real beam), examples and applications; beams, piles, walls, foundation grids, foundation slabs	2
Lec4	Elements of the mining geoengineering: Types of mining deformations and the prediction methods, parameters of the ground surface subsidence, mining categories, tolerance of engineering objects to deformations, the simplest construction principles; practical examples	3
Lec5	Types and construction of retaining structures: Massive (gravity) retaining walls, light (cantilever) retaining walls, structures embedded in soil, reinforced-soil retaining structures; general stability criteria ULS(GEO) and SLS due to Eurocode EC7-1	1
Lec6	Earth pressure theories: The Coulomb-Mohr solutions, the Rankine-Mohr approach, the Coulomb-Poncelet method for the active earth pressure, the Coulomb-Poncelet method for the passive earth pressure, the Rankine-Mohr approach, the Prandtl solution; the Caquot & Kerisel charts of earth pressure coefficients (EC7.1)	3
Lec7	Practical cases of the earth pressure calculations: Angular cantilever walls; role of cohesion - the method of corresponding states of stresses; bearing capacity GEO against the soil heave **Final test #1 (45min)**	2
Lec8	Geoengineering faults and failures: Insufficient geotechnical data, misinterpretation of soil behaviour, design errors, not correct construction processes, unexpected changes of conditions and poor recognition of environmental influences, faults during the repair/rescue action; A case history – The Leaning Tower of Pisa. **Final test #2 (45min)**	2
	Suma godzin	**15**

Forma zajęć - ćwiczenia		Liczba godzin
Cl1		
...		
	Suma godzin	

Forma zajęć - laboratorium		Liczba godzin
Lab1		
…		
	Suma godzin	

Forma zajęć - projekt		Liczba godzin
Proj1	Design Project #1 – Foundation beam on a mining area: project scope, design situation, analysis, project data, calculation methods	1
Proj2	foundation length estimation (linear soil reaction, beam bending moments)	1
Proj3	foundation width estimation (ULS-GEO for a layered subsoil); shaping of the beam transversal cross section	2
Proj4	numerical solving of the finite beam resting on a layered elastic subsoil – ZEM_SIN code	2

Proj5	numerical solving of the finite beam resting on a homogenized elastic subsoil – ZEM_SIN code; comparison of results, conclusions	3
Proj6	analysis of mining deformations and mining forces (ZEM_SIN)	2
Proj7	combination of actions, concrete design; construction drawings	3
Proj8	Project defense/project acceptance - an evaluation test	2
Proj9	Design Project # 2 – Cantilever retaining wall: project scope, design situation, analysis, project data, calculation methods input shaping, setting of loadings	2
Proj10	the Rankine earth pressure, checking of the stability ULS-GEO	2
Proj11	the Poncelet earth pressure, checking of the stability ULS-GEO	2
Proj12	concrete design of the wall and the foundation slab (cantilevers)	2
Proj13	construction details, construction drawings	2
Proj14	Project defense/project acceptance - an evaluation test	2
Proj15	final acceptance	2
	Suma godzin	**30**

Forma zajęć - seminarium		Liczba godzin
Sem1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Lecture: recalling practical examples from geotechnical expertise, sketches and drawings. N2. Lecture and Project: more complex calculation examples can be downloaded from the author's web site [5]. N3. Project: individual consulting, discussion of problems in a group of students. N4. Providing students with the original computer program ZEM_SIN for downloading from the lecturer's website [8], N5. List of problems and calculation tasks for a self-study can be downloaded from the author's web site [5] – some of them are accompanied by hints, answers or full solutions.

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1 (Project)	PEU_W01 PEU_W02 PEU_W03 PEU_U01 PEU_U03 PEU_K01 PEU_K02	Systematical – every week – checking of the student's progress during classes and consulting hours
P1 (Project)	PEU_W01 PEU_W02 PEU_W03 PEU_U01 PEU_U03 PEU_K01 PEU_K02	Final defense of each of two projects; detailed questions about the project, discussion of student's errors or mistakes; project corrections and improvements.
P1 (Lecture)	PEU_W01	Two final tests during two last lectures;

	PEU_W02 PEU_W03 PEU_U01 PEU_U02 PEU_U03 PEU_K02	wide spectrum of questions and calculation tasks (theoretical, practical, interdisciplinary and holistic ones)

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] Bond A., Harris A., Decoding Eurocode 7. *Taylor & Francis*, 2008.
[2] Cernica J., Geotechnical engineering: Foundation design. *John Wiley & Sons*, 1995.
[3] Henry J., Foundation engineering, 1990.
[4] Lancellotta R., Geotechnical engineering, *A.A. Balkema*, 1995*; Spon Press*, 2008.
[5] Reese L.C., Isenhower W.M., Wang S.-T., Analysis and design of shallow and deep foundations. *John Wiley & Sons*, 2006.
[6] Eurocode EC7-1. Geotechnical design, Part 1.
[7] www of world-leading foundation companies.
[8] http://www.ib.pwr.wroc.pl/brzakala

LITERATURA UZUPEŁNIAJĄCA:

[9] Selvadurai A.P.S., Elastic analysis of soil-foundation interaction, *Elsevier*, 1979.
[10] Other Eurocodes and national codes in CE.
[11] http://www.ib.pwr.wroc.pl/brzakala

OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ZAKŁAD, INSTYTUT, ADRES E-MAIL)

Katedra Geotechniki, Hydrotechniki, Budownictwa Podziemnego i Wodnego (K09W02D06):
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CZŁONKOWIE ZESPOŁU DYDAKTYCZNEGO (IMIĘ, NAZWISKO, ADRES E-MAIL)

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Ph.D. students

Załącznik nr 6 do ZW 121/2020

WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO

KARTA PRZEDMIOTU

Nazwa w języku angielskim: **Advanced building physics**
Nazwa w języku polskim: **Zaawansowana fizyka budowli**
Kierunek studiów (jeśli dotyczy): ***budownictwo***
Specjalność (jeśli dotyczy): **Civil Engineering**
Stopień studiów i forma: **~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu: **obowiązkowy ~~/ wybieralny /~~ ~~ogólnouczelniany~~***
Kod przedmiotu: **CEB004162**
Grupa kursów: **~~TAK~~ / 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	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**1**		**2**		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			**2,0**		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	**0,6**		**0,6**		

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI

1. Graduation of civil engineering, environmental engineering architecture or city planning studies.
2. Has knowledge of building construction, technical drawings and general building design.
3. Knows standards, guidelines and regulations about construction and their detail design.
4. Has theoretical basis of detached house design and construction detail solutions.

CELE PRZEDMIOTU

C1. Gain knowledge about design rules of modern, low energy demand, ecological residential and commercial buildings and their details.
C2. Getting acquainted with renewable energy usage possibilities.
C3. Getting acquainted with regulations of rational energy preservation with taking thermal, visual and acoustic comfort of different rooms into consideration.
C4. Getting basis of design team cooperation to connect form and function with rational energy

usage in buildings.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ	
Z zakresu wiedzy:	
PEU_W01	knows the standards, guidelines and regulations referring to the design of buildings and their components
PEU_W02	possesses knowledge about the influence of building investments on the environment
PEU_W03	has extensive knowledge in the area of selected elements, constructions and building structures
Z zakresu umiejętności:	
PEU_U01	is able to use advanced specialized tools when searching Internet databases and other sources which can be used to find both general information and other information related to civil engineering; is able to use information technology to communicate and know how to obtain software which is used to aid the work of a designer and the person organizing and managing building processes
PEU_U02	is able to choose a tool (analytical or numerical) in order to solve engineering issues; is able to use selected software which aid modeling and design processes in construction
PEU_U03	has skills to solve tasks referring to selected theoretical issues and also design elements, constructions and building structures
Z zakresu kompetencji społecznych:	
PEU_K01	is aware of the need to constantly upgrade professional and personal competence in the form of formal or informal education and also improves and develops knowledge in the area of modern processes and technology, related to civil engineering
PEU_K02	is aware of the importance and also understands non-technical aspects and consequences of engineering activity, including influence on the environment and responsibility for implemented decisions
PEU_K03	is able to work independently and cooperate in a team on a specific task; is responsible for both the safety of his work and his subjected team's work

TREŚCI PROGRAMOWE		
	Forma zajęć - wykład	**Liczba godzin**
Wy1	Introduction, work safety regulations training. Course subjects and passing regulations talk through. Laboratory schedule talk through.	1
Wy2	Advanced problems of steady and transient heat flow through building partitions. Thermal dynamics of building partitions, thermal mass. Rules of proper building envelope design according to heat flow.	2
Wy3	Heat flow through windows and glazed facades. Types of glazing, calculation methods, technological possibilities, visual comfort of building users.	2
Wy4	New technologies in building thermal modernisation and in low energy buildings. Ecological aspect of energy saving in buildings.	2
Wy5	Low energy buildings: rating criteria, classification, design and realisation rules.	2
Wy6	The possibilities of renewable energy use in heat balance improvement of different types of buildings.	2
Wy7	Earth-sheltered buildings: classification, typical construction details, soil heat flow, heat transfer through ground walls and floors, energy conservation problems	2
Wy8	Final test	2
	Suma godzin	**15**

	Forma zajęć - ćwiczenia	**Liczba godzin**
Ćw1		

…		
	Suma godzin	

Forma zajęć - laboratorium		**Liczba godzin**
Lab1	Laboratory scheme talk through. Excercises talk through. Familiarize with work safety regulations.	1
Lab2	Climate chambers research.	2
Lab3	Heat flow measurements through building walls	2
Lab4	Infrared thermal camera measurements	2
Lab5	Heat flux measurements (pyranometer, pyrgeometer, differential radiometer)	2
Lab6	Building Integrated Photovoltaics (BIPV)	2
Lab7	Thermal comfort	2
Lab8	Computational building physics	2
	Suma godzin	15

Forma zajęć - projekt		**Liczba godzin**
Pr1		
…		
	Suma godzin	

Forma zajęć - seminarium		**Liczba godzin**
Se1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE	
N1.	Lecture: multimedia presentation of lecture material and chosen building physics software, share of teaching materials through e-learning platforms, use of remote learning platforms (Zoom, MS Teams)
N2.	Laboratory: multimedia presentation, solution of problems with use of laboratory equipment and software, share of teaching materials through e-learning platforms, use of remote learning platforms (Zoom, MS Teams)

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
P1 (laboratorium)	PEU_U01 PEU_U02 PEU_U03 PEU_K01 PEU_K02 PEU_K03	Raport końcowy z wykonanych ćwiczeń laboratoryjnych
P2 (wykład)	PEU_W01 PEU_W02 PEU_W03	Kolokwium - test pisemny lub test on-line

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA: [1] Beggs C., Energy Management, Supply and Conservation. Elsevier, 2002. [2] Clark J., Energy Simulation in Building Design. Wiley Company, 2001. [3] Gratia E., DeHerde A.: Passive Solar Architecture. BRE, 2006. [4] Hens H., Buildings Physics – Heat, Air and Moisture. Ernst & Sohn, 2007. [5] Moss K., Heat and Mass Transfer in Buildings. Elsevier, 2007. [6] Twidell J., Weir T., Renewable Energy Resources. Taylor & Francis, 2006. **LITERATURA UZUPEŁNIAJĄCA:**

OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ZAKŁAD, INSTYTUT, ADRES E-MAIL)
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CZŁONKOWIE ZESPOŁU DYDAKTYCZNEGO (IMIĘ, NAZWISKO, ADRES E-MAIL)
dr inż. Tomasz Kania, tomasz.kania@pwr.edu.pl dr inż. Łukasz Nowak, lukasz.nowak@pwr.edu.pl mgr inż. Paweł Noszczyk, pawel.noszczyk@pwr.edu.pl Employees and PhD students from Department of Building Engineering (K07W02D06)

Załącznik nr 6 do ZW 121/2020

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Nazwa w języku angielskim:	**Methods of applied statistics (geostatistics)**
Nazwa w języku polskim:	**Metody statystyki stosowanej (geostatystyka)**
Kierunek studiów (jeśli dotyczy):	***budownictwo***
Specjalność (jeśli dotyczy):	**Civil Engineering**
Stopień studiów i forma:	**~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu:	**obowiązkowy ~~/ wybieralny /~~ ~~ogólnouczelniany~~***
Kod przedmiotu:	**CEB006963**
Grupa kursów:	**~~TAK~~ / 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	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**1**			**2**	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				**2,0**	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	**0,6**			**0,6**	

*delete as applicable

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI

1. Possesses the knowledge required in the programme of secondary school, connected with mathematics and information science (computer science).
2. Possesses the knowledge concerning the mathematics, mathematical statistics and information science foundations.
3. Possesses the skills of basic making of mathematical statistics tools and basic information techniques.

CELE PRZEDMIOTU

C1. Gaining of the knowledge concerning geostatistics foundations (grounds), representing the branch of applied (spatial) statistics, getting acquainted with basic descriptions, definitions

	and notions applied in geostatistics, such as for example: variogram, covariance, autocorrelation, variograms modeling, cross-validation, kriging, cokriging, interpolation, estimation, simulation, Gaussian models.
C2.	Making acquaintance with basic models and techniques applied in linear stationary geostatistics and non-linear, non-stationary geostatistics.
C3.	Forming up of skills of carrying out of multidimensional structural (variographic) analysis of variation of parameters (regionalized variables), describing the studied regionalized phenomena and of performing of interpolation and estimation of averages values Z* of these parameters, in regular elementary grid.
C4.	Learning of carrying out of multidimensional structural analysis of variation of the studied phenomena and of using of interpolation and estimation techniques and performing of the evaluation of their applying meaning.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

Z zakresu wiedzy:

PEU_W01 Possesses the knowledge concerning an applied geostatistics foundations, taking into account of basic empirical measures of spatial variation and interpolation and estimation techniques, and also concerning their meaning in technical sciences and Earth sciences.

PEU_W02 Knows the foundations (grounds) of subject area (problems) related to the investigating of regionalized phenomena in various areas of knowledge (for instance: civil engineering, geodesy, mining, environment engineering, geology, environment protection) and he understands their meaning during the elaborating and the developing of area (2D), spatial and spatial-time (3D and 4D) geostatistical models.

Z zakresu umiejętności:

PEU_U01 Knows how to carry out the evaluation of basic statistics and to calculate isotropic and directional variograms of the studied parameters and determine character and degree their variation, how to describe and characterize an anisotropy of variability of the considered parameters.

PEU_U02 Knows how to calculate variograms, block-diagrams, raster and isoline maps, and on the ground of maps he knows how to perform delineating grid sections along the sections lines, and moreover he knows how to carry out interpretation of the results of geostatistical analyses.

PEU_U03 Knows how to perform grid sections using the generated sets and how to carry out on their ground , for instance, an initial analysis of soil-water conditions for the needs of civil engineering or also geological-mining conditions for the needs of mining.

PEU_U04 Knows how to serve a specialistic geostatistical software, contained in special packet of geostatistical software and knows how to use adequate computer programs, how to copy, elaborate and interpret the results of spatial analyses (geostatistical studies) and how to prepare projects.

Z zakresu kompetencji społecznych:

PEU_K01 Knows how to work independently and together with team for the realizing of undertaken task.

PEU_K02 Knows how to use of the grounds of knowledge connected with obliging assumptions existing in geostatistics and how to use suitable analytical algorithms.

TREŚCI PROGRAMOWE

Forma zajęć - wykład		**Liczba godzin**
Wy1	Conditions of course crediting. Literature contents. Introduction to geostatistics, basic descriptions, definitions and notations (geostatistics, regionalized phenomena, variogram, covariance, autocorrelation, interpolation, estimation, simulation).	1
Wy2	Basic informations connected with theory of linear stationary geostatistics and non- linear and non-stationary geostatistics.	1

Wy3	Structural analysis of variation of the studied parameters using of variogram function, covariance function and autocorrelation function.	2
Wy4	Modeling of empirical variograms by means of analytical theoretical functions (“geostatistical models”).	1
Wy5	Cross-validation of assumed theoretical models of empirical variograms.	1
Wy6	Investigating of an anisotropy of the studied parameters variation, using the directional variogram function.	1
Wy7	Estimating by applying with quick interpolation and estimation techniques.	3
Wy8	Geostatistical simulations.	1
Wy9	Practical aspects of applying with kriging techniques and simulation methods.	1
Wy10	Fields (areas) of applications of geostatistical methods in country and abroad.	1
Wy11	Crediting colloquy.	2
	Total hours	**15**

Forma zajęć - ćwiczenia		Liczba godzin
Ćw1		
…		
	Suma godzin	

Forma zajęć - laboratorium		Liczba godzin
Lab1	Subject area scope. Literature contents. Principles of BHP. Conditions of course crediting. Compliance of basic geostatistical descriptions, definitions and notations. The elaborating of thematical data bases (2D, 3D), making the ground for geostatistical calculations.	1
Lab2	Geostatistical studies (2D, 3D) of geological-engineering parameters variation of soils and underground waters.	2
Lab3	Geostatistical studies (2D, 3D) of environmental and chemical parameters variation of underground waters.	2
Lab4	Integration of content of data bases containing geological-engineering and environmental parameters values, concerning soil-water environments, i.e soils and underground waters.	2
Lab5	Spatial analyses (2D, 3D) of variation of parameters of mineral resources deposits.	2
Lab6	Processing and modeling of geological-mining parameters (data) in mining (3D).	2
Lab7	Non-stationary case study, presented for instance as an analysis of geological and seismic data.	2
Lab8	Image filtering presented on the example of the analysis of geological and engineering, environmental, climatic, reservoir and material parameters.	1
Lab9	Course crediting.	1
	Suma godzin	**15**

In the frame of the project – computer exercises (15 hours) with applying of the packet of statistical and geostatistical programs of ISATIS – the version of Isatis 2013.1, dongle key USB connected with the software Isatis purchased in the Firm Geovariances, Avon, Ecole des Mines de Paris, France.

Forma zajęć - projekt		Liczba godzin
Pr1		
…		
	Suma godzin	

Forma zajęć - seminarium		Liczba godzin
Se1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Lecture – Multimedial presentations. Word presentation. Explanation of some definitions on the black-board. Replying to inquiries of students. N2. Project (realized in computer laboratory) – carrying out of thematical projects on computers and reports on the ground of distributed didactic materials and the prepared data bases deriving from own sources (thematic data bases). Word and multimedial presentation, explanation of some definions on the black-board. Direct collaboration and discussion with Students.

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1 (laboratorium komputerowe)	PEU_WO1, PEU_UO1	Średnia ocena na podstawie projektów.
F2 (laboratorium komputerowe)	PEU_WO1, PEU_UO1, PEU_KO1	Aktywność na kursach.
F3 (laboratorium komputerowe)	PEU_WO1, PEU_UO1, PEU_KO1	Udział (obecność) w zajęciach projektowych realizowanych w laboratorium komputerowym.
F7 (wykład)	PEU_WO1, PEU_UO1	Kolokwium
F8 (wykład)	PEU_WO1, PEU_UO1	Obecność podczas wykładów
P (labolatorium itd.) =		
P (wykład) =		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] Armstrong M., Basic Linear Geostatistics. Berlin: Springer, 1998, s. 153.
[2] Armstrong M. & Dowd P. A. Editors. Geostatistical Simulations. Kluver Academic Publisher, Dordrecht, p.265, 1994.
[3] Chiles J. P., Delfiner P., Geostatistics: Modeling Spatial Uncertainity. N. Y.: Wiley, (Wiley series in probability and statistics), 1999.
[4] Clark I. & Harper W.V., Practical Geostatistics 2000. Ecosse North America L1c Columbus Ohio, USA, p.342.
[5] Isaaks E., Srivastava R.Mohan, Introduction to Applied Geostatistics. New York Oxford, Oxford University Press, 1989.
[6] Lantuejoul C., Geostatistical Simulation, Models and Algorithms. Berlin: Springer, 2002.
[7] Namysłowska-Wilczyńska B., Geostatystyka Teoria – Zastosowania. Oficyna Wydawnicza Politechniki Wrocławskiej. Wrocław 2006 r., s. 265.
[8] Rivoirard J., Introduction to Disjunctive Kriging and Non-linear Geostatistics. Oxford: Clarendon, 1994.
[9] Wackernagel H., Multivariate Geostatistics, An Introduction with Applications. 2 nd edition,

Springer – Verlag Berlin Heidelberg New York, 1998, s. 256.

LITERATURA UZUPEŁNIAJĄCA:

[1] Deutsch C. & Journel A, 1998, GSLIB: Geostatistical Software Library and User's Guide. Oxford University Press, New York, Oxford. p. 369.
[2] ISATIS, Isatis Software Manual. Geovariances & Ecole des Mines de Paris, Avon Cedex, France, January 2001, s. 585.
[3] Mucha J.: Metody geostatystyczne w dokumentowaniu złóż., Akademia Górniczo- Hutnicza, Wydział Geologii, Geofizyki i Ochrony Środowiska, Katedra Geologii Kopalnianej, Kraków 1994., s. 155.
[4] Mucha J.: Struktura zmienności zawartości [Zn] i [Pb] w Śląsko-Krakowskich złożach rud Zn-Pb. Studia, Rozprawy, Monografie nr 108, Wydawnictwo Instytutu Gospodarki Surowcami Mineralnymi i Energią PAN, Kraków 2002, s. 149.
[5] Namysłowska-Wilczyńska B., Zmienność złóż rud miedzi na monoklinie przedsudeckiej w świetle badań geostatystycznych. Prace Naukowe Instytutu Geotechniki i Hydrotechniki Politechniki Wrocławskiej 64, Seria: Monografie 21, Wrocław 1993, s. 207.

OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ZAKŁAD, INSTYTUT, ADRES E-MAIL)

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Załącznik nr 6 do ZW 121/2020

WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO

KARTA PRZEDMIOTU

Nazwa w języku angielskim:	**Effective properties of composites – introduction to micromechanics**
Nazwa w języku polskim:	**Właściwości efektywne kompozytów –wprowadzenie do mikromodelowania**
Kierunek studiów (jeśli dotyczy):	***budownictwo***
Specjalność (jeśli dotyczy):	**Civil Engineering**
Stopień studiów i forma:	**~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu:	**obowiązkowy ~~/ wybieralny / ogólnouczelniany~~***
Kod przedmiotu:	**CEB006863**
Grupa kursów:	**~~TAK~~ / 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	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**1**		**2**		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			**2,0**		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	**0,6**		**0,6**		

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI

1. The student has knowledge regarding continuous mechanics.
2. The student has knowledge and skills in the field of strength of materials.

CELE PRZEDMIOTU

C1. Learning the methodology of multiscale modelling of composite materials.
C2. Learning the methodology of composite effective properties determination.
C3. Gaining an in-depth knowledge of continuous media mechanics and strength of materials..
C4. Strengthening the ability to work on the task entrusted to and awareness of the need to seek new theoretical and practical solutions.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ	
Z zakresu wiedzy:	
PEU_W01	The student has an in-depth knowledge of multiscale modelling.
PEU_W02	The student knows theoretical method of composite materials analysis
Z zakresu umiejętności:	
PEU_U01	The student can perform upscaling using the multiscale technique.
PEU_U02	The student can estimate and determine effective properties of composite materials.
Z zakresu kompetencji społecznych:	
PEU_K01	The student is able to work on the implementation of tasks independently or in a team (individual preparation of reports and cooperative problem solving in the classroom)
PEU_K02	The student is aware of the need to increase knowledge in the field of composite theory.

TREŚCI PROGRAMOWE

	Forma zajęć - wykład	Liczba godzin
Wy1	Introduction. Principles of micro-macro approach	2
Wy2	Continuous micromechanics. Method of volume and weight averaging.	2
Wy3	Analytical methods of effective properties estimation. Single inclusion problem in diffusion and heat conduction problems.	2
Wy4	Maxwell, Mori-Tanaka and self-consistent estimation schemes.	2
Wy5	Solution of single inclusion problem in elasticity.	2
Wy6	Analytical effective properties estimation schemes for linearly elastic composites.	2
Wy7	Estimation of composite effective properties form digital image of its microstructure	2
Wy8	Final test	1
	Suma godzin	**15**

	Forma zajęć - ćwiczenia	Liczba godzin
Ćw1		
…		
	Suma godzin	

	Forma zajęć - laboratorium	Liczba godzin
Wy1	Introduction. Principles of micro-macro approach	2
Wy2	Continuous micromechanics. Method of volume and weight averaging.	2
Wy3	Analytical methods of effective properties estimation. Single inclusion problem in diffusion and heat conduction problems.	2
Wy4	Maxwell, Mori-Tanaka and self-consistent estimation schemes.	2
Wy5	Solution of single inclusion problem in elasticity.	2
Wy6	Analytical effective properties estimation schemes for linearly elastic composites.	2
Wy7	Estimation of composite effective properties form digital image of its microstructure	2
Wy8	Final test	1
	Suma godzin	**15**

Forma zajęć - projekt		Liczba godzin
Pr1		
…		
	Suma godzin	

Forma zajęć - seminarium		Liczba godzin
Se1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE	
N1.	Classic lecture. Multimedial presentation.
N2.	Laboratory: classic and multimedial presentation regarding laboratory, presentation of computer software, examples of problem solution with computer software.

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1 (laboratorium)	PEU_U01, PEU_U02, PEU_K01	sprawozdanie
F2 (laboratorium)	PEU_U01, PEU_U02, PEU_K01	sprawozdanie
P (laboratorium)= P = 0,4xF1+0,4xF2+0,2xObecność (laboratorium)		
P (wykład)	PEU_W01, PEU_W02, PEU_K02	kolokwium

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] Milton G. W.: The Theory of Composites, Cambridge Univ. Press, 2002.
[2] Torquato S.: Random heterogeneous materials, Springer, 2000.
[3] Hornung U.: Homogenization and porous media, Springer, 1997.
[4] Łydżba D.: Effective properties of composites, Wrocław, 2011.

LITERATURA UZUPEŁNIAJĄCA:

[1] Cherkaev A.: Variational methods for structural optimization, Springer, 2000..

OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ZAKŁAD, INSTYTUT, ADRES E-MAIL)

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Załącznik nr 6 do ZW 121/2020

WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO

KARTA PRZEDMIOTU

Nazwa w języku angielskim:	**Conservation and strengthening of monumental heritage structures**
Nazwa w języku polskim:	**Konserwacja i wzmacnianie konstrukcji zabytkowych**
Kierunek studiów (jeśli dotyczy):	***budownictwo***
Specjalność (jeśli dotyczy):	**Civil Engineering**
Stopień studiów i forma:	**~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu:	**obowiązkowy ~~/ wybieralny / ogólnouczelniany~~***
Kod przedmiotu:	**CEB006763**
Grupa kursów:	**~~TAK~~ / 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	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**1**			**2**	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				**2,0**	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	**0,6**			**0,6**	

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI

1. The student has knowledge of general mechanics, strength of materials, and general principles of shaping structures.
2. Possesses the knowledge concerning traditional building construction including historical objects.
3. The student knows the rules and the guidelines and codes for the design of buildings and their components.
4. The student has a theoretical basis. He has the ability to calculating and construction elements and basic building structures of concrete, steel, timber and masonry structures.
5. Possesses the knowledge concerning building materials.

CELE PRZEDMIOTU

C1. The knowledge concerning technology of strengthening of the elements of the traditional

building. C2. Understanding of the specific calculations of structures after strengthening. C3. The knowledge concerning characteristic of contemporary strengthening materials, including composites. C4. The knowledge concerning moisture protections of existing building. C5. The knowledge concerning doctrine in the conservation of historical constructions.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ
Relating to knowledge: PEU_W01 Pssesses the knowledge concerning methods and technology of strengthening of existing buildings, especially historical objects. PEU_W02 Possesses the knowledge concerning building materials using in strengthening of historical structures. **Relating to skills:** PEU_U01 Knows how to choose the appropriate technology of strengthening taking into account the technical state of the building. PEU_U02 Knows how to prepare the documentation of conservation and strengthening works. **Relating to social competences:** PEU_K01 Student is aware of the need to improve professional and personal skills. PEU_K02 Student knows and understands the consequences of non-technical aspects and engineering activities, including the specification of intervention on the historical objects.

TREŚCI PROGRAMOWE

	Forma zajęć - wykład	**Liczba godzin**
Wy1	Presentation of the range of lecture. Specification and classification of building destruction causes.	2
Wy2	Methods of diagnosis of building destruction causes	2
Wy3	Repair and strengthening of foundations.	2
Wy4	Repair and strengthening of masonry structures.	2
Wy5	Repair and strengthening of timber and glulam structures	2
Wy6	Repair and strengthening of floor structures.	2
Wy7	Technology of drainage and protection of the existing objects against moisture. Specification of conservation and strengthening of historical building. Crediting colloquy.	3
	Suma godzin	**15**

	Forma zajęć - ćwiczenia	**Liczba godzin**
Ćw1		
…		
	Suma godzin	

	Forma zajęć - laboratorium	**Liczba godzin**
Lab1		
…		
	Suma godzin	

	Forma zajęć - projekt	**Liczba godzin**
Pr1	Conditions of course crediting. Subject area scope. Plan of the course. Distribution of projects themes.	2
Pr2	The examples of strengthening of foundation and masonry structures strenghtening.	2
Pr3	The examples of strengthening of timber structures.	2

Pr4	The examples of strengthening of floor structures.	2
Pr5	The examples of strengthening of vault structures.	2
Pr6	Individual project consultations. The rules of the final documentation.	2
Pr7	Pass classes on the basis of completed projects.	3
	Suma godzin	**15**

	Forma zajęć - seminarium	**Liczba godzin**
Se1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Lecture: multimedia presentations N2. Project: presentation of examples

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1 (projekt)	PEU_W01 PEU_U01 PEU_U02 PEU_K01	Analiza projektu
F2 (projekt)	PEU_W01 PEU_U01 PEU_U02 PEU_K01	Obecność
P = 0,85 x F1+0,15 x F2 (projekt)		
P (wykład)	PEU_W02 PEU_U02 PEU_K02	Kolokwium

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] Masłowski E., Spiżewska D.,: „Wzmacnianie konstrukcji budowlanych", Arkady, Warszawa 2000

[2] Mitzel A., Stachurski W., Suwalski J.,: „Awarie konstrukcji betonowych i murowych", Arkady Warszawa 1973

[3] Proceedings of the conference „Structural Analysis of Historical Constructions"

LITERATURA UZUPEŁNIAJĄCA:

[1] Proceedings of the conference "PROHITECH"

[2] Proceedings of the conference "MURICO"

OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ZAKŁAD, INSTYTUT, ADRES E-MAIL)
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CZŁONKOWIE ZESPOŁU DYDAKTYCZNEGO (IMIĘ, NAZWISKO, ADRES E-MAIL)
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Załącznik nr 6 do ZW 121/2020

WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO

KARTA PRZEDMIOTU

Nazwa w języku angielskim:	**Timber structures**
Nazwa w języku polskim:	**Konstrukcje drewniane**
Kierunek studiów (jeśli dotyczy):	***budownictwo***
Specjalność (jeśli dotyczy):	**Civil Engineering**
Stopień studiów i forma:	**~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu:	**~~obowiązkowy~~ / wybieralny ~~/ ogólnouczelniany~~***
Kod przedmiotu:	**CEB006663**
Grupa kursów:	**~~TAK~~ / 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	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**1**			**2**	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				**2,0**	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	**0,6**			**0,6**	

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI

1. The student is able to identify and make a statement loads on components and building structures.
2. The student has knowledge of general mechanics, strength of materials, and general principles of shaping structures.
3. The student knows the rules and the guidelines and codes for the design of buildings and their components.
4. The student has a theoretical basis. He has the ability to calculating and construction elements and basic building structures of concrete, steel, timber and masonry structures.

CELE PRZEDMIOTU

C1. Knowledge of anatomy of the Wood and rulet of timber grading in terms of the proper use of

	the structures.
C2.	Knowledge of the principles for calculating of solid and complex elements made with solid and glued laminatem timber
C3.	Knowledge of the rules for the implementation of connectors for mechanical fasteners, car pentry joints and glued joints. The ability to determine the capacity and vulnerability connectors.
C4.	Knowledge of the principles of protection of timber structures against biological corrosion and fire.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

Z zakresu wiedzy:

PEU_W01	Student knows contemporary, modern building materials and he knows the basic elements of manufacturing them.
PEU_W02	Student has expanded knowledge of analysis, design and calculating of timber structures.

Z zakresu umiejętności:

PEU_U01	Student can design a modern timber structures, also glulam structures.
PEU_U02	Student can make a graphical project documentation in selected computer program.

Z zakresu kompetencji społecznych:

PEU_K01	Student is aware of the need to improve professional and personal skills. student complements and extends knowledge of modern processes and technologies related to civil engineering through formal and informal training
PEU_K02	Student knows and understands the consequences of non-technical aspects and engineering activities. Sstudent understands the impact of these decisions on the environment and he understands the responsibility for decisions.

TREŚCI PROGRAMOWE

	Forma zajęć - wykład	Liczba godzin
Wy1	Examples of historical and contemporary objects made of timber. General discussion of the problems of design of timber structures	2
Wy2	Anatomy of the wood, the effect of anisotropy on the physical and mechanical properties of the material. Natural characteristics of wood and defects.. Specifying the basic mechanical properties. Customary target sizes of structural timber. Principles of visual and machine grading of wood, the grading class and strength class. Engineered wood products - the types and properties.	3
Wy3	Design of timber structures according to the PN-EN 1995. General rules, ultimate limit states, serviceability limit state, the basis of structural analysis.	2
Wy4	Connectors in timber structures. Joints timber-timber, plate- timber, steel-timber by using nails, screws, bolts, dowels, split-rings connectors, toothed-plates connectors, nail plates.	2
Wy5	The bases for calculating the fire resistance according to EN 1995. The requirements for fire resistance. The effect of interaction in case of fire. Methods for calculating the load capacity.	2
Wy6	Glued laminated timber. The parameters of the material, production, technology, connection details. Examples of applications.	2
Wy7	Historic timber structures. Biological corrosion in timber structures. Wood insects and wood-destroying fungi. Mistakes made during the realisation and exploitation of timber structures.	2
	Suma godzin	**15**

	Forma zajęć - ćwiczenia	Liczba godzin
Ćw1		

...		
	Suma godzin	

Forma zajęć - laboratorium		**Liczba godzin**
Lab1		
…		
	Suma godzin	

Forma zajęć - projekt		**Liczba godzin**
Pr1	Explanation of the examination. Set a schedule of classes and transitional periods. General introduction to the design of timber structures. Deal subjects design classes.	2
Pr2	Explanation of the project no. 1 Beams made with the use of mechanical fasteners. Explanation of the assignment – part 1. Designing of solid timber elements.	2
Pr3	Explanation of the project no. 1 Spaced columns with packs or gussets and lattice columns Explanation of the assignment – part 1. Designing of glued laminated timber elements.	2
Pr4	Consultations of calculations.	2
Pr5	Explanation of the assignment – part 2. Designing of connections.	2
Pr6	Consultations of calculations.	2
Pr7	Pass classes on the basis of completed projects	3
	Suma godzin	**15**

Forma zajęć - seminarium		**Liczba godzin**
Se1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Lecture: multimedia presentations N2. Project: presentation of selected computer-aided design software

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1 (project)	PEU_U01, PEU_U02 PEU_K02	project
F2 (project)	PEU_W02, PEU_U01.	test
F3		
P = 0.4×F1 + 0.5×F2 + 0.1× presence (project)		
P (lecture)	PEU_W01, PEU_W02 PEU_K01	test

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] Borgström E. (ed) (2016) Design of timber structures. Volume 1: Structural aspects of timber construction. Swedish Forest Industries Federation, Swedish Wood, Stockholm.
[2] Borgström E. (ed) (2016) Design of timber structures. Volume 2: Rules and formulas according to Eurocode 5. Swedish Forest Industries Federation, Swedish Wood, Stockholm.
[3] Borgström E. (ed) (2016) Design of timber structures. Volume 3: Examples. Swedish Forest Industries Federation, Swedish Wood, Stockholm.
[4] Buczkowski W. i in. (2010) Budownictwo ogólne. Tom 4 – Konstrukcje budynków. Arkady, Warszawa.
[5] Kotwica E., Nożyński W. (2015) Konstrukcje drewniane – przykłady obliczeń. Stowarzyszenie Producentów Płyt Drewnopochodnych w Polsce, Szczecin.
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[7] Krajewski A. Witomski P. (2016) Ochrona drewna – surowca i materiału. Wydawnictwo SGGW, Warszawa.
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[9] Neuhaus H. (2017) Ingenieurholzbau. Grundlagen - Bemessung - Nachweise - Beispiele. Springer Vieweg, Wiesbaden.
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[11] Porteous J., Kermani A. (2013) Structural Timber design to Eurocode 5. Blackwell Publishing, Oxford.
[12] Stefańczyk B. i in. (2010) Budownictwo ogólne. Tom 1 - Materiały i wyroby budowlane. Arkady, Warszawa.
[13] Normy:
PN-EN 1995-1-1:2010. Eurokod 5: Projektowanie konstrukcji drewnianych. Część 1-1: Postanowienia ogólne. Reguły ogólne i reguły dotyczące budynków.
PN-EN 1995-1-2:2008. Eurokod 5: Projektowanie konstrukcji drewnianych. Część 1-2: Postanowienia ogólne. Projektowanie konstrukcji z uwagi na warunki pożarowe.
PN-EN 14080:2013-07. Konstrukcje drewniane. Drewno klejone warstwowo i drewno lite klejone warstwowo. Wymagania.
PN-EN 338:2016-06. Drewno konstrukcyjne. Klasy wytrzymałości.
PN-B-01042:1999. Rysunek konstrukcyjny budowlany. Konstrukcje drewniane.

LITERATURA UZUPEŁNIAJĄCA:

[1] Aicher S., Reinhardt H.-W., Garrecht H., Eds (2014) Materials and Joints in Timber Structures. Recent Developments of Technology. Springer, Dordrecht, Heidelberg, New York, London.
[2] Becker K., Blass H. (2006) Ingenieurholzbau nach DIN 1052. Einführung mit Beispielen. Ernst&Sohn, Berlin.
[3] Erler K. (2004) Alte Holzbauwerke: beurteilen und sanieren. Huss-Medien Verlag Bauwesen, Berlin.
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[5] Jasieńko J. (2003) Połączenia klejowe i inżynierskie w naprawie, konserwacji i wzmacnianiu zabytkowych konstrukcji drewnianych. DWE, Wrocław.
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OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ZAKŁAD, INSTYTUT, ADRES E-MAIL)

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3.	dr inż. Krzysztof Raszczuk, krzysztof.raszczuk@pwr.edu.pl
4.	mgr inż. Anna Karolak, anna.karolak@pwr.edu.pl
5.	doktoranci

Załącznik nr 6 do ZW 121/2020

WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO

KARTA PRZEDMIOTU

Nazwa w języku angielskim:	**Prestressed concrete structures**
Nazwa w języku polskim:	**Betonowe konstrukcje sprężone**
Kierunek studiów (jeśli dotyczy):	***budownictwo***
Specjalność (jeśli dotyczy):	**Civil Engineering**
Stopień studiów i forma:	**~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu:	**~~obowiązkowy~~ / wybieralny / ~~ogólnouczelniany~~***
Kod przedmiotu:	**CEB006563**
Grupa kursów:	**TAK / ~~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	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**1**			**2**	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				**2,0**	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	**0,6**			**0,6**	

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI

1. Possesses the knowledge and understands basics of the methods used in structural mechanics, knows selected CAD software.
2. Possesses the skills of statical analysis of a bar and spatial structure.
3. Possesses the knowledge of theoretical basics of finite element method and general rules of nonlinear analysis of engineering structures.
4. Possesses the knowledge and understands calculations and detailing of a complex concrete structures – acknowledged by the grade from CEB3361.
5. Possesses the knowledge of codes and standards of design of buildings and elements.
6. Possesses the skills of using internet and other sources for searching general information and information on building engineering, He possesses the skills of using information techiques to communicate and obtaining CAD software.
7. Is responsible for honest results of his work and reliable interpretation.

CELE PRZEDMIOTU
C1. Forming up of skills of computing and detailing of prestressed concrete structures. C2. Learning of carrying out of multidimensional structural analysis the prestressed structures. C3. Gaining of the knowledge of prestress techniques and methods. C4. Gaining of the knowledge of limit state analysis of prestressed concrete structures.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

Z zakresu wiedzy:

PEU_W01 Possesses the knowledge concerning computation and detailing of complex prestressed structures.

PEU_W02 Possesses the knowledge and understands design rules of complex precast and monolithic prestressed concrete structures.

Z zakresu umiejętności:

PEU_U01 Knows how to design precast or monolithic prestressed element or part of a structure being prestressed.

PEU_U02 Knows how to check required ultimate and serviceability limit states related to prestressed structures.

PEU_U03 Possesses the knowledge how to use respective codes, standards and literature

Z zakresu kompetencji społecznych:

PEU_K01 Knows how to extend the knowledge on contemporary concrete structures and design methods.

PEU_K02 He is responsible for honest results of his design.

TREŚCI PROGRAMOWE

	Forma zajęć - wykład	Liczba godzin
Wy1	The concept of prestressing, historical review, definitions, differences between prestressed and reinforced concrete.	1
Wy2	Prestressed concrete applications.	1
Wy3	Properties of concrete used in prestressed structures.	1
Wy4	Properties of prestressing steel and other prestressing materials.	1
Wy5	Technology of pretensioned concrete.	1
Wy6	Technology of posttensioned concrete.	1
Wy7	Axisymmetric structures, tanks, silos, pipes. Structures prestressed with unbonded tendons.	1
Wy8	Ultimate limit states (flexure, shear and tension).	1
Wy9	Design situations and stress limitation.	1
Wy10	Immediate losses of prestress.	1
Wy11	Immediate losses of prestress.	1
Wy12	Time dependent losses of prestress. Prestressing force during tensioning.	1
Wy13	Effects of prestressing at ultimate and serviceability limit states. Prestressing in structure analysis.	1
Wy14	Serviceability limit states: camber, deflection and cracking	1
Wy15	Anchoring to concrete.	1
	Suma godzin	**15**

	Forma zajęć - ćwiczenia	Liczba godzin
Ćw1		
...		
	Suma godzin	

Forma zajęć - laboratorium	Liczba godzin

Lab1		
	Suma godzin	

In the frame of the project – computer exercises (15 hours) with applying of the packet of statistical and geostatistical programs of ISATIS – the version of Isatis 2013.1, dongle key USB connected with the software Isatis purchased in the Firm Geovariances, Avon, Ecole des Mines de Paris, France.

	Forma zajęć - projekt	**Liczba godzin**
Pr1	Project scope and example presentation.	1
Pr2	Basic assumption and rules.	1
Pr3	Preliminary design. Structure analysis.	1
Pr4	Load combinations used at ultimate and serviceability limit states.	1
Pr5	Immediate losses of prestress.	1
Pr6	Immediate losses of prestress.	1
Pr7	Time dependent losses of prestress.	1
Pr8	Prestressing force during tensioning.	1
Pr9	Stress limitation during tensioning.	1
Pr10	Checking ultimate limit states.	1
Pr11	Checking servicebility limit states.	1
Pr12	Anchorage and shear design.	1
Pr13	Detailing of reinforcement and prestressing tendons.	1
Pr14	Drawings of prestressed structures.	1
Pr15	Project submission.	1
	Suma godzin	**15**

	Forma zajęć - seminarium	**Liczba godzin**
Se1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Lecture: Information lecture, problematic lecture, multimedial presentations, company presentations.
N2. Project: Presentation of the project scope, examples of structures, direct collaboration and discussion with Students.

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1 (evaluation of loads and preliminary dimensions of a structure)	PEU_W01 PEU_U01 PEU_U03 PEU_K01 PEU_K02	Evaluation of the project part
F2 (static computations with load combinantions finshed)	PEU_W01 PEU_U01 PEU_U03	Evaluation of the project part

	PEU_K01 PEU_K02	
F3(prestress loss calculated)	PEU_W01 PEU_W02 PEU_U01 PEU_U03 PEU_K01 PEU_K02	Evaluation of the project part
F4 (calculations of limit states finished)	PEU_W01 PEU_W02 PEU_U01 PEU_U03 PEU_K01 PEU_K02	Evaluation of the project part
F5 (drawing and specification finished)	PEU_W01 PEU_W02 PEU_U01 PEU_U02 PEU_U03 PEU_K01 PEU_K02	Evaluation of the whole project with grade
P = 0,1xF1+0,2xF2+0,2xF3+0,2xF4+0,3xF5		
P (lecture)	PEU_W01 PEU_W02 PEU_K01	Colloquium

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] Teng S., Kong F. K.: Reinforced and Prestressed Concrete: Eurocodes Taylor & Francis Ltd; 2009.

[2] Dolan Ch. W., Hamilton H. R.: Prestressed Concrete. Building, Design, and Construction. Springer Nature Switzerland AG 2019.

[2] Navy E. G.: Pre-stressed Concrete. A Fundamental Approach. Prentice Hall, Upper Saddle River, New Jersey 07458, 2000.

LITERATURA UZUPEŁNIAJĄCA:

[1] Ghali A.: Circular storage tanks and silos. E & FN Spon, London 2000.

[2] Raju N. K., Pre-stressed concrete, 2008.

[3] Naaman A. E.: Prestressed Concrete. Analysis and design. Techno Press 3000, Michigan 2004.

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[6] Manual for the design of concrete building structures to Eurocode 2. The Institution of Structural Engineers, London. 2006.

[7] EN 1992-1-1: Eurocode 2: Design of concrete structures-Part 1-1: General rules and rules for buildings.

[8] EN 1992-3: Eurocode 2: Design of concrete structures-Part 3: Liquid retaining and containing structures.

OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ZAKŁAD, INSTYTUT, ADRES E-MAIL)

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WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO
KARTA PRZEDMIOTU
Nazwa w języku angielskim: **Hydrology for building engineers**
Nazwa w języku polskim: **Hydrologia dla inżynierów budownictwa**
Kierunek studiów (jeśli dotyczy): *budownictwo*
Specjalność (jeśli dotyczy): **Civil Engineering**
Stopień studiów i forma: **~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu: **~~obowiązkowy~~ / wybieralny / ~~ogólnouczelniany~~***
Kod przedmiotu: **CEB006363**
Grupa kursów: **~~TAK~~ / 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	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	~~Examination /~~ crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**1**		**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)	**0,6**		**0,6**		

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI
1. The student possesses knowledge of the areas of mathematics, applied statistics, hydraulics and hydrology, geology and hydrology
2. Understands the processes of atmospheric precipitation and resulting outflows.
3. Understands the concept of natural and artificial basin and defining their characteristics.

	CELE PRZEDMIOTU
C1.	Gaining a knowledge on the calculation of the water balance and determination of its constituents for river basins natural - watercourse and artificial catchment within the urban area.
C2.	Acquiring knowledge and skills for calculating extreme flows - flood and drought for

	controlled and uncontrolled catchments..
C3.	Acquisition of knowledge in the use of mathematical models of precipitation-outflow within natural and artificial catchments, including urbanized ones.
C4.	Strengthening the ability to work in a project team and the awareness of the need to find new solutions to theoretical and practical hydrologic calculations for sizing of hydraulic structures and drainage areas of urban areas and more.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

Z zakresu wiedzy:

PEU_W01 The student knows and understands the rules for the calculation of water balance and its components for river basins.

PEU_W02 The student has in-depth expertise in the implementation and development of hydrometric measurements.

PEU_W03 The student knows the rules for calculating extreme flows in the catchment controlled and uncontrolled.

PEU_W04 The student has expertise in modeling the outflow of water from the catchment.

Z zakresu umiejętności:

PEU_U01 The student establishes correlations based on hydrometric measurements.

PEU_U02 The student prepares a detailed water balance for the catchment.

PEU_U03 The student can calculate statistical methods extreme water flows.

PEU_U04 The student determines water flow in the basin uncontrolled.

PEU_U05 The student creates a simple model for the catchment uncontrolled.

Z zakresu kompetencji społecznych:

PEU_K01 The student can work independently on the performance of a task or project team during the hydrological calculations.

PEU_K02 The student is aware of the need to increase knowledge in the field of modern computational techniques in hydrology for design of hydraulic structures and communication

TREŚCI PROGRAMOWE

	Forma zajęć - wykład	Liczba godzin
Wy1	Problems and tasks of hydrology rainwater and surface water for construction engineers.	1
Wy2	Water balance. Determination of components of the water balance equation for the natural catchment and the artificial catchment, including urbanized catchment.	2
Wy3	Hydrometry. Measurements of water levels, the flow velocity and intensity water discharge.	2
Wy4	Hydrography. Observations gauges. Flow curve of the gauge section. The purpose of the construction of the flow curve. Floodwater hydrograph and methods of its creation.	2
Wy5	Transferring hydrological information from the controlled area to an uncontrolled region of a given watercourse.	1
Wy6	Determination of probable maximum and minimum flows for controlled catchments.	2
Wy7	Determination of maximum flow for small catchments uncontrolled.	2
Wy8	Basics of mathematical modeling of hydrological phenomena.	2
Wy 9	Test	
	Suma godzin	**15**

	Forma zajęć - ćwiczenia	Liczba godzin
Ćw1		

...		
	Suma godzin	

Forma zajęć - laboratorium		**Liczba godzin**
Lab1	Water-economy balance	2
Lab2	The development of hydrologic curves for the catchment of the selected watercourse.	4
Lab3	The calculation of the maximum probable flow in the controlled catchment.	4
Lab4	The calculation of the maximum probable flow in a small uncontrolled catchment.	2
Lab5	Construction of the flood hydrograph in controlled catchment and uncontrolled catchment..	2
Lab6	Crediting of the laboratory.	1
	Suma godzin	**15**

Forma zajęć - projekt		**Liczba godzin**
Pr1		
…		
	Suma godzin	

Forma zajęć - seminarium		**Liczba godzin**
Se1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Lecture: multimedia presentations lecture content N2. Laboratory: multimedia presentations, defining and solving problems using the software, N3. Consultation in the form of direct meetings and via e-mail

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
P (lecture)	PEU_W01 PEU_W02 PEU_W03 PEU_W04	Final test
F (computer laboratory)	PEU_W01 PEU_U02 PEU_K01	Attendance and report writing
F (computer laboratory)	PEU_W02 PEU_U01 PEU_K01	Attendance and report writing
F (computer laboratory)	PEU_W03 PEU_U03 PEU_K01 PEU_K02	Attendance and report writing
F (computer laboratory)	PEU_W03 PEU_U04	Attendance and report writing

	PEU_K01 PEU_K02	
F (computer laboratory)	PEU_W04 PEU_U05 PEU_K01 PEU_K02	Attendance and report writing
P (laboratory etc) = P = (F1+F2+F3+F4+F5)/5		
P (lecture) =		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

1. Brutsaert W., Hydrology. An Introduction, Cambridge University Press, Cambridge, 2010.
2. Chow V. T., Handbook of Applied Hydrology, McGraw-Hill, New York, 1964.
3. Chow V. T., Mays L. W., Maidment D. R., Applied Hydrology, McGraw-Hill, New York, 1988.
4. Davie T., Fundamentals of hydrology, Routledge, Taylor & Francis Group, London and New York, 2010.
5. Shaw E. M., Beven K. J., Chappell N. A., Lamb R., Hydrology in practice, Spon Press, Taylor & Francis Group, Taylor & Francis Group, 2011.

LITERATURA UZUPEŁNIAJĄCA:

1. Baban R., Design of diversion weirs. John Wiley & Sons, 1995.
2. Ghosh S. N., Flood control and drainage engineering, A.A. Balkema/Rotterdam/Brookfield, 1999.

OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ZAKŁAD, INSTYTUT, ADRES E-MAIL)

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WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO

KARTA PRZEDMIOTU

va w języku angielskim: **Modern testing methods for non-destructive inspection of building structures**
va w języku polskim: **Nowoczesne metody badań nieniszczących konstrukcji budowlanych**
Kierunek studiów (jeśli dotyczy): ***budownictwo***
Specjalność (jeśli dotyczy): **Civil Engineering**
Stopień studiów i forma: **~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu: **~~obowiązkowy~~ / wybieralny / ~~ogólnouczelniany~~***
Kod przedmiotu: **CEB006163**
Grupa kursów: **~~TAK~~ / 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	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**1**		**2**		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			**2.0**		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	**0.6**		**0.6**		

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI

1. The student possesses knowledge of the areas of basic aspects of building structures, building materials and concrete structures.
2. The student knows the principles of building materials and testing their strength parameters.

CELE PRZEDMIOTU

C1. Introduction of modern testing methods for quality control of building materials and structures during their erection.
C2. Introduction of modern testing methods for quality control of existing building structures.
C3. Learning modern testing systems for NDT examination of building structures.
C4. Developing skills of basic and advanced testing procedures for building structures examination

	necessary for evaluation of their technical conditions.
C5.	Strengthening the ability to work in a team and making students aware of the need to constantly expand knowledge of modern testing methods for building structures examination.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ	
Z zakresu wiedzy:	
PEU_W01	The student knows and understands the specific implementation of quality control of building materials and structures during their erection.
PEU_W02	The student knows and understands the specific implementation of quality control of existing building structures with particular attention focused on the evaluation of their technical conditions.
Z zakresu umiejętności:	
PEU_U01	The student is able to plan and carry out test procedures components of building structures and interpret the results of the evaluation of their quality and mechanical properties.
PEU_U02	The student can evaluate the technical condition of building structures using modern non-destructive testing methods.
PEU_U03	The student has the skills necessary to use modern non-destructive testing systems.
Z zakresu kompetencji społecznych:	
PEU_K01	The student can work independently or in a team task.
PEU_K02	The student is aware of the need to constantly expand knowledge of both traditional and modern testing methods for building structures examination.

TREŚCI PROGRAMOWE		
	Forma zajęć - wykład	**Liczba godzin**
Wy1	Introduction, aims, scope and plan of the subject. Brief history review of the development of testing methods addressed for building structures.	2
Wy2	Characteristics of modern testing methods for non-destructive evaluation of “in-situ” concrete compressive strength (LOK-Test, CAPO-Test, COMA-Test, Schmidt's hammer) and tensile strength using “pull-off” measurements (DYNA, Bond-Test).	2
Wy3	Nondestructive evaluation of “in-situ” compressive strength – case study	2
Wy4	Characteristics of modern testing methods for non-destructive evaluation of corrosion risk assessment of building structures (Rainbow-Test, Aquamerck Test, Rapie Chloride Test, Corrosion Mapping Systems – Bloodhound, Galva Pulse).	2
Wy5	Modern testing methods for non-destructive examination of structural integrity of building structures („Impact-Echo”, Impulse Response).	2
Wy6	Modern testing methods for non-destructive examination of structural integrity of building structures – case study	2
Wy7	Modern methods for locating and identifying the reinforcing steel bars (Cover-Master, Profometer, Ground Penetrating Radar, radiography) and “in-situ” nondestructive evaluation of concrete water permeability by means of GWT method.	2
Wy8	Final examination test	1
	Suma godzin	**15**

	Forma zajęć - ćwiczenia	**Liczba godzin**
Ćw1		
...		
	Suma godzin	

Forma zajęć - laboratorium		Liczba godzin
Lab1	Introduction. Safety regulations. General description of non-destructive testing methods. Introduction to laboratory exercises with ultrasonic measurements	2
Lab2	Short test nr 1. Exercises no 1 - ultrasonic measurements. Determination of ultrasonic pulse velocity in different building materials.	2
Lab3	Short test nr 2. Principles of the concrete compressive strength evaluation by means of rebound measurements. Introduction to laboratory exercises. Overview of available testing systems and measurement techniques. Interpretation of obtained results.	2
Lab4	Short test nr 3. Exercises no 2 - rebound measurements.	2
Lab5	Exercises no 3 – Evaluation of the concrete compressive and tension strength by means of “pull-out” and “pull-off” measurements.	2
Lab6	Exercises no 4 - Localization and identification of the reinforcing steel bars in concrete structures. Non-destructive cover the thickness layer measurements.	2
Lab7	Exercises no 5 - Non-destructive moisture measurements of different materials.	2
Lab8	Short test nr 4. Summary and final recognition.	1
	Suma godzin	**15**

Forma zajęć - projekt		Liczba godzin
Pr1		
…		
	Suma godzin	

Forma zajęć - seminarium		Liczba godzin
Se1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. LECTURE: classic lecture, multimedia presentations, educational films, on-line education N2. LABORATORY: practical laboratory tests, preparation of test reports, discussion of the results obtained, on-line consultation N3. Consultation, including on-line consultation.

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1 (L1-L2)	PEU_U01 PEU_U02 PEU_U03	Short test no 1

	PEU_K01	
F2 (L2-L3)	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Short test no 2, Assessment of the Exercises no 1 Discussion of the results obtained
F3 (L4-L5)	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Short test no 3, Assessment of the Exercises no 2 Discussion of the results obtained
F4 (L5-L8)	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Short test no 4, Assessment of the Exercises no 3, 4 and 5 Discussion of the results obtained
P (laboratory) = 0,60 x average rating of short tests results+ 0.4 x average rating of test reports evaluation		
P (lecture)	PEU_W01 PEU_W02 PEU_U01 PEU_U02 PEU_K02	Crediting with grade basing on the final examination test

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] Sansalone M.J., W.B. Streett W.B., Impact-Echo Nondestructive Evaluation of Concrete and Mansory, Buullbrier Press, 1977.

[2] Schickert G., Wiggenhauser H., Non-Destructive Testing in Civil Engineering. Berlin, 1995.

[3] Bungey J.H., Millard S.G., M.G., Testing of Concrete in Structures, 4th Edition, Taylor&Francis, London and New York, 2006.

[4] Breysse D., Non-Destructive Assessment of Concrete Structures: Reliability and Limits of Single and Combinated Techniques, State of the Art, Report of the RILEM Technical Committee 207-INR, Springer Dordrecht Heidelberg London New York, 2012

LITERATURA UZUPEŁNIAJĄCA:

OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ZAKŁAD, INSTYTUT, ADRES E-MAIL)

dr inż. Andrzej Moczko, Department of Building Engineering, andrzej.moczko@pwr.edu.pl

CZŁONKOWIE ZESPOŁU DYDAKTYCZNEGO (IMIĘ, NAZWISKO, ADRES E-MAIL)

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Załącznik nr 6 do ZW 121/2020

WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO

KARTA PRZEDMIOTU

Nazwa w języku angielskim:	**Artificial intelligence in civil engineering**
Nazwa w języku polskim:	**Sztuczna inteligencja w inżynierii lądowej**
Kierunek studiów (jeśli dotyczy):	***budownictwo***
Specjalność (jeśli dotyczy):	**Civil Engineering**
Stopień studiów i forma:	**~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu:	**~~obowiązkowy~~ / wybieralny / ~~ogólnouczelniany~~ ***
Kod przedmiotu:	**CEB006063**
Grupa kursów:	**~~TAK~~ / 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	~~Egzamin /~~ zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	~~Egzamin /~~ zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**1**		**2**		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			**2,0**		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	**0,6**		**0,6**		

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Basic knowledge in civil engineering – types of structures and processes
2. Skill in application of basic computer techniques

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CELE PRZEDMIOTU

C1. Learning the fundamental techniques used in computer tools with elements of artificial intelligence – applied in civil engineering

C2. Development of ability to design, computer implementation and testing of simple expert tools with elements of artificial intelligence

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ	
Z zakresu wiedzy:	
PEU_W01	The student knows and understands methods of knowledge acquisition and representation in expert systems
PEU_W02	The student knows methodology of design, computer implementation and testing of knowledge-based expert systems with elements of artificial intelligence
Z zakresu umiejętności:	
PEU_U01	The student has skill to independent acquisition of knowledge in civil engineering
PEU_U02	The student has skill to design, computer implementation and testing of simple expert tools with elements of artificial intelligence, supporting decisions in civil engineering
Z zakresu kompetencji społecznych:	
PEU_K01	The student is able to unaided solving the problems and is also prepared to a team-work (laboratory reports, laboratory exercises)

TREŚCI PROGRAMOWE		
Forma zajęć - wykład		**Liczba godzin**
Wy1	Introduction to the lectures: aims, scope and plan of the course. Basic literature and examination rules. Artificial intelligence – what is this? Basic terms and definitions.	1
Wy2	Artificial intelligence in expert systems – classification, architecture, evolution, directions of development. Expert systems and range of their application in civil engineering.	2
Wy3	Technologies of knowledge acquisition and representation in computer systems. Knowledge bases and data bases. Expert functions in computer systems supporting management.	2
Wy4	Artificial neural networks – conception, architecture, training and testing techniques, applications.	2
Wy5	Fuzzy logic – fuzzy problems, linguistic variables, fuzzy reasoning procedures, testing, applications.	2
Wy6	Expert systems based on knowledge – design and implementation. Technology of hybrid networks in expert systems.	2
Wy7	Examples of artificial intelligence applications in civil engineering – expert tools supporting structure analysis and infrastructure management.	2
Wy8	Colloquium	2
	Suma godzin	**15**

Forma zajęć - ćwiczenia		**Liczba godzin**
Ćw1		
Ćw2		
Ćw3		
Ćw4		
..		
	Suma godzin	

Forma zajęć - laboratorium		**Liczba godzin**
La1	General introduction: organization, crediting rules. Distribution of individual tasks, discussion of each task.	1
La2	Technologies of knowledge acquisition and computer representation – examples from selected fields of civil engineering.	2
La3	Technology of artificial neural networks creation – introduction to computer	2

	software.	
La4	Practical design, training and testing of artificial neural networks.	2
La5	Individual task – conceptual design.	2
La6	Individual task – knowledge acquisition.	2
La7	Individual task – computer implementation and testing.	2
La8	Presentation of results and evaluation of the report.	2
	Suma godzin	**15**

Forma zajęć - projekt		**Liczba godzin**
Pr1		
Pr2		
Pr3		
Pr4		
…		
	Suma godzin	

Forma zajęć - seminarium		**Liczba godzin**
Se1		
Se2		
Se3		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. Lecture: multimedia presentations of all parts of the course programme, presentation of computer software supporting bridge management.
N2. Laboratory: multimedia presentations, software presentations, data preparation, data input and processing by means of computer systems, analysis and discussion of the results.
N3. Individual consultations.

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
P (wykład)	PEU_W01, PEU_W02,	kolokwium zaliczeniowe
P (laboratorium)	PEU_U01, PEU_U02, PEU_K01	sprawozdanie-raport, wykonywanie ćwiczeń w trakcie zajęć

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
<u>LITERATURA PODSTAWOWA:</u> [1] Russell S., Norvig P., Artificial Intelligence: A Modern Approach, Prentice Hall, 2009. [2] Samarasinghe S., Neural Networks for Applied Sciences and Engineering: From Fundamentals Complex Pattern Recognition, Auerbach Publications – Taylor & Francis Group, 2006. [3] Wang P. P., Ruan D., Kerre E. E., Fuzzy Logic: A Spectrum of Theoretical and Practical Issues, Springer, 2007. **<u>LITERATURA UZUPEŁNIAJĄCA:</u>** [1] Gurney K., An Introduction to Neural Networks, Taylor & Francis e-Library, 2005. [2] Liebowitz J., The Handbook of Applied Expert Systems, CRC Press, 1999. [3] Nguyen H. T., Prasad N. R., Walker C. L., Walker E. A., A First Course in Fuzzy and Neural Control, CHAPMAN & HALL/CRC, 2003.
OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ADRES E-MAIL)
prof. dr hab. inż. Jan Bień, jan.bien@pwr.edu.pl mgr inż. Aleksander Mróz, aleksander.mroz@pwr.edu.pl

Załącznik nr 6 do ZW 121/2020

WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim:	**Metody komputerowe**
Nazwa przedmiotu w języku angielskim:	**Computational mechanics**
Kierunek studiów (jeśli dotyczy):	***budownictwo***
Specjalność (jeśli dotyczy):	**Civil Engineering**
Poziom i forma studiów:	**~~I~~ / II stopień / ~~jednolite studia magisterskie~~*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu:	**obowiązkowy / ~~wybieralny / ogólnouczelniany~~***
Kod przedmiotu:	**CEB005362**
Grupa kursów:	**~~TAK~~ / 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	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**1**		**2**		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			**2,0**		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	**0,5**		**1,1**		

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Ma rozszerzoną wiedzę z algebry liniowej i analizy matematycznej, która jest podstawą przedmiotów z zakresu mechaniki budowli.
2. Ma wiedzę z zakresu mechaniki ogólnej, wytrzymałości materiałów i teorii sprężystości.
3. Ma podstawową wiedzę z zakresu metod obliczeniowych.

CELE PRZEDMIOTU

C1. Zapoznanie z energetycznymi funkcjonałami teorii sprężystości, będącymi podstawą formułowania metod komputerowych (MES).
C2. Przypomnienie algorytmu MES dla zagadnienia płaskiego i jego implementacja dla płyty cienkiej.
C3. Zapoznanie z podstawowymi elementami skończonymi stosowanymi w analizie płyt i powłok.
C4. Zapoznanie z zastosowaniem MES w zagadnieniach geometrycznie nieliniowych i zadaniach

	dynamiki.
C5.	Rozszerzenie metody różnic skończonych na analizę zagadnienia płyty.
C6.	Zapoznanie z podstawami metody elementów brzegowych.Presentation of BEM algorithm.
C7.	Wykształcenie umiejętności interpretacji i weryfikacji wyników oraz oszacowania błędu metod komputerowych teorii sprężystości.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

Z zakresu wiedzy:

PEU_W01	Zna podstawy teoretyczne tworzenia algorytmów komputerowych wspomagających analizę złożonych konstrukcji budowlanych.
PEU_W02	Zna zasady modelowania płyt, powłok i złożonych konstrukcji budowlanych MES.
PEU_W03	Zna algorytm metody różnic skończonych w zastosowaniu do płyt.
PEU_W04	Zna podstawy teoretyczne metody elementów brzegowych

Z zakresu umiejętności:

PEU_U01	Poprawnie definiuje modele obliczeniowe płyt powłok i złożonych konstrukcji prętowo - powierzchniowych MES.
PEU_U02	Korzysta z programów komputerowych wspomagających modelowanie i analizę konstrukcji w budownictwie.

Z zakresu kompetencji społecznych:

PEU_K01	Jest odpowiedzialny za rzetelność uzyskanych wyników swoich prac i poprawność ich interpretacji.
PEU_K02	Ma świadomość konieczności poszerzania wiedzy w zakresie współczesnych technik i programów do analizy konstrukcji budowlanych.

TREŚCI PROGRAMOWE

	Forma zajęć - wykład	Liczba godzin
Wy1	Wprowadzenie. Klasyfikacja metod komputerowych.	1
Wy2	Metoda różnic skończonych w zagadnieniu płyty cienkiej. Schematy różnicowe dla równań modelu fizycznego.	2
Wy3	Metoda różnic skończonych w zagadnieniu płyty cienkiej. Warunki brzegowe. Przykłady.	2
Wy4	Funkcjonał Lagrange'a w zagadnieniu zginania płyt cienkich – algorytm MES.	2
Wy5	Elementy skończone stosowane w płytach cienkich. Prostokątny element niedostosowany. Prostokątny element dostosowany.	2
Wy6	Trójkątny element niedostosowany. Płaski trójkątny element powłokowy jako złożenie elementu tarczowego i płytowego.	2
Wy7	MES w zagadnieniach geometrycznie nieliniowych. Nieliniowe równanie równowagi. Kolokwium zaliczeniowe	2
Wy8	MES w zagadnieniach geometrycznie nieliniowych. Zagadnienie stateczności początkowej. Kolokwium zaliczeniowe – poprawa.	2
	Suma godzin	**15**

	Forma zajęć - ćwiczenia	Liczba godzin
Ćw1		
...		
	Suma godzin	

	Forma zajęć - laboratorium	Liczba godzin
La1	Wprowadzenie. Przeszkolenie BHP. Omówienie zasad zaliczania. Ustalenie harmonogramu zajęć. Przedstawienie programu obliczeniowego. Weryfikacja analitycznych rozwiązań przykładów z przedmiotu Theory of	2

	elasticity and plasticity – koncentracja naprężeń przy otworze w rozciąganej tarczy.	
La2	Przedstawienie programu obliczeniowego. Weryfikacja analitycznych rozwiązań przykładów z przedmiotu Theory of elasticity and plasticity – statyka i stateczność płyt.	2
La3	Przedstawienie programu obliczeniowego. Weryfikacja analitycznych rozwiązań przykładów z przedmiotu Theory of elasticity and plasticity – rozwiązanie powłoki.	2
La4	Ćwiczenie domowe nr 1 – model geometryczny.	2
La5	Ćwiczenie domowe nr 1 – model dyskretny, warunki brzegowe, obciążenia	2
La6	Ćwiczenie domowe nr 1 – rozwiązanie, prezentacja i dyskusja wyników	2
La7	Ćwiczenie domowe nr 1 – samodzielne rozwiązywanie prostych schematów	2
La8	Ćwiczenie domowe nr 1 – prezentacja sprawozdań, test przy komputerze	2
La9	Ćwiczenie domowe nr 2 – model geometryczny i dyskretny, obciążenie, warunki podparcia	2
La10	Ćwiczenie domowe nr 2 – rozwiązanie, prezentacja i dyskusja wyników	2
La11	Ćwiczenie domowe nr 2 – samodzielne rozwiązywanie prostych schematów	2
La12	Ćwiczenie domowe nr 2 – prezentacja sprawozdań, test przy komputerze	2
La13	Algorytm metody elementów brzegowych na przykładzie zagadnienia tarczy. MES w analizie zagadnień dynamiki konstrukcji.	2
La14	Test przy komputerze – Ćwiczenie nr 1 - poprawa	2
La15	Test przy komputerze – Ćwiczenie nr 2 - poprawa	2
	Suma godzin	**30**

Forma zajęć - projekt		Liczba godzin
Pr1		
…		
	Suma godzin	

Forma zajęć - seminarium		Liczba godzin
Se1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Wykład: tradycyjna forma wykładu. N2. Laboratorium: prezentacje multimedialne, definiowanie i rozwiązywanie problemów z wykorzystaniem dedykowanych programów, dyskusja wyników, tradycyjna forma wykładu, rozwiązanie zadań ilustrujących wykład. N3. Konsultacje.

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
P (laboratorium)	PEU_W02, PEU_W03, PEU_U01, PEU_U02, PEU_K01, PEU_K02.	samodzielna praca z programem obliczeniowym kolokwia

P (wykład)	PEU_W01, PEU_W02, PEU_U01, PEU_K01, PEU_K02.	kolokwium zaliczeniowe

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA
LITERATURA PODSTAWOWA: 1. O. C. Zienkiewicz, R. L. Taylor, J. Z. Zhu, The Finite Element Method, Sixth Edition, McGraw-Hill 2005. 2. Bathe J-K., Finite Element Procedures, Part 1-2, Prentice Hall 1995. 3. Banerjee P. K., Butterfield R., Boundary element methods in engineering science, McGraw-Hill 1981. **LITERATURA UZUPEŁNIAJĄCA:** 1. C. A. Brebbia, J. C. F. Telles, L. C. Wrobel, Boundary Elements Techniques, Springer-Verlag, Berlin 1984. 2. Washizu Kyuichiro, Variational methods in elasticity and plasticity, Pergamon Press, 1982.
OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ADRES E-MAIL)
Dr inż. Grzegorz Waśniewski, Katedra Mechaniki Budowli i Inżynierii Miejskiej, grzegorz.wasniewski@pwr.edu.pl.
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Załącznik nr 6 do ZW 121/2020

WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO

KARTA PRZEDMIOTU

Nazwa w języku angielskim:	**Budownictwo Mieszkaniowe**
Nazwa w języku polskim:	**Appartment Building**
Kierunek studiów (jeśli dotyczy):	***budownictwo***
Specjalność (jeśli dotyczy):	**Civil Engineering**
Stopień studiów i forma:	**~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu:	**obowiązkowy ~~/ wybieralny /~~ ~~ogólnouczelniany~~***
Kod przedmiotu:	**CEB004462**
Grupa kursów:	**~~TAK~~ / 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	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**2**			**1**	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				**1,0**	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	**1,1**			**0,6**	

* niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI

1. The student has knowledge of the building engineering of the first degree of engineering studies, especially in building structures and concrete structures.
2. The student has knowledge of basic mechanics and strength of materials necessary for the design of buildings.
3. The student knows the standard requirements relating to loads for buildings and design of the building structures.

CELE PRZEDMIOTU

C1. Learning the principles of architectural and structural requirements for designing multi-storey apartment buildings.

C2. Introduction of structural characteristic of concrete large slab systems with particular attention pied on the possibilities of their modernization and renovation.

C3. Introduction of technological and structural solutions used in modern apartment building systems based on the monolithic technology.

C4.	Developing personal skills for determining loading regimes and internal forces in multi-storey stiffening walls weakened by internal openings.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

Z zakresu wiedzy:

PEU_W01	The student knows and understands the specific structural and functional requirements of modern apartment building engineering.
PEU_W02	The student knows and understands the principles of design and calculation concerning multi-storey buildings which structures are basing on prefabricated and monolithic concrete technology.

Z zakresu umiejętności:

PEU_U01	The student is able to identify loading regimes acting on the high multi-storey stiffening walls and define resulting internal forces with particular emphasis on the walls weakened by internal openings.
PEU_U02	The student can do structural calculation of load-bearing and stiffening walls in multi-storey apartment buildings and make an assessment of their spatial rigidity.

Z zakresu kompetencji społecznych:

PEU_K01	The student can work independently or in a team task (making relevant report of project).
PEU_K02	The student is aware of the need to constantly expand knowledge of traditional and modern structural solutions for multi-storey apartment buildings. He is also interesting in expanding knowledge concerning modern systems for modernization such structures and testing their technical conditions.

TREŚCI PROGRAMOWE

Forma zajęć - wykład		Liczba
Wy1	Introduction, aims, scope and plan of the subject. Brief history review of the development of industrialized building engineering in Poland and Europe. Fire regulations.	**2**
Wy2	General structural and functional requirements specific to modern apartment building engineering.	**2**
Wy3	Principles of loading regimes acting on the high multi-storey buildings with particular emphasis on wind load conditions.	**2**
Wy4	Principles of determining internal forces in multi-storey concrete structures with particular attention pied on the walls weakened by internal openings.	**4**
Wy5	Overview of concrete large panel systems existing in Polish apartment building engineering. For example, description of W-70, WK-70 and WWP systems. Information concerning possibilities of technical and technological transformations of this type structures. Foreign large-panel building.	**4**
Wy6	Verification of multi-spatial rigidity of high concrete buildings including calculation of foundation plate rotation.	**2**
Wy7	Overview of modern concrete monolithic technology designed for multi-storey apartment buildings. For example, description of PERI, NOE, ULM.A and DOCA technology.	**4**
Wy8	Overview of potential risks and conditions to ensure the safety of residential high-rise buildings.	**2**
Wy9	Modern system solutions for windows and doors	**2**

Wy10	Modern material systems and solutions for finishing works.	**2**
Wy11	Modern systems and solutions for renovation and modernization of multi-family residential buildings, with particular emphasis on thermo-modernization systems.	**2**
Wy12	Final examination test.	**2**
	Suma godzin	**30**

Forma zajęć - ćwiczenia		Liczba godzin
Ćw1		
...		
	Suma godzin	

Forma zajęć - laboratorium		Liczba godzin
La1		
…		
	Suma godzin	

Forma zajęć - projekt		Liczba godzin
Pr1	Introduction. Characteristic of the project. Schedule and organization of the project work. Issue of individual student subjects and discussion of their scope.	**2**
Pr2	Principles of design and dimensioning of the typical floor drawings.	**2**
Pr3	Identification of typical rigid systems and and calculation of geometrical characteristics of individual structural walls.	**2**
Pr4	Principles of determining wind load regimes for high-rise buildings. Identification of the other loads occurring in multi-storey apartment buildings. Consultation of student projects.	**2**
Pr5	Description of procedures for determining internal forces in multi-storey, concrete walls weakened by internal openings. Consultation of student projects.	**2**
Pr6	Principles of spatial rigidity assessment in multi-storey apartment buildings. Consultation of student projects.	**2**
Pr7	Consultation of student projects.	**2**
Pr8	Assessment of student projects and final recognition.	**1**
	Suma godzin	**15**

Forma zajęć - seminarium		Liczba godzin
Se1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE

N1. LECTURE: classic lecture, multimedia presentations, educational films, on-line education

N2. PROJECT: discussion of selected aspects related to designing multi-storey apartment buildings, discussion of proposed design solutions, project realization as a team work, on-line consultation

N3. Consultation of student projects, including on-line consultation.

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
P (projekt)	PEU_U01 PEU_U02 PEU_K01	ocena końcowa projektu, włączając ocenę on-line
P (wykład)	PEU_W01 PEU_W02 PEU_U01 PEU_U02 PEU_K02	zaliczenie na podstawie końcowego kolokwium lub kolokwium on-line

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] Petersson H., Analysis of Loadbearing Walls in Multi-storey Buildings, Chalmers University of Technology, Goeteborg, 1974.

OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ZAKŁAD, INSTYTUT, ADRES E-MAIL)

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dr inż. Andrzej Moczko, Department of Building Engineering, andrzej.moczko@pwr.edu.pl

CZŁONKOWIE ZESPOŁU DYDAKTYCZNEGO (IMIĘ, NAZWISKO, ADRES E-MAIL)

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Załącznik nr 6 do ZW 121/2020

WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO

KARTA PRZEDMIOTU

Nazwa w języku angielskim: **Roads, streets and airports**
Nazwa w języku polskim: **Drogi, ulice i lotniska**
Kierunek studiów (jeśli dotyczy): ***budownictwo***
Specjalność (jeśli dotyczy): **Civil Engineering**
Stopień studiów i forma: **~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu: **obowiązkowy ~~/ wybieralny / ogólnouczelniany~~***
Kod przedmiotu: **CEB004162**
Grupa kursów: **~~TAK~~ / 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*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**2**			**2**	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				**2,0**	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	**1,1**			**1,3**	

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI

1. Student knows the basics of mathematical statistics
2. Student knows the basics of roads' and streets' design
3. Student knows the basics of roads' traffic signals design

CELE PRZEDMIOTU

C1. Familiarizing the students with methodology of traffic forecasting, crossings design (intersections and interchanges), advanced signaling, airports' elements
C2. Education skills of: traffic forecasting, crossings design (intersections and interchanges), advanced signaling, airports' elements
C3. Strengthening the ability to conduct research in the group

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ	
Z zakresu wiedzy:	
PEU_W01	Student knows how make traffic forecasting
PEU_W02	Student knows the rules of design the road’s crossings (intersections and interchanges) and advanced signaling
PEU_W03	Student knows the rules of design the airports’ elements
Z zakresu umiejętności:	
PEU_U01	Student can forecast the traffic
PEU_U02	Student can design the road’s crossings (intersections and interchanges) and advanced signaling
PEU_U03	Student can design the airports’ elements
Z zakresu kompetencji społecznych:	
PEU_K01	Student can cooperate with the group in traffic analyses

TREŚCI PROGRAMOWE

	Forma zajęć - wykład	Liczba godzin
Wy1	Classification. Basic terms and definitions, review and summary of current regulations.	2
Wy2	Prognoses and modelling of traffic. Methods of measuring and identifying traffic.	2
Wy3	Road’s design. Multicriteria analyses. Requirements for the location in the road lane.	2
Wy4	Intersections	2
Wy5	Interchanges	2
Wy6	Traffic engineering – fundamentals	2
Wy7	Control the traffic. Signal planning	2
Wy8	The capacity of roads and junctions	2
Wy9	Elements of airports. Field planning	2
Wy10	Number, length and directions of airport’s runways	2
Wy11	Street design	2
Wy12	Planning of public transport	2
Wy13	Calmed traffic. Pedestrians and Cyclists	2
Wy14	Pavements, materials, keeping of roads. Catalog and individual methods. Drainage methods.	2
Wy15	Test	2
	Suma godzin	**30**

	Forma zajęć - ćwiczenia	Liczba godzin
Ćw1		
…		
	Suma godzin	

	Forma zajęć - laboratorium	Liczba godzin
Lab1		
…		
	Suma godzin	

	Forma zajęć - projekt	Liczba godzin
Pr1	Introduction	2
Pr2	Prognoses of traffic	2
Pr3	Routing calls from city to airport. Requirements for the location in the road lane.	2

Pr4	Choice of variant	2
Pr5	Location plan for the selected variant	2
Pr6	Intersection location plan	2
Pr7	Design of flexible pavement	2
Pr8	Signaling project - preliminary calculations	2
Pr9	Signaling project - accommodation	2
Pr10	Evaluation of traffic conditions for the intersection	2
Pr11	Complement existing work	2
Pr12	Calculate the length and direction of the runways at the airport	2
Pr13	Airfield location plan at the airport	2
Pr14	Project summary. Rules for the preparation of project documentation. Discussing formal and legal requirements.	2
Pr15	Mark	2
	Suma godzin	**30**

Forma zajęć - seminarium		Liczba godzin
Se1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. multimedia presentation N2. personal computer, interactive whiteboard (calculations, drawings, descriptions)

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1 (projekt)	PEU_U01	sprawozdanie
F2 (projekt)	PEU_U02 PEU_K01	sprawozdanie
F3 (projekt)	PEU_U03	sprawozdanie
P (projekt) = F1 * 0,3 + F2 * 0,4 + F3 * 0,3		
P (wykład)	PEU_W01 PEU_W02 PEU_W03	kolokwium

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] Robinson R., Road Engineering for Development, Taylor & Francis, 2004
[2] Wells A.T., Young S., Airport Planning and Management, McGraw-Hill Professional, 2004
[3] Roess R.P., Prassas E.S., McShane W.R., Traffic Engineering (3rd Edition), Prentice Hall, 2004
[4] OBWIESZCZENIE MINISTRA INFRASTRUKTURY I BUDOWNICTWA z dnia 23 grudnia 2015 r. w sprawie ogłoszenia jednolitego tekstu rozporządzenia Ministra Transportu i Gospodarki Morskiej w sprawie warunków technicznych, jakim powinny odpowiadać drogi publiczne i ich usytuowanie, poz. 124, wraz z późniejszymi zmianami
[5] ROZPORZĄDZENIE MINISTRA TRANSPORTU, BUDOWNICTWA I GOSPODARKI MORSKIEJ z dnia 25 kwietnia 2012 r. w sprawie szczegółowego zakresu i formy projektu

budowlanego, wraz z późniejszymi zmianami
[6] Rozporządzenie Ministra Infrastruktury z dnia 16.01.2002 r. w sprawie przepisów techniczno-budowlanych dotyczących autostrad płatnych. Dz.U.02.12.116, wraz z późniejszymi zmianami

LITERATURA UZUPEŁNIAJĄCA:

[1] Manual of Uniform Traffic Control Devices (MUTCD) 2003
[2] Highway Capacity Manual (HCM) 2000
[3] Wybrane, aktualne artykuły z: „Journal of Transportation Engineering”

OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ZAKŁAD, INSTYTUT, ADRES E-MAIL)
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Załącznik nr 6 do ZW 121/2020

WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO

KARTA PRZEDMIOTU

Nazwa w języku angielskim:	**Railways**
Nazwa w języku polskim:	**Koleje**
Kierunek studiów (jeśli dotyczy):	***budownictwo***
Specjalność (jeśli dotyczy):	**Civil Engineering**
Stopień studiów i forma:	**~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu:	**obowiązkowy ~~/ wybieralny / ogólnouczelniany~~***
Kod przedmiotu:	**CEB004062**
Grupa kursów:	**~~TAK~~ / NIE***

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	**30**			**30**	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	**30**			**60**	
Forma zaliczenia	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**1**			**2**	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				**1,7**	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	**1,1**			**1,1**	

* niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI

1. Ability for English language use (understanding, writing and speaking) on B2 level.
2. General, basic knowledge on railroads.
3. Skills of reading and use of maps and technical drawings.
4. Skills of using normal cross sections and longitudinal sections of railway track.

CELE PRZEDMIOTU

C1. Acquiring of basic skills to design the layouts of railway tracks and stations.
C2. Acquiring of basic skills to design the railway station drainage systems.
C3. Acquiring of knowledge on layout of railway tracks and stations.
C4. Acquiring of knowledge on various track structures.

C5.	Acquiring of basic knowledge on railway works technology.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

Z zakresu wiedzy:

PEU_W01 Knows and understands railway network structure, distinguishes between types of operating posts and knows their function.
PEU_W02 Knows railway infrastructure elements, their function and way of work.
PEU_W03 Distinguishes types of railway track structures, knows their pros and cons.
PEU_W04 Knows conditions of railway infrastructure work (loads and ambient conditions) and understands the matter of their proper drainage and protection.
PEU_W05 Knows basic technologic processes in railway technology.

Z zakresu umiejętności:

PEU_U01 Knows how to design a railway line in plane, in profile and in cross section.
PEU_U02 Knows how to design a track layout of a small station and the auxiliary objects for passenger and freight services.
PEU_U03 Knows how to design a drainage system of a railway line and station.

Z zakresu kompetencji społecznych:

PEU_K01 Is able to work on completing tasks alone and in group
PEU_K02 Understands the need of collecting and passing to the society information and opinions on engineering activity

TREŚCI PROGRAMOWE

	Forma zajęć - wykład	Liczba godzin
Wy1	Definitions of the rail road. Basic facts of railway engineering history. Elements of railway infrastructure. Classification of railway lines.	2
Wy2	Elements of track. Technical standards of track.	2
Wy3	Railway track subgrade. Rules for shaping and material requirements. Elements of drainage system of railway lines and stations.	2
Wy4	Kinematics of the train move. Rail-wheel co-operation. Basic assumptions for track geometry calculations.	2
Wy5	Track geometry design in plane and in profile. Railway structure gauge.	2
Wy6	Tramway. History of city transportation. Elements of tramway track. Design of track and platforms.	2
Wy7	Continuous welded track. Track on grade crossing..	2
Wy8	Ballastless track. Track on bridges.	**2**
Wy9	Turnouts. Ladder track. Derailers. Trap points and bump stops. Turning tables and shift tables. Gauntlet track.	2
Wy10	Railways in Poland and in the world. Elements of railway infrastructure. Operation posts. Intermodal transport.	2
Wy11	Stations. Classification, functions, track alignments.	2
Wy12	Basic technologic processes in railway technology.	2
Wy13	Machines and devices in railway technology.	2
Wy14	Modernization of railway lines. Rules for design and applied technologies.	2
Wy15	Final test. Results disscussion.	2
	Suma godzin	30

Forma zajęć - ćwiczenia	Liczba godzin

Ćw1		
…		
	Suma godzin	

Forma zajęć - laboratorium		**Liczba godzin**
La1		
…		
	Suma godzin	

Forma zajęć - projekt		**Liczba godzin**
Pr1	Organization of work. Requirements and rules. Issuing of the data for the project. Description of the project scope. List of compulsory and auxiliary readings and lectures for the project, including local and international regulations.	2
Pr2	Railway line section in plane. Geometry of the track layout. Cant and cant ramp. Design of transition curves.	2
Pr3	Characteristic cross section of the track. Shaping of embankments at bridges and viaduct.	2
Pr4	Profile of railway line. Geometric correlation between plane, profile and cross section.	2
Pr5	Drainage design. Shaping of ditches in plane, profile and cross section.	2
Pr6	Design of protection layers in subgrade. Students work review (plane, profile).	2
Pr7	Resume of the first part of the project. Students work review (plane, profile, cross sections)	2
Pr8	Introduction to the design of railway siding. Plane layout, requirements and rules.	2
Pr9	Track alignment and track geometry in stations and marshalling yards.	2
Pr10	Number and length of marshalling yard and station tracks. Calculation of the main auxiliary tracks number.	2
Pr11	Loading fronts for freight services. Calculation of warehouse, stack square and loading ramp.	2
Pr12	Turnouts: kinds, geometry, dimensions, applications, special trackwork. Principles of track connection shaping.	2
Pr13	Elements of drainage system on marshalling yard and loading front – geometric design.	2
Pr14	Cross section of the marshalling yard and loading front.	2
Pr15	Resume of the second part of the project. Students work review.	2
	Suma godzin	**30**

Forma zajęć - seminarium		**Liczba godzin**
Se1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE	
N1.	Lecture: multimedia presentation, blackboard
N2.	Design: multimedia presentation, blackboard.
N3.	Design: exemplary design drawing, model of the railway station drainage system.

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1 (projekt)	PEU_U01 PEU_U02 PEU_U03 PEU_W04	ocena projektu
F2 (projekt)	PEU_K01 PEU_K02	ocena projektu
P (projekt) = 0,65×F1 + 0,2×F2 + 0,15×praca systematyczna (przegląd projektu)		
P (wykład)	PEU_W01 PEU_W02 PEU_W03 PEU_W04 PEU_W05	końcowe kolokwium

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] Dz. U. nr 151.: Rozporządzenie Ministra Transportu i Gospodarki Morskiej w sprawie warunków technicznych, jakim powinny odpowiadać budowle kolejowe i ich usytuowanie with changes 2014, 2018
[2] Dz. U. nr 33.: Rozporządzenie Ministra Transportu i Gospodarki Morskiej z dnia 26 lutego 1996 r. w sprawie warunków technicznych jakim powinny odpowiadać skrzyżowania linii kolejowych z drogami publicznymi i ich usytuowanie (ze zmianami: Dziennik Ustaw Rzeczpospolitej Polskiej Nr 100 z 9.11.2000, pozycja 1082.
[3] TSI Infrastructure: Commission Regulation (EU) No 1299/2014 of 18 November 2014 on the technical specifications for interoperability relating to the 'infrastructure' subsystem of the rail system in the European Union Text with EEA relevance. *OJ L 356, 12.12.2014, p. 1–109*
[4] Bonnet, Clifford F.: Practical Railway Engineering. London: Imperial College Press, 2010
[5] Esveld C.: Modern Railway Track, 2nd ed. Zaltbommel: MRT-Productions, 2001.

LITERATURA UZUPEŁNIAJĄCA:

[1] Id-1 (D-1) Warunki techniczne utrzymania nawierzchni na liniach kolejowych - PKP Polskie Linie Kolejowe S.A., Warszawa 2005; ze zmianami: 2006, 2010, 2015
[2] Id-3 (D-4) Warunki techniczne utrzymania podtorza kolejowego - PKP Polskie Linie Kolejowe S.A., Warszawa 2009.
[3] Standardy Techniczne - Szczegółowe warunki techniczne dla modernizacji lub budowy linii kolejowych do prędkości Vmax ≤ 200 km/h (dla taboru konwencjonalnego) / 250 km/h (dla taboru z wychylnym pudłem) – PKP PLK Warszawa 2009 - ze zmianami 2017, 2018
[4] Fahrwege der Bahnen im Nah- und Regionalverkehr in Deutschland = Local and regional railway tracks in Germany. VDV, Alba Fachverlag. Düsseldorf, 2007
[5] Jackson A.A.: The railway dictionary: worldwide railway facts and terminology. Stroud Sutton 2006
[6] Yi S.: Principles of railway location and design. Academic Press 2018
[7] Understanding track engineering. Lavenham Press 2014
[8] Freudenstein S.: Ballastless tracks. Ernst&Sohn 2018
[9] Indraratna B. et al.: Advanced rail geotechnology – ballasted track. CRC Press/Balkema 2011

OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ZAKŁAD, INSTYTUT, ADRES E-MAIL)
dr inż. Igor Gisterek, Katedra Dróg, Mostów, Kolei i Lotnisk, igor.gisterek@pwr.edu.pl
CZŁONKOWIE ZESPOŁU DYDAKTYCZNEGO (IMIĘ, NAZWISKO, ADRES E-MAIL)
Nauczyciele i doktoranci z Zakładu Kolei, Katedry Dróg, Mostów, Kolei i Lotnisk

Załącznik nr 6 do ZW 121/2020

WYDZIAŁ BUDOWNICTWA LĄDOWEGO I WODNEGO
KARTA PRZEDMIOTU

Nazwa w języku angielskim:	**Underground structures – urban infrastructure**
Nazwa w języku polskim:	**Budownictwo podziemne – infrastruktura miejska**
Kierunek studiów (jeśli dotyczy):	***budownictwo***
Specjalność (jeśli dotyczy):	**Civil Engineering**
Stopień studiów i forma:	**~~I~~ / II stopień*, stacjonarna / ~~niestacjonarna~~***
Rodzaj przedmiotu:	**obowiązkowy ~~/ wybieralny / ogólnouczelniany~~***
Kod przedmiotu:	**CEB003962**
Grupa kursów:	**~~TAK~~ / 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~~*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**2**			**2**	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				**2,0**	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	**1,0**			**1,2**	

* niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI

1. The student possesses knowledge of structural mechanics.
2. The student knows the principles of soil mechanics with relation to civil engineering.
3. The student knows standards of concrete structure designing.

CELE PRZEDMIOTU

C1. Learning the principles of interaction: tunnel support – surrounding rock mass
C2. Gaining the different types of underground structures and various executing technologies.
C3. Skills acquisition of design of reinforced concrete tunnel support.
C4. Skills acquisition of advanced design of tunnel support located at great depth

C5.	Skills acquisition of solving, interpreting and verifying of the results of analytical calculations.
C6.	Strengthening the ability to work on the task entrusted to and awareness of the need to seek new theoretical and practical solutions.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ	
Z zakresu wiedzy:	
PEU_W01	Student has an in-depth knowledge of analysis, design and construction of underground structures in urban infrastructure.
PEU_W02	Student has an in-depth knowledge of rock mechanics and tunnel support design.
Z zakresu umiejętności:	
PEU_U01	The student can properly create a computational model of underground structure.
PEU_U02	The student can properly design all the elements of underground structure.
Z zakresu kompetencji społecznych:	
PEU_K01	The student can works independently or with a team..
PEU_K02	The student is aware of the need to continuously increase own knowledge in the field of design techniques of underground structures.

TREŚCI PROGRAMOWE		
	Forma zajęć - wykład	**Liczba godzin**
Wy1	Introduction - the basic definition and classification of underground urban infrastructure: rapid transit systems, underground passages, road tunnels, tram tunnels.	2
Wy2	Definition and classification of underground space by the use, function and depth. Potential psychological problems associated with underground space. Designing of shallow underground structures.	2
Wy3	Specificity of loads acting on shallow underground structures. Evaluation of loads acting on tunnel lining.	2
Wy4	Specificity of loads acting on shallow underground structures – further information. A procedure of internal forces determination. A choice of proper static scheme and calculation of elastic constraints stiffness.	2
Wy5	Executing technologies of shallow tunnels. Methods of supporting the walls of deep excavations.	2
Wy6	Trenchless technologies of shallow tunnels execution – Milan method, Tunnel Boring Machines: presentation of different techniques for excavation face support.	2
Wy7	Specific features of deep tunnels. Characteristics of design approach for tunnels located in the rock mass. Scale effect with respect to mechanical properties of the rock mass. Advanced ventilation systems of long and deep tunnels.	2
Wy8	Longitudinal profile of deep tunnels and its implication for drainage and ventilation facility. Characteristics of minimum safety requirements for road and railway tunnels in accordance with EU Directives.	2
Wy9	Advanced systems of waterproofing of tunnel structure. Insulation membranes between temporary and final linings used in modern tunneling.	2
Wy10	Definition and estimation of the critical depth for excavation located in	2

	rock mass governed by: a) Coulomb - Mohr or b) Hoek – Brown failure criterion.	
Wy11	Deformation earth pressure. The elastic-plastic problem of circular excavation at great depth - Part I: elastic deformation. Tunnel located above the critical depth.	2
Wy12	Deformation earth pressure. The elastic-plastic problem of circular excavation at great depth - Part II: plastic deformation. Tunnel located below the critical depth.	2
Wy13	Static earth load acting on tunnel support. Engineering methods for assessing static rock pressure. Role of tunnel support mechanical characteristics and time of final lining installation on "rock-tunnel" support interaction.	2
Wy14	Parametric evaluation of the quality of the rock mass. Rock Mass Classification systems: RQD, RMR, Q, GSI. Preliminary selection of the support type based on RMR, Q or GSI values.	2
Wy15	Tunneling techniques in rock masses. Tunneling shields, types of shields, excavation techniques, New Austrian Tunneling Method, drill and blast method, sequential excavation process in the conditions of the weak rock mass.	2
	Suma godzin	**15**

Forma zajęć - ćwiczenia		Liczba godzin
Ćw1		
...		
	Suma godzin	

Forma zajęć - laboratorium		Liczba godzin
La1		
...		
	Suma godzin	

Forma zajęć - projekt		Liczba godzin
Pr1	Presentation of the scope of the project, the completion and the available literature. Discussion of the design scope. Presentation of design procedure in case of structures located in the rock masses.	2
Pr2	Principles of cross-section design of tunnel support - Car tunnel. Factors influencing the geometry of tunnel cross-section. Discussion on methods of waterproofing of tunnel structure. Individual students work on projects.	2
Pr3	Principles of cross-section design of tunnel support - railway tunnel. Factors influencing the geometry of tunnel cross-section. Individual students work on projects.	2
Pr4	Practical use of geomechanics classification of rock mass: RMR and GSI. Presentation of Rock Mass Classification systems with special regard to GSI approach. Determination of deformation parameters of the rock mass with the use of GSI index and intact rock properties. Individual students work on projects.	2
Pr5	Presentation of Hoek-Brown failure criterion. Differences between	2

	intact rock (rock specimen) and rock mass with respect to the their mechanical behavior. Relations enabling estimations of failure criterion parameters based on the GSI classification. Determination of the properties of disturbed rock mass existing in the vicinity of underground excavation. Estimation of critical depth.	
Pr6	The elastic-plastic boundary value problem of circular excavation at great depth: elastic and elastic-plastic solution. Rock mass pressure acting on tunnel support as a function of plastic zone radii in two extreme cases: (a) excavation located above the critical depth, (b) excavation located below the critical depth.	2
Pr7	The value of rock mass pressure corresponding to maximum radii of plastic zone.	2
Pr8	Verification of the student calculations of rock mass pressure acting on tunnel support.	2
Pr9	Computational model of static interaction in the system: tunnel support – rock mass. Evaluation of parameters of computational model. Iterative procedure of internal forces evaluation.	2
Pr10	Strength designing of concrete tunnel support.	2
Pr11	Discussion on the students final design of tunnel support and verification of the internal forces of tunnel structure evaluated by students.	2
Pr12	Principles of proper ventilation preservation in tunnel: Pulsfort and Bendelius method. Determination of the minimum discharge of ventilation to keep the concentration of pollutant on the safe level. Calculation example.	2
Pr13	The problem of preserving the safety in tunnel. Elements of additional equipment in tunnel arising from the directives in force in the European Union.	2
Pr14	Drilling and blasting technologies in tunnel excavation execution. Description of tunneling works according to the rules of New Austrian Tunneling Method with assumption of the advance performed by the drill and blast technique.	2
Pr15	Presentation of the final design of tunnel support.	2
	Suma godzin	**30**

Forma zajęć - seminarium		Liczba godzin
Se1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Lecture: classic lecture and multimedial presentations
N2. Project: solving of calculation example, multimedial presentation,

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ		
Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1 (projekt)	PEU_U01, PEU_U02, PEU_K01	częściowa ocena projektu tunelu od studentów
F2 (projekt)	PEU_U01, PEU_U02, PEU_K01	prezentacja końcowego projektu tunelu
P = 0,5xF1+0,4xF2+0,1xOBECNOŚĆ (projekt)		
F1 (wykład)	PEU_W01, PEU_W02, PEU_K02	egzamin

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] Chapman D., Metje N., Stärk A.: “Introduction to Tunnel Construction”, Taylor and Francis Group, 2010.
[2] Goel, Rajnish K., Bhawani S., Zhao K.: “Underground infrastructures: planning, design, and construction”, Butterworth-Heinemann, 2012.
[3] Bieniawski Z. T.: „Engineering Rock Mass Classifications”, Wiley, 1989.
[4] Hoek E.: Support of underground excavations in hard rock, 1995.
[5] Megaw T.M.: Tunnels: planning, design, construction, 1983.
[6] Kolymbas D.: Tunneling and tunnel mechanics: a rational approach to tunneling, 2005.

LITERATURA UZUPEŁNIAJĄCA:

[1] Lunardi P.: Design and construction of tunnels, 2008.

OPIEKUN PRZEDMIOTU (IMIĘ, NAZWISKO, ZAKŁAD, INSTYTUT, ADRES E-MAIL)

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Katedra Mechaniki Budowli i Inżynierii Miejskiej:
prof. dr hab. inż. Cezary Madryas, Cezary.Madryas@pwr.edu.pl

Zał. Nr 1 do ZW 16/2020

PROGRAM OF STUDIES

FACULTY: **Civil Engineering**
MAIN FIELD OF STUDY: **civil engineering**
DISCIPLINES: **D1 Civil engineering and transport (major discipline)**
~~D2* ……………………………~~
~~D3* ……………………………~~
~~D4* ……………………………~~

EDUCATION LEVEL: ~~**first-level (licencjat/inżynier) studies**~~ **/ second-level studies** ~~**/ magister uniform studies**~~*****
FORM OF STUDIES: **full-time studies /** ~~**part-time studies**~~*****
PROFILE: general academic / ~~**practical**~~ *****
LANGUAGE OF STUDY: **English for specialization: Civil Engineering**

Content:
1. Assumed learning outcomes – Attachment no. 1 to the program of studies
2. Description of the program of studies – Attachment no. 2 to the program of studies
3. Plan of studies – Attachment no. 3 to the program of studies

Resolution no. … of the Senate of Wroclaw University of Science and Technology

In effect since 1.10.2022

*delete as applicable

ASSUMED LEARNING OUTCOMES
Specialization: Civil Engineering (CEB)

Faculty: Civil Engineering
Main field of study: civil engineering
Education level: second-level studies
Profile: general academic profile

<u>Location of the field of study</u>
Branch of science: engineering and technical sciences
Discipline / discipline for several disciplines, please indicate the leading discipline)
Civil engineering and transport (major discipline)

<u>Explanation of the markings:</u>
P6U – universal first degree characteristics corresponding to education at the first-level studies - 6 PRK level *
P7U – universal first degree characteristics corresponding to education at the second-level studies - 7 PRK level *

P6S – second degree characteristics corresponding to education at the first-level studies - 6 PRK level *
P7S – second degree characteristics corresponding to education at the second-level studies - 7 PRK level *

W - category "knowledge"
U - category "skills"
K - category "social competences"
K (*faculty symbol*) _W1, K (*faculty symbol*) _W2, K (*faculty symbol*) _W3, … - main-field-of study learning outcomes related to the category "knowledge"
K (*faculty symbol*) _U1, K (*faculty symbol*) _U2, K (*faculty symbol*) _U3, … - main-field-of study learning outcomes related to the category "skills"
K (*faculty symbol*) _K1, K (*faculty symbol*) _K2, K (*faculty symbol*) _K3, … - main-field-of study learning outcomes related to the category "social competences"
Note: the effects with the U code are obtained only during practical classes.

Main field of study learning outcomes	Description of learning outcomes for the main-field-of study	Reference to PRK characteristics		
		Universal first degree characteristics (U)	Second degree characteristics typical for qualifications obtained in higher education (S)	
			Characteristics for qualifications on 7 levels PRK	Characteristics for qualifications on 6 and 7 levels of PRK, enabling acquiring engineering competences
KNOWLEDGE (W)				
K2_W01	possesses essential advanced knowledge in the area of chosen sections of mathematics and physics in the scope being the basis for the strength of materials, mechanics, including dynamics as well as the theory of structures.	**P7U_W**		**P7S_WG_INZ**
K2_W02	possesses broadened knowledge of advanced problems related to the strength of materials and materials modelling	**P7U_W**	**P7S_WG,**	**P7S_WG_INZ**
K2_W03	possesses the necessary knowledge about the theoretical basis of methods for modelling, analysis and dimensioning of advanced (complex) structures	**P7U_W**	**P7S_WG**	**P7S_WG_INZ**
K2_W04	knows advanced methods of mechanics and theory of structures	**P7U_W**	**P7S_WG**	**P7S_WG_INZ**
K2_W05	possesses fundamental knowledge of theoretical basis of analysis and structure optimization as well as complex structural systems design	**P7U_W**		**P7S_WG_INZ**
K2_W06	knows standard, guidelines and regulations relevant to the building constructions design and their elements	**P7U_W**		
K2_W07	knows principles of analysis, construction and dimensioning of complex building construction: steel and reinforced concrete	**P7U_W**	**P7S_WG**	**P7S_WG_INZ**
K2_W08	knows the principles of cooperation of the subgrade and complex structures	**P7U_W**	**P7S_WG**	**P7S_WG_INZ**
K2_W09	knows classification and the range of applications of computer programs supporting the analysis and design of complex building constructions	**P7U_W**	**P7S_WG**	**P7S_WG_INZ**
K2_W10	knows currently used, modern building materials and basic components of technologies and their production	**P7U_W**	**P7S_WK**	**P7S_WK_INZ**
K2_W11	knows the rules of creating procedures for the implementation of building investments; knows programs useful for planning of building investments including management of operation and maintenance	**P7U_W**	**P7S_WG, P7S_WK**	**P7S_WG_INZ, P7S_WK_INZ**
K2_W12	possesses grounded knowledge of running a business relevant to the construction industry; understands principles and basis of financial management of a company	**P7U_W**	**P7S_WK**	**P7S_WK_INZ**
K2_W13	possesses knowledge of the influence of implementation of construction projects on environment	**P7U_W**	**P7S_WK**	**P7S_WK_INZ**
K2_W14	knows construction law and the Occupational Health and Safety Act	**P7U_W**	**P7S_WK**	**P7S_WK_INZ**
K2_W15	knows patent law as well as intellectual property protection regulations and also code of ethics	**P7U_W**	**P7S_WG, P7S_WK**	**P7S_WG_INZ, P7S_WK_INZ**
SKILLS (U)				
K2_U01	is able to use advanced specialist tools to search databases and other sources related to discipline of civil engineering and transport; is able to use	**P7U_U**	**P7S_UW, P7S_UU**	**P7S_UW_INZ**

	information technologies for communication and knows how to choose software that supports the work of a designer and a person who organizes and manages building processes as well as operation and maintenance of building objects			
K2_U02	possesses language skills in fields of study related to the studied discipline according to CEFR requirements for at least B2+ level; possesses ability to communicate in foreign languages and knows elements of technical language in the area of civil engineering	**P7U_U**	**P7S_UK**	
K2_U03	is able to establish directions of further education and follow the process of self-learning	**P7U_U**	**P7S_UK**	
K2_U04	is able to make a classification of simple and complex building structures	**P7U_U**	**P7S_UW**	**P7S_UW_INZ**
K2_U05	is able to make assessment and any kind of loads combinations acting on building objects together with their adequate combinations	**P7U_U**	**P7S_UW**	**P7S_UW_INZ**
K2_U06	is able to use advanced methods of mechanics and the theory of structures	**P7U_U**	**P7S_UW**	**P7S_UW_INZ**
K2_U07	is able to use the methods of modelling, analysis and dimensioning of advanced (complex) structures	**P7U_U**	**P7S_UW**	**P7S_UW_INZ**
K2_U08	is able to solve complex concepts in the area of chosen sections of mathematics, being the basis of advanced construction analysis methods; is able to choose tools (analytical or numerical) to solve engineering problems; is able to use chosen computer programs supporting modelling and design processes in civil engineering	**P7U_U**	**P7S_UW**	**P7S_UW_INZ**
K2_U09	is able to critically assess the results of numerical analysis of complex engineering structures	**P7U_U**		**P7S_UW_INZ**
K2_U10	is able to design complex foundations of building objects	**P7U_U**	**P7S_UW**	**P7S_UW_INZ**
K2_U11	is able to model and design complex elements and structures	**P7U_U**	**P7S_UW**	**P7S_UW_INZ**
K2_U12	is able to prepare a graphics project documentation in the environment of chosen graphics programs	**P7U_U**	**P7S_UW**	**P7S_UW_INZ**
K2_U13	is able to prepare the schedule of construction works and cost estimate of a construction undertaking and assess the efficiency of construction projects within the work team	**P7U_U**	**P7S_UO**	
K2_U14	is able to assess threats related to construction projects implementation and implement adequate safety principles, is able to develop norms and standards of work and quality management procedures within the work team	**P7U_U**	**P7S_UW, P7S_UK, P7S_UO, P7S_UU**	**P7S_UW_INZ**
K2_U15	is able to plan and carry our laboratory experiments leading to quality assessment of applied materials and also the assessment of the strength of building structure elements	**P7U_U**		
K2_U16	is able to, according to scientific principles, using scientific know-how to formulate and develop entry works of a research type leading to solving engineering problems as well as technological and organizational, in civil engineering	**P7U_U**	**P7S_UW, P7S_UU**	**P7S_UW_INZ**
K2_U17	is able to plan, prepare and carry out research and prepare elaborations which prepare him/her to take up research work	**P7U_U**	**P7S_UW, P7S_UU**	**P7S_UW_INZ**

COMPETENCES (K)				
K2_K01	is aware of the need to continually improve professional and personal competences; in the form of formal or informal education, it complements and expands knowledge in the field of modern processes and technologies related to civil engineering and transport	**P7U_K**	**P7S_KK**	
K2_K02	realizes the significance and understands non-technical aspects and consequences of engineering activity and especially its influence on the natural environment and the related responsibility for decisions	**P7U_K**	**P7S_KK**	
K2_K03	is able to work independently and cooperate in a group on given tasks is responsible for safety of his own work as well as his team	**P7U_K**	**P7S_KK, P7S_KO**	
K2_K04	Realizes the significance of professional behaviour and obey the code of ethics; identifies correctly and solve dilemmas related to the profession; is able to set priorities which help in implementing a task set by himself or others	**P7U_K**	**P7S_KO, P7S_KR**	
K2_K05	is able to think and act in a creative and entrepreneurial way	**P7U_K**	**P7S_KO**	
K2_K06	realizes the social role of technical university graduates and especially understands the need to formulate information and share it with society, e.g. through mass media, in relation to achievements in environmental engineering and other aspects of engineering activity; makes attempts at sharing such information and opinions in an understandable way, justifying different points of view.	**P7U_K**	**P7S_KK, P7S_KO, P7S_KR**	
K2_K07	is aware of the necessity of individual and team activities going far beyond an engineering activity	**P7U_K**	**P7S_KK, P7S_KO, P7S_KR**	

Zał. nr 3 do ZW 16/2020

Attachment no. 2. to the Program of Studies

DESCRIPTION OF THE PROGRAM OF STUDIES

FACULTY: Civil Engineering

MAIN FIELD OF STUDY: Civil Engineering

EDUCATION LEVEL: ~~first-level (licencjat/inżynier) studies /~~ second-level studies ~~/ magister uniform studies*~~

FORM OF STUDIES: full-time studies ~~/ part-time studies *~~

PROFILE: general academic ~~/ practical *~~

SPECIALIZATION: Civil Engineering

LANGUAGE OF STUDY: English

1. General description

1.1. Number of semesters:	***3***
1.2. Total number of ECTS points necessary to complete studies at a given level:	***90***
1.3. Total number of hours:	***1035***

1.4. Prerequisites (particularly for second-level studies):

An applicant for second level studies in Civil Engineering in the Civil Engineering Department of Wroclaw University of Science and Technology must have qualifications of first level studies and be competent in continuing education at second level studies in this faculty. Candidates applying for second level studies in Civil Engineering must:

- possess knowledge from selected fields of mathematics and physics which enables the understanding of the physical basis of construction and also the formulation and solving of simple problems in the area of civil engineering;

- possess knowledge from chemistry which enables the understanding of the basis of chemical properties and the construction of building materials;

- be able to read and understand architectural, constructional and geodesy drawings and make proper project documentation in a graphical environment on selected CAD software;

- possess knowledge and be competent in the area of structural mechanics, strength of materials and principles of the general formation of building structures;

- possess knowledge and ability to apply the principles of structural mechanics and bar construction analysis in the areas of statics, dynamics and stability;

- be able to apply appropriate computational models and carry out structural mechanic analysis of simple bar structures which are statically determinate and indeterminate;

- possess knowledge and skills in the area of designing selected elements and simple constructions made of: metal, reinforced concrete, wood, masonry and composite;

- possess knowledge and basic skills in designing hydrotechnical and bridge building structures and structures related to transport infrastructure;

- knows the basics of soil mechanics and principles of modeling, dimensioning and construction of foundations;

- knows the basics of building physics and understand the phenomenon of heat transfer and diffusion of moisture in building objects;

- be able to select and apply correct tools for solving issues regarding analysis, building structure design and carrying out construction works;

- be able to estimate costs and formulate schedules of building works, building site developments and building works execution projects;

- possess skills in the area of interpretation, presentation and documentation of simple experiments and also in the area of presentation and documentation of the results of task implementation with project characteristics.

The principles for verifying the competencies of candidates are determined by the appropriate resolutions of the Faculty Council.

1.5. Upon completion of studies graduate obtains professional degree of:	***magister inżynier***

1.6. Graduate profile, employability:

After finishing second level studies in the Civil Engineering Faculty, a graduate, using his acquired knowledge and skills is ready to make decisions regarding the appropriate usage of materials, construction design and construction projects. Knows the current trends in the design and execution of building projects. Uses principles of occupational health and safety. Is able to design buildings, knows the principles of structural mechanics and is able to formulate, create, and then use the appropriate computational models of complex engineering structures. Can make and read technical drawings, recognize geodesy and cartography documentations and manage construction works. Is able to formulate and solve new engineering, technical and organizational issues related to civil engineering. Can use modern computer aided technics in the design of constructional structures and projects. Can critically select arguments supporting collective decisions related to the execution of tasks in civil engineering. Is able to formulate and publish reports on the progress of carried out works.

Is able to work in a team and supervise a team's duties. Is responsible for the safety of a supervised team. Is aware of the need to improve his professional and personal competence. Follows ethical rules. Knows and uses the principles of construction law.

Has language skills in the fields of science and scientific disciplines relevant to the studied faculty and requirements for B+ level of the Common European Framework of Reference for Languages. Is prepared to continue his education at third level studies. Graduates are able to: solve complex design, organizational and technological issues, formulate and carry out research programs, run projects of international scope, participate in the marketing and promotion of building products, continue their education and participate in research and disciplines directly related to civil engineering and building production, constantly update their qualifications and knowledge and also manage large groups of people. Graduates are qualified to take a job in: construction and design offices, executive enterprises, research institutes and development centres and also guidence institutions disseminating knowledge from civil engeneering.

Futhermore, graduates of each specialization achieve additional extended competence refering to the education outcomes of their specialization:

A graduate of Building Structures possesses enriched knowledge and advanced design skills in the area of pre-stressed concrete structures, complex structures and high and thin-walled constructions. Furthermore, a graduate is competent at solving issues related to the rheology, reliability and limit states of constructions and also failures and renovations of constructions. A specificity of the specialization in Building Technology is to provide graduates extensive knowledge and competency in the area of methods of executing building structures, organizing building works, procedures of executing building investments and also managing building projects and industrial production of prefabricated elements. Graduates of this specialization possess knowledge and skills referring to the exploitation, renovation, modernization and diagnostics of building structures and real estate management.

The specialization in Hydroengineering Structures enables graduates to be competent in the area of designing hydrotechnical constructions, steel hydrotechnical constructions, specific concrete and municipal buildings. It also provides graduates knowledge about the exploitation and regulation of rivers and water-ways, water power plants, hydrotechnical tunnels, water and sewage installations, the renovation of hydrotechnical constructions and also permanent and temporary water drainage. The extensive competence of graduates of Underground and Urban Infrastructures comes as a result of finishing basic and field courses such as: building works and earth engineering, underground engineering, civil engineering, network infrastructure, maintenance of underground constructions, specific foundations and also foundation engineering in specific terrains. The specialization of Roads and Airports educates students who achieve extensive knowledge and skills in the area of materials and road surfaces, water drainage of traffic infrastructure, theory of road surface dimensioning, computer aided designing of roads and airports and also municipal engineering and municipal transport services.

Furthermore, graduates are competent in the area of transport systems. The specialization of Railway Engineering gives graduates extensive knowledge and competency in the area of rail surfaces theory, rail works technology, the design of railway stations, railway traffic engeneering, railway traffic navigation, railway exploitation, municipal engineering, drainage of traffic infrastructure, rail surface diagnosis, durability and reliability of rail surfaces and also computer methods in designing railway trucks.

A graduate of the specialization of Bridges, apart from possessing the same knowledge as graduates from the other specialisations, also has extended knowledge and skills in the area of bridge construction theory, the design and execution of concrete, metal and wooden bridges, computer aided design of bridges, testing and rehabilitation of bridges and primer coat constructions. A graduate also has a possibility to become acquainted with the computer systems which aid bridge management.

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Theory of Structures is a specialization for particularly talented students. Graduates of this specialization are competent in the area of mathematical methods in mechanics, theory of plain girders and solving problems regarding the reliability and limit states of constructions. Futhermore, they possess extensive knowledge and skills in the dynamics of continuous systems, rheology and computer construction modelling.

The specialization of Civil Engineering carried out in English language provides graduates with extensive knowledge and competency in the area of the design and execution of multiple building structures such as: complex structures with reinforced concrete or metal constructions, housing buildings, municipal constructions, roads and highways, bridges and also objects of railway infrastructures. Furthermore, a graduate possesses extensive knowledge in the area of Hydraulic issues and also computer aided design. Each graduate can achieve more knowledge about the chosen constructions after choosing one of the wide range of blocks that are on offer.

1.7. Possibility of continuing studies:	***eligibility to apply for admission to a doctoral school, non-degree postgraduate programmes***

1.8. Indicate connection with University's mission and its development strategy:
The Civil Engineering Faculty on second level studies with specializations carried out during full-time studies: Building Structures; Building Technology; Hydroengineering Structrues; Underground and Urban Infrastructures; Roads and Airports; Railway Infrastructue, Bridges, Theory of Structures; Civil Engineering (conducted in English) which is run according to the mission and development strategy of the Civil Engineering Department of Wroclaw University of Technology. Studies on the Civil Engineering Faculty are closely related to scientific and research works carried out at the Civil Engineering Department by its departments.

2. Detailed description

2.1. The total number of learning outcomes in the program of study:	*directional*	*W (knowledge) =*	***15***
		U (skills) =	***17***
		K (competences) =	***7***
		W + U + K =	***39***

2.2. For the main field of study assigned to more than one discipline - the number of learning outcomes assigned to the discipline:	
D1 (major), (this number must be greater than half the total number of learning outcomes)	***39***
D2 -	
D3 -	
D4 -	

2.3. For the field of study assigned to more than one discipline - percentage share of the number of ECTS points for each discipline:		
D1	*% points ECTS:*	***100***
D2 -		
D3 -		
D4 -		

2.4a. For the general academic profile field of study – the number of ECTS points assigned to the classes related to the University's academic activity in the discipline or disciplines to which the faculty is assigned (must be greater than 50% of the total number of ECTS points from 2.1):	***82***
2.4b. For the practical profile field of study - the number of ECTS points assigned to the classes shaping practical skills (must be greater than 50% of the total number of ECTS points from 2.1):	-

2.5. Concise analysis of compliance of the assumed learning outcomes with the needs of the labor market
The education program aims to comprehensively prepare highly qualified engineering technical staff in the widely considered field of civil engineering. Graduates of the Civil Engineering Department with the general academic profile are prepared to work independently in the field of organization and implementation of construction processes, managing the maintenance and exploitation of building infrastructure and are also prepared to participate in building structure designing processes. Graduates possess the knowledge and skills necessary to organize and direct a team's work in all areas of civil engineering. Education profiles and diploma specializations prepare students to be able to undertake work in the most wanted market areas: cubature building, industrial structures and also management of building processes (Building Structures; Building Technology), water constructions, ground and underground structures (Hydroengineering; Underground and Urban Infrastructures) and also in the area of transport infrastructure structures (Roads and Airports, Railway Infrastructures, Bridges).
Universal basic knowledge enables graduates to flexibly adapt to the changing needs of the labour market. The specialization of Theory of Structrues prepares graduates for research and science work, and the specialization Civil Engineering (conducted in English) gives graduates the opportunity to establish cooperation with international construction companies. The basis of all specializations is knowledge and skills which enable graduates to obtain appropriate professional qualifications.

2.6. The total number of ECTS points that a student must obtain in classes requiring direct participation of academic teachers or other persons conducting classes and students (enter the sum of ECTS points for courses / groups of courses marked with the BK1 code)	***48.2***
2.7. Total number of ECTS points which student has to obtain from basic sciences classes	
Number of ECTS points for obligatory subjects:	***3***
Number of ECTS points for optional subjects:	***0***
Total number of ECTS points:	***3***
2.8. Total number of ECTS points, which student has to obtain from practical classes, including project and laboratory classes (enter total number of ECTS points for courses/group of courses denoted with code P)	
Number of ECTS points for obligatory subjects:	***42.4***
Number of ECTS points for optional subjects:	***8.5***
Total number of ECTS points:	***50.9***
2.9. Minimum number of ECTS points, which student has to obtain doing education blocks offered as part of university-wide classes or other main field of study (enter number of ECTS points for courses/groups of courses denoted with code O)	***6***
2.10. Total number of ECTS points, which student may obtain doing optional blocks (min. 30% of total number of ECTS points):	***69***

3. Description of the process leading to learning outcomes acquisition:

In the process of obtaining the required knowledge, skills and social competences acquired in the learning process, the following elements are taken into account:
- various subjects, including the assigned ECTS points for various didactic forms,
- subjects include specific thematic content, carried out in the form of didactic classes, in particular in the form of a lecture,
laboratory, exercises, seminar, internships specified in the study program; a course may include more than one form of classes; a subject or group of subjects may be a module for which the assumed learning outcomes have been assigned in the study program,
- learning outcomes in the field of knowledge, skills and social competences with adapting the direction of construction at WBLiW PWr (for the general academic profile) to the Characteristics of the Polish Qualifications Framework for Higher Education,
- study plan taking into account various specialties as well as compulsory and optional subjects, as well as subjects in the field of general education, basic, major and specialty sciences,
- various forms of verification and assessment of the student's achievement of the assumed learning outcomes (exams, credits).

The process leading to the achievement of learning outcomes includes:
- participation of students in organized classes, which according to the Study Regulations is obligatory. Classes may be held in the traditional, remote-synchronous or mixed form with the use of electronic tools for distance learning recommended by the University;
- the use by students of consultations with the Lecturers, which are carried out outside the time of classes in the traditional and remote form (not exceeding 50% of the time devoted to consultations). The length of consultation hours is determined in accordance with the applicable Internal Regulation. The list of consultation dates is posted on the faculty website;
- students' own work, which includes:
- studying the literature recommended by the Lecturers and the teaching materials provided,
- preparation of projects, reports and other forms of required studies,
- preparation for classes and for credits, tests and exams;

Course cards have been prepared for all subjects (courses) assigned to the study program. Each of them lists the learning outcomes specific to that subject (course). Students completing and completing the courses assigned to the study program at the same time confirm that they have obtained learning outcomes in the field of acquired knowledge, skills and social competences, assigned to a given subject (course). The student's implementation of all subjects (courses) assigned to the study program means the achievement of all learning outcomes specified in the study program.

Subject cards, the assigned learning outcomes and the methods of assessing their achievement used by the lecturers are controlled, assessed and verified by:
- Departmental Committee for Evaluation and Quality Assurance of Education,
- Departmental Program Committees,
- Vice-Dean for Didactics, conducting a survey of the Lecturers each semester in the field of the methods and tools used to verify students' achievement of learning outcomes.

4. List of education blocks

Definitions:

[1]BU – number of ECTS points assigned to hours of classes requiring direct contact of teachers with students
[2]Traditional – T, distance – Z
[3]Exam – E, crediting with grade – Z. For the group of courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – O
[5] Course / group of courses Concerning scientific activities– DN
[6]Practical course / group of courses – P. For the group of courses (GK) - in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education, PD – basic sciences, K – field-of-studies, S – specialization
CNPS – total student's work; ZZU – organized courses; 1 ECTS = 30 hrs NPS
Note: the effects with the U code are obtained only during practical classes.

Specialization: Civil Engineering

4.1. List of obligatory blocks
4.1.1. List of general education blocks
4.1.1.1. Block Humanistic and Managerial classes (min. 3 ECTS)

No.	Course / group of courses code	Name of course / group of courses (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course / group of courses	Way[3] of crediting	Course/group of courses				
			lec	cl	lab	pr	sem		ZZU	CNPS	total	DN[5] classes	BU[1] classes			university-wide[4]	Concerning scientific activities[5]	practical P[6]	kind[7]	type
1	**CEB008563**	Construction project management. Zarządzanie przedsięwzięciami budowlanymi	1					K2_W11, K2_W12, K2_W13, K2_W14, K2_W15, K2_U01, K2_U08, K2_U13, K2_U14, K2_K01, K2_K02, K2_K05	15	30	1	0	0.6	T, Z	Z		0		KO	Ob.
				1					15	60	2	0	0.6	T, Z	Z		0	1.5	KO	Ob.
		Total	1	1	0	0	0		30	90	3	0	1.2				0	1.5		

4.1.1.2. Block Foreign languages
4.1.1.3. Block Sport classes
4.1.1.4. Block Information technology

In total for obligatory general education blocks:

Total number of hours					Total number of hours ZZU	Total number of hours CNPS	Total number of ECTS points	Total number of ECTS points DN[5]	number of ECTS points BU[1]	number of ECTS points P
lec	cl	lab	pr	sem						
1	1	0	0	0	30	90	3	0	1.2	1.5

4.1.2. List of basic science blocks
4.1.2.1. Block Mathematics (min. 2 ECTS)

No.	Course / group of courses code	Name of course / group of courses (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course / group of courses	Way[3] of crediting	Course/group of courses				
			lec	cl	lab	pr	sem		ZZU	CNPS	total	DN[5] classes	BU[1] classes			university-wide[4]	Concerning scientific activities[5]	practical P[6]	kind[7]	type
1	**CEB008061**	Selected topics in mathematics. Matematyka - wybrane zagadnienia	1					K2_W01, K2_U08, K2_K01, K2_K02, K2_K03, K2_K06	15	30	1	1	0.6	T, Z	E		1		PD	Ob.
				1					15	30	1	1	0.6	T, Z	Z		1	0.6	PD	Ob.
		Total	1	1	0	0	0		30	60	2	2	1.2				2	0.6		

4.1.2.2. Block Physics (min. 1 ECTS)

No.	Course / group of courses code	Name of course / group of courses (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course / group of courses	Way[3] of crediting	Course/group of courses				
			lec	cl	lab	pr	sem		ZZU	CNPS	total	DN[5] classes	BU[1] classes			university-wide[4]	Concerning scientific activities[5]	practical P[6]	kind[7]	type
1	**FZP007163**	Physics of modern materials. Fizyka nowoczesnych materiałów	1					K2_W01, K2_W02, K2_W04, K2_U03, K2_U08, K2_K01, K2_K02, K2_K06	15	30	1	1	0.5	T, Z	Z	O			PD	Ob.
		Total	1	0	0	0	0		15	30	1	1	0.5					0.0		

4.1.2.3. Block Chemistry

In total for obligatory basic science blocks:

Total number of hours					Total number of hours ZZU	Total number of hours CNPS	Total number of ECTS points	Total number of ECTS points DN[5]	number of ECTS points BU[1]	number of ECTS points P
lec	cl	lab	pr	sem						
2	1	0	0	0	45	90	3	3	1.7	0.6

4.1.3. List of main-field-of-study blocks

No.	Course / group of courses code	Name of course / group of courses (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course / group of courses	Way[3] of crediting	Course/group of courses				
			lec	cl	lab	pr	sem		ZZU	CNPS	total	DN[5] classes	BU[1] classes			university-wide[4]	Concerning scientific activities[5]	practical P[6]	kind[7]	type
1	**CEB007361**	Selected topics in geo-engineering - foundation. Fundamentowanie - wybrane zagadnienia	1					K2_W01, K2_W06, K2_W08, K2_U04, K2_U05, K2_U09, K2_U10, K2_U16, K2_U17, K2_K03, K2_K06	15	30	1	1	0.5	T, Z	Z		1		K	Ob.
						2			30	30	1	1	1.1	T, Z	Z		1	1.3	K	Ob.
2	**CEB008361**	Theory of elasticity and plasticity. Teoria sprężystości i plastyczności	2					K2_W01, K2_W02, K2_W04, K2_U02, K2_U04, K2_U08, K2_K01	30	30	1	1	1.1	T, Z	Z		1		K	Ob.
				1					15	30	1	1	0.6	T, Z	Z		1	0.4	K	Ob.
3	**CEB008461**	Selected topics in structural mechanics. Statyka budowli - wybrane zagadnienia	2					K2_W03, K2_W04, K2_W05, K2_U06, K2_U07, K2_U09, K2_K01, K2_K03	30	60	2	2	1.2	T, Z	E		2		K	Ob.
				1					15	30	1	1	0.6	T, Z	Z		1	0.7	K	Ob.
					1				15	30	1	1	0.6	T, Z	Z		1	0.7	K	Ob.
4	**CEB007962**	Dynamics. Dynamika budowli	1					K2_W01, K2_W03, K2_W04, K2_W05, K2_U03, K2_U05, K2_U06, K2_U07, K2_U09, K2_U16, K2_K01, K2_K02	15	60	2	2	0.7	T, Z	E		2		K	Ob.
					1				15	30	1	1	0.6	T, Z	Z		1	1.0	K	Ob.
5	**CEB005362**	Computational mechanics. Metody komputerowe	1					K2_W01, K2_W02, K2_W03, K2_W04, K2_W05, K2_W09, K2_U02, K2_U06, K2_U08, K2_U09, K2_U16, K2_K01, K2_K04	15	60	2	2	0.5	T, Z	Z		2		K	Ob.
					2				30	60	2	2	1.1	T, Z	Z		2	2.0	K	Ob.
		Total	7	2	4	2	0		225	450	15	15	8.6				15	6.1		

In total for main-field-of-study blocks:

Total number of hours					Total number of hours ZZU	Total number of hours CNPS	Total number of ECTS points	Total number of ECTS points DN[5]	number of ECTS points BU[1]
lec	cl	lab	pr	sem					
7	2	4	2	0	225	450	15	15	8.6

number of ECTS points P
6.1

4.1.4. List of specialization blocks

No.	Course / group of courses code	Name of course / group of courses (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course / group of courses	Way[3] of crediting	Course/group of courses				
			lec	cl	lab	pr	sem		ZZU	CNPS	total	DN[5] classes	BU[1] classes			university-wide[4]	Concerning scientific activities[5]	practical P[6]	kind[7]	type
1	**CEB007561**	Concrete structures - objects. Konstrukcje betonowe - obiekty	2					K2_W04, K2_W06, K2_W07, K2_W08, K2_U09, K2_U11, K2_U12, K2_K01, K2_K02, K2_K03	30	60	2	2	1.1	T, Z	E		2		S	Ob.
						2			30	60	2	2	1.1	T, Z	Z		2	2.0	S	Ob.
2	**CEB007661**	Metal structures - objects. Konstrukcje metalowe - obiekty	2					K2_W01, K2_W02, K2_W04, K2_W05, K2_W06, K2_W07, K2_W09, K2_U01, K2_U02, K2_U04, K2_U05, K2_U06, K2_U07, K2_U08, K2_U09, K2_U11, K2_U12, K2_K01, K2_K02, K_K03	30	60	2	2	1.1	T, Z	E		2		S	Ob.
						2			30	60	2	2	1.1	T, Z	Z		2	2.0	S	Ob.
3	**CEB007761**	Advanced computer aided engineering. Zaawansowane komputerowe wspomaganie projektowania			2			K2_W03, K2_W04, K2_W05, K2_W06, K2_W07, K2_W09, K2_U04, K2_U05, K2_U06, K2_U07, K2_U08, K2_U09, K2_U11, K2_U12, K2_K01, K2_K02, K2_K03	30	60	2	2	1.2	T, Z	Z		2	2.0	S	Ob.

4	**CEB007861**	Hydraulics in civil engineering. Hydraulika w budownictwie	1					K2_W01, K2_W02, K2_W06, K2_W14, K2_U01, K2_U02, K2_U03, K2_U06, K2_U17, K2_U19, K2_U20, K2_K01, K2_K02, K2_K03	15	30	1	1	0.6	T, Z	Z		1		S	Ob.
						1			15	30	1	1	0.6	T, Z	Z		1	1.0	S	Ob.
5	**CEB007961**	BIM in Civil Engineering. BIM w inżynierii lądowej			4			K2_W03, K2_W06, K2_W14, K2_W15, K2_W06, K2_W03, K2_W06, K2_W10, K2_U04, K2_U01, K2_U12, K2_U17, K2_U04, K2_U01, K2_K03, K2_K04	60	120	4	4	3.3	T, Z	E		4	4	S	Ob.
6	**CEB008662**	Construction techniques and processes. Technologia robót budowlanych	1					K2_W10, K2_W11, K2_W13, K2_W14, K2_U01, K2_U13, K2_U14, K2_U16, K2_K01, K2_K02, K2_K04	15	30	1	1	0.7	T, Z	E		1		S	Ob.
						2			30	60	2	2	1.1	T, Z	Z		2	2.0	S	Ob.
7	**CEB004462**	Apartment building. Budownictwo mieszkaniowe	2					K2_W04, K2_W06, K2_W07, K2_W14, K2_U02, K2_U04, K2_U05, K2_U06, K2_U11, K2_K01, K2_K03, K2_K05, K2_K06	30	60	2	2	1.1	T, Z	Z		2		S	Ob.
						1			15	30	1	1	0.6	T, Z	Z		1	1.0	S	Ob.
8	**CEB003962**	Underground structures - urban infrastructure. Budownictwo podziemne - infrastruktura miejska	2					K2_W05, K2_W06, K2_W11, K2_W13, K2_U04, K2_U05, K2_U06, K2_U07, K2_U09, K2_U12, K2_K01, K2_K03	30	60	2	2	1.2	T, Z	E		2		S	Ob.
						2			30	60	2	2	1.2	T, Z	Z		2	2.0	S	Ob.
9	**CEB004062**	Railways. Koleje	2					K2_W06, K2_W07, K2_U04, K2_U05, K2_U12, K2_K01, K2_K03, K2_K06	30	30	1	1	1.1	T, Z	Z		1		S	Ob.
						2			30	60	2	2	1.1	T, Z	Z		2	1.7	S	Ob.

10	**CEB004162**	Roads, streets and airports. Drogi, ulice i lotniska	2					K2_W01, K2_W06, K2_W09, K2_U01, K2_U08, K2_U12, K2_U16, K2_K01, K2_K02, K2_K03	30	60	2	2	1.3	T, Z	Z		2		S	Ob.
						2			30	60	2	2	1.3	T, Z	Z		2	2.0	S	Ob.
11	**CEB008062**	Bridges. Mosty	2					K2_W03, K2_W04, K2_W05, K2_W06, K2_W07, K2_W10, K2_U02, K2_U04, K2_U05, K2_U07, K2_U08, K2_U11, K2_U12, K2_K01, K2_K02, K2_K03	30	60	2	2	1.3	T, Z	E		2		S	Ob.
						2			30	60	2	2	1.3	T, Z	Z		2	2.0	S	Ob.
12	**CEB009863**	Master thesis seminar. Seminarium dyplomowe					2	K2_W15, K2_U01, K2_U02, K2_U15, K2_U16, K2_U17, K2_K01, K2_K02, K2_K03, K2_K06	30	90	3	3	1.3	T, Z	Z		3	2.7	S	Ob.
13	**CEB099963**	Master thesis (MSc). Praca dyplomowa magisterska						K2_W02-K2_W05, K2_W07, K2_W09, K2_U01, K2_U06-K2_U09, K2_U15, K2_U16, K2_U17, K2_K01, K2_K02, K2_K04		540	18	18	7	T, Z	Z		18	18.0	S	Ob.
		Total	16	0	6	16	2		600	1740	58	58	31.7				58	42.4		

4.2. List of elective blocks

4.2.1. List of general education blocks

4.2.1.1. Block Humanistic and managerial classes (min. 2 ECTS)

No.	Course / group of courses code	Name of course / group of courses (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course / group of courses	Way[3] of crediting	Course/group of courses				
			lec	cl	lab	pr	sem		ZZU	CNPS	total	DN[5] classes	BU[1] classes			university-wide[4]	Concerning scientific activities[5]	practical P[6]	kind[7]	type
1		**List from optional block A**					1		15	60	2	0	0.6	T, Z	Z	O	0	1.5	KO	W
	FLH020361	Ethics in engineering. Etyka inżynierska						K2_W13, K2_W14, K2_W15, K2_U01, K2_K01, K2_K02, K2_K04, K2_K06												
	FLH020461	Ethics in business. Etyka w biznesie																		
		Total	0	0	0	0	1		15	60	2	0	0.6				0	1.5		

4.2.1.2. Block Foreign languages (min. 3 ECTS)

No.	Kod kursu / grupy kursów	Nazwa kursu / grupy kursów (grupę kursów oznaczyć symbolem GK)	Tygodniowa liczba godzin					Symbol kierunkowego 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	total	DN[5] classes	BU[1] classes			ogólno-uczelniany[4]	zw. z dział. Nauk[5]	o char. praktycz. P[6]	rodzaj[7]	typ
1		**List from optional block B**		1					15	30	1	0	0.5	T, Z	Z	O	0	1.0	KO	W
	JZL100709BK	Foreign language I Język obcy I						K2_U01, K2_U02, K2_K01, K2_K06												
2		**List from optional block C**		3					45	60	2	0	1.5	T, Z	Z	O	0	2.0	KO	W
	JZL100710BK	Foreign language II Język obcy II						K2_U01, K2_U02, K2_K01, K2_K06												
		Total	0	4	0	0	0		60	90	3	0	2.0				0	3.0		

4.2.1.3. Block *Sport classes* (min. ##### ECTS)

4.2.1.4. Block Information technology (min. ECTS)

In total for optional general education blocks:

Total number of hours					Total number of hours ZZU	Total number of hours CNPS	Total number of ECTS points	Total number of ECTS points DN[5]	number of ECTS points BU[1]
lec	cl	lab	pr	sem					
0	4	0	0	1	75	150	5	0	2.6

number of ECTS points P
4.5

In total for general education blocks:

Total number of hours					Total number of hours ZZU	Total number of hours CNPS	Total number of ECTS points	Total number of ECTS points DN[5]	number of ECTS points BU[1]
lec	cl	lab	pr	sem					
1	5	0	0	1	105	240	8	0	3.8

number of ECTS points P
6.0

4.2.2. List of basic science blocks
4.2.2.1. Block Mathematics (min. ECTS)
4.2.2.2. Block Physics (min. ECTS)
4.2.2.3. Block Chemistry (min. ECTS)

In total for optional basic science blocks:

Total number of hours					Total number of hours ZZU	Total number of hours CNPS	Total number of ECTS points	Total number of ECTS points DN[5]	number of ECTS points BU[1]
lec	cl	lab	pr	sem					
0	0	0	0	0	0	0	0	0	0.0

number of ECTS points P
0.0

In total for basic science blocks:

Total number of hours					Total number of hours ZZU	Total number of hours CNPS	Total number of ECTS points	Total number of ECTS points DN[5]	number of ECTS points BU[1]
lec	cl	lab	pr	sem					
2	1	0	0	0	45	90	3	3	1.7

number of ECTS points P
0.6

4.2.3. List of main-field-of-study blocks
4.2.3.1. Optional main-field-of-study blocks

No.	Course / group of courses code	Name of course / group of courses (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course / group of courses	Way[3] of crediting	Course/group of courses				
			lec	cl	lab	pr	sem		ZZU	CNPS	total	DN[5] classes	BU[1] classes			university-wide[4]	Concerning scientific activities[5]	practical P[6]	kind[7]	type
		Total	0	0	0	0	0		0	0	0	0	0.0					0.0		

In total for main-field-of-study blocks:

Total number of hours					Total number of hours ZZU	Total number of hours CNPS	Total number of ECTS points	Total number of ECTS points DN[5]	number of ECTS points BU[1]
lec	cl	lab	pr	sem					
0	0	0	0	0	0	0	0	0	0.0

number of ECTS points P
0.0

4.2.4. List of specializationo blocks

Specialization: Civil Engineering

No.	Course / group of courses code	Name of course / group of courses (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course / group of courses	Way[3] of crediting	Course/group of courses				
			lec	cl	lab	pr	sem		ZZU	CNPS	total	DN[5] classes	BU[1] classes			university-wide[4]	Concerning scientific activities[5]	practical P[6]	kind[7]	type
1		**List from optional block 1**	1						15	30	1	1	0.6	T, Z	Z		1		S	W
					1				15	60	2	2	0.6	T, Z	Z		2	2.0	S	W
	CEB006063	Artificial intelligence in civil engineering. Sztuczna inteligencja w budownictwie						K2_W11, K2_W12, K2_U16, K2_U17, K2_K01, K2_K03												
	CEB006163	Modern testing methods for non-destructive inspection of building structures. Nowoczesne metody badań nieniszczących konstrukcji budowlanych						K2_W06, K2_W10, K2_U04, K2_U15, K2_U16, K2_U17, K2_K01, K2_K03, K2_K05, K2_K06												
	CEB007063	Advanced building physics. Zaawansowana fizyka budowli						K2_W06, K2_W13, K2_U01, K2_U04, K2_U08, K2_K01, K2_K02, K2_K03												
	CEB006363	Hydrology for building engineers. Hydrologia dla inżynierów budowlanych						K2_W01, K2_W02, K2_W03, K2_W09, K2_CEB_W22, K2_U07, K2_U08, K2_CEB_U23, K2_K01, K2_K02, K2_K03, K2_K04, K2_K05, K2_K06												
	CEB006863	Effective properties of composites - introduction to micro-mechanics. Właściwości efektywne kompozytów - wprowadzenie do mikromodelowania						K2_W02, K2_W05, K2_U16, K2_K01, K2_K03												

2		**List from optional block 2**	1						15	30	1	1	0.6	T, Z	Z		1		S	W
						1			15	60	2	2	0.6	T, Z	Z		2	2.0	S	W
	CEB006563	Pre-stressed concrete structures. Betonowe konstrukcje sprężone						K2_W06, K2_W07, K2_W09, K2_W10, K2_U01, K2_U04, K2_U05, K2_U11, K2_U12, K2_U17, K2_K01, K2_K03												
	CEB006663	Timber structures. Konstrukcje drewniane						K2_W05, K2_W06, K2_W10, K2_U04, K2_U05, K2_U07, K2_U12, K2_K01, K2_K02												
	CEB006763	Conservation and strengthening of monumental heritage structures. Konserwacja i wzmacnianie konstrukcji zabytkowych						K2_W02, K2_W06, K2_W09, K2_W10, K2_U04, K2_U05, K2_U12, K2_K01, K2_K02, K2_K06												
	CEB006963	Methods of applied statistics (geo-statistics). Metody statystyki stosowanej (geostatystyka)						K2_W01, K2_W09, K2_U01, K2_U03, K2_U08, K2_U16, K2_U17, K2_K01, K2_K02, K2_K03, K2_K06												
	CEB008263	Sustainable housing. Budownictwo zrównoważone						K2_W06, K2_W13, K2_U01, K2_U04, K2_U08, K2_K01, K2_K02, K2_K03												
		Total	2	0	1	1	0		60	180	6	6	2.4				6	4.0		

4.3. Training block - concerning principles of training crediting

Name of training	Industrial internship		
Number of ECTS points	Number of ECTS points for BU[1] classes	Training crediting mode	Code
		There is no obligatory training in the programme for the 2nd level studies.	
Training duration	Training objective		
-	-		

4.4. Diploma dissertation block

BOOK OF PROCEDURES of the Faculty of Civil Engineering of the Wrocław University of Science and Technology. Diploma procedure Pr 8/4. Approved by the Dean of the Faculty of CE of WUST on September 22, 2020

Type of diploma dissertation	Master	
Number of diploma dissertation semesters	Number of ECTS points	Code
1	18	CEB099963
Character of diploma dissertation		
Master Thesis carried out at the second level studies can be a study, study and design or experimental and design one. It should demonstrate a graduate skills acquired during the studies, its scope should not go beyond the issues included in the programme of courses, both of the main field and specialization ones, with regard to the matters contained in the learning outcomes for the 1st level studies.		
Number of BU[1] ECTS points	0.3	
Number of ECTS DN[5] points	18	

5. Ways of verifying assumed educational effects

Type of classes	Ways of verifying assumed educational effects
lecture	e.g. examination, progress/final test
class	e.g. progress, final test, presentation
laboratory	e.g. pretest, report from laboratory, presentation
project	e.g. report, project defence
seminar	e.g. participation in discussion, topic presentation, essay
training	e.g. report from training
diploma dissertation	prepared diploma dissertation, defence, examination

6. Range of diploma dissertation

The general rules for the organization and conduct of the diploma examination are set out in §25 of the Regulations of Higher Education at Wrocław University of Technology. Detailed rules concerning the organization, course and scope of the diploma examination in the field of construction are specified in the faculty diploma procedure posted on the faculty website.

The exam consists of two parts:
a) presentation of the subject of the diploma thesis, the methods of its implementation and the results obtained, and the defense of the diploma thesis by the student answering (orally or drawing) oral questions from members of the Diploma Examination Board asked during or immediately after the presentation of the thesis, and concerning only the content of the thesis and the methodology;
b) an oral exam in the field of major and specialization subjects, concerning the verification of the student's knowledge in the scope specified in the curriculum of a given specialization of second-cycle studies. During the exam, the student is asked at least three questions, two of which relate to major subjects, and at least one to specialized subjects.

The scope of examination questions concerns the student's knowledge and skills in all subjects included in the curriculum of a given specialization. In particular, examination questions may refer to specific points of the curriculum content on the subject cards of a given curriculum. The curriculum and the set of subject cards are available on the Faculty's website. The examination questions are formulated by the members of the commission appointed by the chairman of the Diploma Examination Board. The examination cannot include questions on issues that were not included in the curriculum of the studies completed by the examined student.

7. Requirements concerning deadlines for crediting courses/groups of courses for all courses in particular blocks

According to the Regulations of higher education at the WUST.

8. Study plan (attachment no. 3)

Approved by the relevant legislative body of the Student Government:

....

Data | Name, surname and signature of the student representative

....

Data Signature of the Dean of the Faculty / Director of the Branch

Zał. nr 4 do ZW 16/2020
Attachment no. 3 to Program of Studies

PLAN OF STUDIES

FACULTY: Civil Engineering

MAIN FIELD OF STUDY: Civil Engineering

EDUCATION LEVEL: ~~first-level (licencjat/inżynier) studies /~~ second-level studies ~~/ magister uniform studies*~~

FORM OF STUDIES: full-time studies ~~/ part-time studies *~~

PROFILE: general academic ~~/ practical *~~

SPECIALIZATION: Civil Engineering

LANGUAGE OF STUDY: English

In effect since 1.10.2022

1. **Set of obligatory and optional courses and groups of courses in semesteral arrangement**

Definitions:

[1]BU – number of ECTS points assigned to hours of classes requiring direct contact of teachers with students
[2]Traditional – T, distance – Z
[3]Exam – E, crediting with grade – Z. For the group of courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – O
[5] Course / group of courses Concerning scientific activities– DN
[6]Practical course / group of courses – P. For the group of courses (GK) - in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education, PD – basic sciences, K – field-of-studies, S – specialization
CNPS – total student's work; ZZU – organized courses; 1 ECTS = 30 hrs NPS
Note: the effects with the U code are obtained only during practical classes.

Blocks for optional specialization: Civil Engineering CEB [9]
Specialization: Civil Engineering (language of studies: English)

Semester 1
Obligatory courses **number of ECTS points 28**

No.	Course / group of courses code	Name of course / group of courses (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course / group of courses	Way[3] of crediting	Course/group of courses				
			lec	cl	lab	pr	sem		ZZU	CNPS	total	DN[5] classes	BU[1] classes			university-wide[4]	Concerning scientific	practical P[6]	kind[7]	type
1	**FZP007163**	Physics of modern materiale. Fizyka nowoczesnych materiałów	1					K2_W01, K2_W02, K2_W04, K2_U03, K2_U08, K2_K01, K2_K02, K2_K06	15	30	1	1	0.5	T, Z	Z	O	1		PD	Ob.
2	**CEB008061**	Selected topics in mathematics. Matematyka - wybrane zagadnienia	1					K2_W01, K2_U08, K2_K01, K2_K02, K2_K03, K2_K06	15	30	1	1	0.6	T, Z	E		1		PD	Ob.
				1					15	30	1	1	0.6	T, Z	Z		1	0.6	PD	Ob.

3	**CEB007361**	Selected topics in geo-engineering - foundation. Fundamentowanie - wybrane zagadnienia	1					K2_W01, K2_W06, K2_W08, K2_U04, K2_U05, K2_U09, K2_U10, K2_U16, K2_U17, K2_K03, K2_K06	15	30	1	1	0.5	T, Z	Z		1		K	Ob.
						2			30	30	1	1	1.1	T, Z	Z		1	1.3	K	Ob.
4	**CEB008361**	Theory of elasticity and plasticity. Teoria sprężystości i plastyczności	2					K2_W01, K2_W02, K2_W04, K2_U02, K2_U04, K2_U08, K2_K01	30	30	1	1	1.1	T, Z	Z		1		K	Ob.
				1					15	30	1	1	0.6	T, Z	Z		1	0.4	K	Ob.
5	**CEB008461**	Selected topics in structural mechanics. Statyka budowli - wybrane zagadnienia	2					K2_W03, K2_W04, K2_W05, K2_U06, K2_U07, K2_U09, K2_K01, K2_K03	30	60	2	2	1.2	T, Z	E		2		K	Ob.
				1					15	30	1	1	0.6	T, Z	Z		1	0.7	K	Ob.
					1				15	30	1	1	0.6	T, Z	Z		1	0.7	K	Ob.
6	**CEB007561**	Concrete structures - objects. Konstrukcje betonowe - obiekty	2					K2_W04, K2_W06, K2_W07, K2_W08, K2_U09, K2_U11, K2_U12, K2_K01, K2_K02, K2_K03	30	60	2	2	1.1	T, Z	E		2		S	Ob.
						2			30	60	2	2	1.1	T, Z	Z		2	2.0	S	Ob.
7	**CEB007661**	Metal structures - objects. Konstrukcje metalowe - obiekty	2					K2_W01, K2_W02, K2_W04, K2_W05, K2_W06, K2_W07, K2_W09, K2_U01, K2_U02, K2_U04, K2_U05, K2_U06, K2_U07, K2_U08, K2_U09, K2_U11, K2_U12, K2_K01, K2_K02, K_K03	30	60	2	2	1.1	T, Z	E		2		S	Ob.
						2			30	60	2	2	1.1	T, Z	Z		2	2.0	S	Ob.

No.	Course / group of courses code	Name of course / group of courses (denote group of courses with symbol GK)	lec	cl	lab	pr	sem	Learning effect symbol	ZZU	CNPS	total	DN[5] classes	BU[1] classes	Form[2] of course / group of courses	Way[3] of crediting	university-wide[4]	Concerning scientific	practical P[6]	kind[7]	type
8	**CEB007761**	Advanced computer aided engineering. Zaawansowane komputerowe spomaganie projektowania			2			K2_W03, K2_W04, K2_W05, K2_W06, K2_W07, K2_W09, K2_U04, K2_U05, K2_U06, K2_U07, K2_U08, K2_U09, K2_U11, K2_U12, K2_K01, K2_K02, K2_K03	30	60	2	2	1.2	T, Z	Z		2	2.0	S	Ob.
9	**CEB007861**	Hydraulics in civil engineering. Hydraulika w budownictwie	1					K2_W01, K2_W02, K2_W06, K2_W14, K2_U01, K2_U02, K2_U03, K2_U06, K2_U17, K2_U19, K2_U20, K2_K01, K2_K02, K2_K03	15	30	1	1	0.6	T, Z	Z		1		S	Ob.
						1			15	30	1	1	0.6	T, Z	Z		1	1.0	S	Ob.
10	**CEB007961**	BIM in Civil Engineering. BIM w inżynierii lądowej			4			K2_W03, K2_W06, K2_W14, K2_W15, K2_W06, K2_W03, K2_W06, K2_W10, K2_U04, K2_U01, K2_U12, K2_U17,	60	120	4	4	3.3	T, Z	Z		4	4	S	Ob.
		List from optional block A																		
1	**JZL100709BK**	Foreign language I Język obcy I		1				K2_U01, K2_U02, K2_K01, K2_K06	15	30	1	0	0.5	T, Z	Z	O	0	1.0	KO	W
		Total	12	4	7	7	0		450	840	28	27	18				27	15.7		

Kursy wybieralne **number of ECTS points 2**

No.	Course / group of courses code	Name of course / group of courses (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course / group of courses	Way[3] of crediting	Course/group of courses				
			lec	cl	lab	pr	sem		ZZU	CNPS	total	DN[5] classes	BU[1] classes			university-wide[4]	Concerning scientific	practical P[6]	kind[7]	type
1		**List from optional block B**					1		15	60	2	0	0.6	T, Z	Z	O	0	1.5	KO	W
	FLH020361	Ethics in engineering. Etyka inżynierska						K2_W13, K2_W14, K2_W15, K2_U01, K2_K01, K2_K02, K2_K04, K2_K06												
	FLH020461	Ethics in business. Etyka w biznesie																		
		Total	0	0	0	0	1		15	60	2	0	0.6				0	1.5		

Total in semester:

Total number of hours					Total number of hours ZZU	Total number of hours CNPS	Total number of ECTS points	Total number of ECTS points DN[5]	number of ECTS points BU[1]	number of ECTS points P
lec	cl	lab	pr	sem						
12	4	7	7	1	465	900	30	27	18.6	17.2

Semester 2
Obligatory courses **number of ECTS points 30**

No.	Course / group of courses code	Name of course / group of courses (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form² of course / group of courses	Way³ of crediting	Course/group of courses				
			lec	cl	lab	pr	sem		ZZU	CNPS	total	DN⁵ classes	BU¹ classes			university-wide⁴	Concerning scientific	practical P⁶	kind⁷	type
1	**CEB007962**	Dynamics. Dynamika budowli	1					K2_W01, K2_W03, K2_W04, K2_W05, K2_U03, K2_U05, K2_U06, K2_U07, K2_U09, K2_U16, K2_K01, K2_K02	15	60	2	2	0.7	T, Z	E		2		K	Ob.
					1				15	30	1	1	0.6	T, Z	Z		1	1.0	K	Ob.
2	**CEB005362**	Computational mechanics. Metody komputerowe	1					K2_W01, K2_W02, K2_W03, K2_W04, K2_W05, K2_W09, K2_U02, K2_U06, K2_U08, K2_U09, K2_U16, K2_K01, K2_K04	15	60	2	2	0.5	T, Z	Z		2		K	Ob.
					2				30	60	2	2	1.1	T, Z	Z		2	2.0	K	Ob.
3	**CEB008662**	Construction techniques and processes. Technologia robót budowlanych	1					K2_W10, K2_W11, K2_W13, K2_W14, K2_U01, K2_U13, K2_U14, K2_U16, K2_K01, K2_K02, K2_K04	15	30	1	1	0.7	T, Z	E		1		S	Ob.
						2			30	60	2	2	1.1	T, Z	Z		2	2.0	S	Ob.
4	**CEB004462**	Apartment building. Budownictwo mieszkaniowe	2					K2_W04, K2_W06, K2_W07, K2_W14, K2_U02, K2_U04, K2_U05, K2_U06, K2_U11, K2_K01, K2_K03, K2_K05, K2_K06	30	60	2	2	1.1	T, Z	Z		2		S	Ob.
						1			15	30	1	1	0.6	T, Z	Z		1	1.0	S	Ob.
5	**CEB003962**	Underground structures - urban infrastructure. Budownictwo podziemne - infrastruktura miejska	2					K2_W05, K2_W06, K2_W11, K2_W13, K2_U04, K2_U05, K2_U06, K2_U07, K2_U09, K2_U12, K2_K01, K2_K03	30	60	2	2	1.2	T, Z	E		2		S	Ob.
						2			30	60	2	2	1.2	T, Z	Z		2	2.0	S	Ob.
6	**CEB004062**	Railways. Koleje	2					K2_W06, K2_W07, K2_U04, K2_U05, K2_U12, K2_K01, K2_K03, K2_K06	30	30	1	1	1.1	T, Z	Z		1		S	Ob.
						2			30	60	2	2	1.1	T, Z	Z		2	1.7	S	Ob.

7	**CEB004162**	Roads, streets and airports. Drogi, ulice i lotniska	2					K2_W01, K2_W06, K2_W09, K2_U01, K2_U08, K2_U12, K2_U16, K2_K01, K2_K02, K2_K03	30	60	2	2	1.3	T, Z	Z		2		S	Ob.
						2			30	60	2	2	1.3	T, Z	Z		2	2.0	S	Ob.
8	**CEB008062**	Bridges. Mosty	2					K2_W03, K2_W04, K2_W05, K2_W06, K2_W07, K2_W10, K2_U02, K2_U04, K2_U05, K2_U07, K2_U08, K2_U11, K2_U12, K2_K01, K2_K02, K2_K03	30	60	2	2	1.3	T, Z	E		2		S	Ob.
						2			30	60	2	2	1.3	T, Z	Z		2	2.0	S	Ob.
		List from optional block C																		
9	**JZL100710BK**	Foreign language II Język obcy II		3				K2_U01, K2_U02, K2_K01, K2_K06	45	60	2	0	1.5	T, Z	Z	O	0	2.0	KO	W
		Total	13	3	3	11	0		450	900	30	28	17.7				28	15.7		

Total in semester:

Total number of hours					Total number of hours ZZU	Total number of hours CNPS	Total number of ECTS points	Total number of ECTS points DN[5]	number of ECTS points BU[1]	number of ECTS points P
lec	cl	lab	pr	sem						
13	3	3	11	0	450	900	30	28	17.7	15.7

Total accumulated:

Total number of hours					Total number of hours ZZU	Total number of hours CNPS	Total number of ECTS points	Total number of ECTS points DN[5]	number of ECTS points BU[1]	number of ECTS points P
lec	cl	lab	pr	sem						
25	7	10	18	1	915	1800	60	55	36.3	32.9

Semester 3

Obligatory courses **number of ECTS points 24**

No.	Course / group of courses code	Name of course / group of courses (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course / group of courses	Way[3] of crediting	Course/group of courses				
			lec	cl	lab	pr	sem		ZZU	CNPS	total	DN[5] classes	BU[1] classes			university-wide[4]	Concerning scientific	practical P[6]	kind[7]	type
1	**CEB008563**	Construction project management. Zarządzanie przedsięwzięciami budowlanymi	1					K2_W11, K2_W12, K2_W13, K2_W14, K2_W15, K2_U01, K2_U08, K2_U13, K2_U14, K2_K01, K2_K02, K2_K05	15	30	1	0	0.6	T, Z	Z		0		KO	Ob.
				1					15	60	2	0	0.6	T, Z	Z		0	1.5	KO	Ob.
2	**CEB009863**	Master thesis seminar. Seminarium dyplomowe					2	K2_W15, K2_U01, K2_U02, K2_U15, K2_U16, K2_U17, K2_K01, K2_K02, K2_K03, K2_K06	30	90	3	3	1.3	T, Z	Z		3	2.7	S	Ob.
3	**CEB099963**	Master thesis (MSc). Praca dyplomowa magisterska						K2_W02-K2_W05, K2_W07, K2_W09, K2_U01, K2_U06-K2_U09, K2_U15, K2_U16, K2_U17, K2_K01, K2_K02, K2_K04		540	18	18	7	T, Z	Z		18	18.0	S	Ob.
		Total	1	1	0	0	2		60	720	24	21	9.5				21	22.2		

Optional courses **number of ECTS points 6**

No.	Course / group of courses code	Name of course / group of courses (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course / group of courses	Way[3] of crediting	Course/group of courses				
			lec	cl	lab	pr	sem		ZZU	CNPS	total	DN[5] classes	BU[1] classes			university-wide[4]	Concerning scientific	practical P[6]	kind[7]	type
1		**List from optional block 1**	1						15	30	1	1	0.6	T, Z	Z		1		S	W
					1				15	60	2	2	0.6	T, Z	Z		2	2.0	S	W
	CEB006063	Artificial intelligence in civil engineering. Sztuczna inteligencja w budownictwie						K2_W11, K2_W12, K2_U16, K2_U17, K2_K01, K2_K03												
	CEB006163	Modern testing methods for non- destructive inspection of building structures. Nowoczesne metody badań nieniszczących konstrukcji budowlanych						K2_W06, K2_W10, K2_U04, K2_U15, K2_U16, K2_U17, K2_K01, K2_K03, K2_K05, K2_K06												
	CEB007063	Adavnaced building physics. Zaawansowana fizyka budowli						K2_W06, K2_W13, K2_U01, K2_U04, K2_U08, K2_K01, K2_K02, K2_K03												
	CEB006363	Hydrology for building engineers. Hydrologia dla inżynierów budowlanych						K2_W01, K2_W02, K2_W03, K2_W09, K2_CEB_W22, K2_U07, K2_U08, K2_CEB_U23, K2_K01, K2_K02, K2_K03, K2_K04, K2_K05, K2_K06												
	CEB006863	Effective properties of composites - introduction to micro-mechanics. Właściwości efektywne kompozytów - wprowadzenie do mikromodelowania						K2_W02, K2_W05, K2_U16, K2_K01, K2_K03												

2		**List from optional block 2**	1						15	30	1	1	0.6	T, Z	Z		1		S	W
						1			15	60	2	2	0.6	T, Z	Z		2	2.0	S	W
	CEB006563	Pre-stressed concrete structures. Betonowe konstrukcje sprężone						K2_W06, K2_W07, K2_W09, K2_W10, K2_U01, K2_U04, K2_U05, K2_U11, K2_U12, K2_U17, K2_K01, K2_K03												
	CEB006663	Timber structures. Konstrukcje drewniane						K2_W05, K2_W06, K2_W10, K2_U04, K2_U05, K2_U07, K2_U12, K2_K01, K2_K02												
	CEB006763	Conservation and strengthening of monumental heritage structures. Konserwacja i wzmacnianie konstrukcji zabytkowych						K2_W02, K2_W06, K2_W09, K2_W10, K2_U04, K2_U05, K2_U12, K2_K01, K2_K02, K2_K06												
	CEB006963	Methods of applied statistics (geo-statistics). Metody statystyki stosowanej (geostatystyka)						K2_W01, K2_W09, K2_U01, K2_U03, K2_U08, K2_U16, K2_U17, K2_K01, K2_K02, K2_K03, K2_K06												
	CEB008263	Sustainable housing. Budownictwo zrównoważone						K2_W06, K2_W13, K2_U01, K2_U04, K2_U08, K2_K01, K2_K02, K2_K03												
		Total	2	0	1	1	0		60	180	6	6	2.4				6	4.0		

Total in semester:

Total number of hours					Total number of hours ZZU	Total number of hours CNPS	Total number of ECTS points	Total number of ECTS points DN[5]	number of ECTS points BU[1]	number of ECTS points P
lec	cl	lab	pr	sem						
3	1	1	1	2	120	900	30	27	11.9	26.2

Total accumulated:

Total number of hours					Total number of hours ZZU	Total number of hours CNPS	Total number of ECTS points	Total number of ECTS points DN[5]	number of ECTS points BU[1]	number of ECTS points P
lec	cl	lab	pr	sem						
28	8	11	19	3	1035	2700	90	82	48.2	59.1

Total number of ZZU hours: **1035**
Hours - lectures: **40.6%**
Hours - other courses: **59.4%**
ECTS - BU: **53.6%**
ECTS - P: **65.7%**

2. Set of examinations in semestral arrangement

No	Course code	Names of courses ending with examination	Semester
		Civil Engineering	
1	**CEB008061**	Selected topics in mathematics. Matematyka - wybrane zagadnienia	1
2	**CEB008461**	Selected topics in structural mechanics. Statyka budowli - wybrane zagadnienia	1
3	**CEB007561**	Concrete structures - objects. Konstrukcje betonowe - obiekty	1
4	**CEB007661**	Metal structures - objects. Konstrukcje metalowe - obiekty	1
5	**CEB007962**	Dynamics. Dynamika budowli	2
6	**CEB008662**	Construction techniques and processes. Technologia robót budowlanych	2
7	**CEB003962**	Underground structures - urban infrastructure. Budownictwo podziemne - infrastruktura miejska	2
8	**CEB008062**	Bridges. Mosty	2

3. Numbers of allowable deficit of ECTS points after particular semesters

Semester	Allowable deficit of ECTS points after semester	Total number of points required for registration for the next semester
1	15	15
2	13	47

Opinion of the faculty student government legislative body:

Date Name and surname, signature of the student representative

Date Signature of the Dean of the Faculty / Director of the Branch

COURSE CATALOGUE

SUBJECT FORMS

FACULTY: Civil Engineering

MAIN FIELD OF STUDY: *civil engineering*

in area of technical science

EDUCATION LEVEL: ~~1st /~~ 2nd * level, ~~licencjat / inżynier / magister~~

~~/~~ magister inżynier (MSc) studies*

FORM OF STUDIES: full-time ~~/ part-time~~*

PROFILE: general academic ~~/ practical~~ *

SPECIALIZATION*: Civil Engineering

LANGUAGE OF STUDY: English

Zał. nr 5 do ZW 16/2020

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in English:	**Advanced building physics**
Name of subject in Polish:	**Zaawansowana fizyka budowli**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level~~, uniform magister~~ studies*, full-time ~~/ part-time studies~~***
Kind of subject:	**~~obligatory~~ / optional / ~~university-wide~~***
Subject code:	**CEB007063**
Group of courses:	**~~YES~~ / 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	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**		**2**		
including number of ECTS points for practical (P) classes			**2,0**		
including number of ECTS points for direct teacher-student contact (BK) classes	**0,6**		**0,6**		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
1. Graduation of civil engineering, environmental engineering architecture or city planning studies.
2. Has knowledge of building construction, technical drawings and general building design.
3. Knows standards, guidelines and regulations about construction and their detail design.
4. Has theoretical basis of detached house design and construction detail solutions.

SUBJECT OBJECTIVES
C1. Gain knowledge about design rules of modern, low energy demand, ecological residential and commercial buildings and their details.
C2. Getting acquainted with renewable energy usage possibilities.
C3. Getting acquainted with regulations of rational energy preservation with taking thermal, visual and acoustic comfort of different rooms into consideration.
C4. Getting basis of design team cooperation to connect form and function with rational energy usage in buildings.

SUBJECT LEARNING OUTCOMES	
Relating to knowledge:	
PEU_W01	knows the standards, guidelines and regulations referring to the design of buildings and their components
PEU_W02	possesses knowledge about the influence of building investments on the environment
PEU_W03	has extensive knowledge in the area of selected elements, constructions and building structures
Relating to skills:	
PEU_U01	is able to use advanced specialized tools when searching Internet databases and other sources which can be used to find both general information and other information related to civil engineering; is able to use information technology to communicate and know how to obtain software which is used to aid the work of a designer and the person organizing and managing building processes
PEU_U02	is able to choose a tool (analytical or numerical) in order to solve engineering issues; is able to use selected software which aid modeling and design processes in construction
PEU_U03	has skills to solve tasks referring to selected theoretical issues and also design elements, constructions and building structures
Relating to social competences:	
PEU_K01	is aware of the need to constantly upgrade professional and personal competence in the form of formal or informal education and also improves and develops knowledge in the area of modern processes and technology, related to civil engineering
PEU_K02	is aware of the importance and also understands non-technical aspects and consequences of engineering activity, including influence on the environment and responsibility for implemented decisions
PEU_K03	is able to work independently and cooperate in a team on a specific task; is responsible for both the safety of his work and his subjected team's work

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Introduction, work safety regulations training. Course subjects and passing regulations talk through. Laboratory schedule talk through.	1
Lec2	Advanced problems of steady and transient heat flow through building partitions. Thermal dynamics of building partitions, thermal mass. Rules of proper building envelope design according to heat flow.	2
Lec3	Heat flow through windows and glazed facades. Types of glazing, calculation methods, technological possibilities, visual comfort of building users.	2
Lec4	New technologies in building thermal modernisation and in low energy buildings. Ecological aspect of energy saving in buildings.	2
Lec5	Low energy buildings: rating criteria, classification, design and realisation rules.	2
Lec6	The possibilities of renewable energy use in heat balance improvement of different types of buildings.	2
Lec7	Earth-sheltered buildings: classification, typical construction details, soil heat flow, heat transfer through ground walls and floors, energy conservation problems	2
Lec8	Final test	2
	Total hours	**15**

Form of classes - class		**Number of hours**
Cl1		
...		
	Total hours	

Form of classes - laboratory		Number of hours
Lab1	Laboratory scheme talk through. Excercises talk through. Familiarize with work safety regulations.	1
Lab2	Climate chambers research.	2
Lab3	Heat flow measurements through building walls	2
Lab4	Infrared thermal camera measurements	2
Lab5	Heat flux measurements (pyranometer, pyrgeometer, differential radiometer)	2
Lab6	Building Integrated Photovoltaics (BIPV)	2
Lab7	Thermal comfort	2
Lab8	Computational building physics	2
	Total hours	15

Form of classes - project		Number of hours
Proj1		
…		
	Total hours	

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED	
N1.	Lecture: multimedia presentation of lecture material and chosen building physics software, share of teaching materials through e-learning platforms, use of remote learning platforms (Zoom, MS Teams)
N2.	Laboratory: multimedia presentation, solution of problems with use of laboratory equipment and software, share of teaching materials through e-learning platforms, use of remote learning platforms (Zoom, MS Teams)

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation F – forming (during semester), P – concluding (at the end of semester)	Learning outcomes number	Way of evaluating learning outcomes achievement
P1 (laboratory)	PEU_U01 PEU_U02 PEU_U03 PEU_K01 PEU_K02 PEU_K03	Final report from carried out laboratory excercises
P2 (lecture)	PEU_W01 PEU_W02 PEU_W03	Colloquium – written test or on-line test

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: [1] Beggs C., Energy Management, Supply and Conservation. Elsevier, 2002. [2] Clark J., Energy Simulation in Building Design. Wiley Company, 2001. [3] Gratia E., DeHerde A.: Passive Solar Architecture. BRE, 2006. [4] Hens H., Buildings Physics – Heat, Air and Moisture. Ernst & Sohn, 2007. [5] Moss K., Heat and Mass Transfer in Buildings. Elsevier, 2007. [6] Twidell J., Weir T., Renewable Energy Resources. Taylor & Francis, 2006. **SECONDARY LITERATURE:**

SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)
prof. dr hab. inż. Henryk Nowak, Department of Building Engineering, henryk.nowak@pwr.edu.pl
MEMBERS OF TEH EDUCATIONAL TEAM (NAME AND SURNAME, E-MAIL ADDRESS)
dr inż. Tomasz Kania, tomasz.kania@pwr.edu.pl dr inż. Łukasz Nowak, lukasz.nowak@pwr.edu.pl mgr inż. Paweł Noszczyk, pawel.noszczyk@pwr.edu.pl Employees and PhD students from Department of Building Engineering (K07W02D06)

Zał. nr 5 do ZW 16/2020

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in English:	**Hydrology for building engineers**
Name of subject in Polish:	**Hydrologia dla inżynierów budownictwa**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level~~, uniform magister~~ studies*, full-time ~~/ part-time studies~~***
Kind of subject:	**~~obligatory~~ / optional / ~~university-wide~~***
Subject code:	**CEB006363**
Group of courses:	**~~YES~~ / 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	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	~~Examination /~~ crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**		**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)	**0,6**		**0,6**		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student possesses knowledge of the areas of mathematics, applied statistics, hydraulics and hydrology, geology and hydrology
2. Understands the processes of atmospheric precipitation and resulting outflows.
3. Understands the concept of natural and artificial basin and defining their characteristics.

SUBJECT OBJECTIVES

C1. Gaining a knowledge on the calculation of the water balance and determination of its constituents for river basins natural - watercourse and artificial catchment within the urban area.

C2. Acquiring knowledge and skills for calculating extreme flows - flood and drought for controlled and uncontrolled catchments..

C3. Acquisition of knowledge in the use of mathematical models of precipitation-outflow within natural and artificial catchments, including urbanized ones.

C4. Strengthening the ability to work in a project team and the awareness of the need to find new

solutions to theoretical and practical hydrologic calculations for sizing of hydraulic structures and drainage areas of urban areas and more.

SUBJECT LEARNING OUTCOMES	
Relating to knowledge:	
PEU_W01	The student knows and understands the rules for the calculation of water balance and its components for river basins.
PEU_W02	The student has in-depth expertise in the implementation and development of hydrometric measurements.
PEU_W03	The student knows the rules for calculating extreme flows in the catchment controlled and uncontrolled.
PEU_W04	The student has expertise in modeling the outflow of water from the catchment.
Relating to skills:	
PEU_U01	The student establishes correlations based on hydrometric measurements.
PEU_U02	The student prepares a detailed water balance for the catchment.
PEU_U03	The student can calculate statistical methods extreme water flows.
PEU_U04	The student determines water flow in the basin uncontrolled.
PEU_U05	The student creates a simple model for the catchment uncontrolled.
Relating to social competences:	
PEU_K01	The student can work independently on the performance of a task or project team during the hydrological calculations.
PEU_K02	The student is aware of the need to increase knowledge in the field of modern computational techniques in hydrology for design of hydraulic structures and communication

PROGRAMME CONTENT		
	Form of classes - lecture	**Number of hours**
Lec1	Problems and tasks of hydrology rainwater and surface water for construction engineers.	1
Lec2	Water balance. Determination of components of the water balance equation for the natural catchment and the artificial catchment, including urbanized catchment.	2
Lec3	Hydrometry. Measurements of water levels, the flow velocity and intensity water discharge.	2
Lec4	Hydrography. Observations gauges. Flow curve of the gauge section. The purpose of the construction of the flow curve. Floodwater hydrograph and methods of its creation.	2
Lec5	Transferring hydrological information from the controlled area to an uncontrolled region of a given watercourse.	1
Lec6	Determination of probable maximum and minimum flows for controlled catchments.	2
Lec7	Determination of maximum flow for small catchments uncontrolled.	2
Lec8	Basics of mathematical modeling of hydrological phenomena.	2
Lec 9	Test	
	Total hours	**15**

	Form of classes - class	**Number of hours**
Cl1		
...		
	Total hours	

	Form of classes - laboratory	**Number of**

		hours
Lab1	Water-economy balance	2
Lab2	The development of hydrologic curves for the catchment of the selected watercourse.	4
Lab3	The calculation of the maximum probable flow in the controlled catchment.	4
Lab4	The calculation of the maximum probable flow in a small uncontrolled catchment.	2
Lab5	Construction of the flood hydrograph in controlled catchment and uncontrolled catchment..	2
Lab6	Crediting of the laboratory.	1
	Total hours	**15**

Form of classes - project		**Number of hours**
Proj1		
…		
	Total hours	

Form of classes - seminar		**Number of hours**
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
N1. Lecture: multimedia presentations lecture content N2. Laboratory: multimedia presentations, defining and solving problems using the software, N3. Consultation in the form of direct meetings and via e-mail

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
P (lecture)	PEU_W01 PEU_W02 PEU_W03 PEU_W04	Final test
F (computer laboratory)	PEU_W01 PEU_U02 PEU_K01	Attendance and report writing
F (computer laboratory)	PEU_W02 PEU_U01 PEU_K01	Attendance and report writing
F (computer laboratory)	PEU_W03 PEU_U03 PEU_K01 PEU_K02	Attendance and report writing
F (computer laboratory)	PEU_W03 PEU_U04 PEU_K01 PEU_K02	Attendance and report writing

F (computer laboratory)	PEU_W04 PEU_U05 PEU_K01 PEU_K02	Attendance and report writing
P (laboratory etc) = P = (F1+F2+F3+F4+F5)/5		
P (lecture) =		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

1. Brutsaert W., Hydrology. An Introduction, Cambridge University Press, Cambridge, 2010.
2. Chow V. T., Handbook of Applied Hydrology, McGraw-Hill, New York, 1964.
3. Chow V. T., Mays L. W., Maidment D. R., Applied Hydrology, McGraw-Hill, New York, 1988.
4. Davie T., Fundamentals of hydrology, Routledge, Taylor & Francis Group, London and New York, 2010.
5. Shaw E. M., Beven K. J., Chappell N. A., Lamb R., Hydrology in practice, Spon Press, Taylor & Francis Group, Taylor & Francis Group, 2011.

SECONDARY LITERATURE:

1. Baban R., Design of diversion weirs. John Wiley & Sons, 1995.
2. Ghosh S. N., Flood control and drainage engineering, A.A. Balkema/Rotterdam/Brookfield, 1999.

SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)

Wojciech Rędowicz, Katedra Geotechniki, Hydrotechniki, Budownictwa Podziemnego i Wodnego, Pracownia Budownictwa Wodnego, Geodezji i Geologii Inżynierskiej, Wojciech.Redowicz@pwr.edu.pl

MEMBERS OF TEH EDUCATIONAL TEAM (NAME AND SURNAME, E-MAIL ADDRESS)

Jerzy Machajski. Katedra Geotrechniki, Hydrotechniki, Budownictwa Podziemnego i Wodnego. Jerzy.Machajski@pwr.edu.pl

Oscar Herrera-Granados. Katedra Geotechniki, Hydrotechniki, Budownictwa Podziemnego i Wodnego. Oscar.Herrera-Granados@pwr.edu.pl

Zał. nr 5 do ZW 16/2020

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in English:	**Prestressed concrete structures**
Name of subject in Polish:	**Betonowe konstrukcje sprężone**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level~~, uniform magister~~ studies*, full-time ~~/ part-time studies~~***
Kind of subject:	**~~obligatory~~ / optional / ~~university-wide~~***
Subject code:	**CEB006563**
Group of courses:	**YES / ~~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	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**			**2**	
including number of ECTS points for practical (P) classes				**2,0**	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**0,6**			**0,6**	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Possesses the knowledge and understands basics of the methods used in structural mechanics, knows selected CAD software.
2. Possesses the skills of statical analysis of a bar and spatial structure.
3. Possesses the knowledge of theoretical basics of finite element method and general rules of nonlinear analysis of engineering structures.
4. Possesses the knowledge and understands calculations and detailing of a complex concrete structures – acknowledged by the grade from CEB3361.
5. Possesses the knowledge of codes and standards of design of buildings and elements.
6. Possesses the skills of using internet and other sources for searching general information and information on building engineering, He possesses the skills of using information techiques to communicate and obtaining CAD software.
7. Is responsible for honest results of his work and reliable interpretation.

SUBJECT OBJECTIVES

C1. Forming up of skills of computing and detailing of prestressed concrete structures. C2. Learning of carrying out of multidimensional structural analysis the prestressed structures. C3. Gaining of the knowledge of prestress techniques and methods. C4. Gaining of the knowledge of limit state analysis of prestressed concrete structures.

SUBJECT LEARNING OUTCOMES	
Relating to knowledge:	
PEU_W01	Possesses the knowledge concerning computation and detailing of complex prestressed structures.
PEU_W02	Possesses the knowledge and understands design rules of complex precast and monolithic prestressed concrete structures.
Relating to skills:	
PEU_U01	Knows how to design precast or monolithic prestressed element or part of a structure being prestressed.
PEU_U02	Knows how to check required ultimate and serviceability limit states related to prestressed structures.
PEU_U03	Possesses the knowledge how to use respective codes, standards and literature
Relating to social competences:	
PEU_K01	Knows how to extend the knowledge on contemporary concrete structures and design methods.
PEU_K02	He is responsible for honest results of his design.

PROGRAMME CONTENT

Form of classes - lecture		Number of hours
Lec1	The concept of prestressing, historical review, definitions, differences between prestressed and reinforced concrete.	1
Lec2	Prestressed concrete applications.	1
Lec3	Properties of concrete used in prestressed structures.	1
Lec4	Properties of prestressing steel and other prestressing materials.	1
Lec5	Technology of pretensioned concrete.	1
Lec6	Technology of posttensioned concrete.	1
Lec7	Axisymmetric structures, tanks, silos, pipes. Structures prestressed with unbonded tendons.	1
Lec8	Ultimate limit states (flexure, shear and tension).	1
Lec9	Design situations and stress limitation.	1
Lec10	Immediate losses of prestress.	1
Lec11	Immediate losses of prestress.	1
Lec12	Time dependent losses of prestress. Prestressing force during tensioning.	1
Lec13	Effects of prestressing at ultimate and serviceability limit states. Prestressing in structure analysis.	1
Lec14	Serviceability limit states: camber, deflection and cracking	1
Lec15	Anchoring to concrete.	1
	Total hours	**15**

Form of classes - class		Number of hours
Cl1		
...		
	Total hours	

Form of classes - laboratory		Number of hours
Lab1		

	Total hours	

In the frame of the project – computer exercises (15 hours) with applying of the packet of statistical and geostatistical programs of ISATIS – the version of Isatis 2013.1, dongle key USB connected with the software Isatis purchased in the Firm Geovariances, Avon, Ecole des Mines de Paris, France.

Form of classes - project		Number of hours
Proj1	Project scope and example presentation.	1
Proj2	Basic assumption and rules.	1
Proj3	Preliminary design. Structure analysis.	1
Proj4	Load combinations used at ultimate and serviceability limit states.	1
Proj5	Immediate losses of prestress.	1
Proj6	Immediate losses of prestress.	1
Proj7	Time dependent losses of prestress.	1
Proj8	Prestressing force during tensioning.	1
Proj9	Stress limitation during tensioning.	1
Proj10	Checking ultimate limit states.	1
Proj11	Checking servicebility limit states.	1
Proj12	Anchorage and shear design.	1
Proj13	Detailing of reinforcement and prestressing tendons.	1
Proj14	Drawings of prestressed structures.	1
Proj15	Project submission.	1
	Total hours	**15**

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
N1. Lecture: Information lecture, problematic lecture, multimedial presentations, company presentations. N2. Project: Presentation of the project scope, examples of structures, direct collaboration and discussion with Students.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1 (evaluation of loads and preliminary dimensions of a structure)	PEU_W01 PEU_U01 PEU_U03 PEU_K01 PEU_K02	Evaluation of the project part
F2 (static computations with load combinantions finshed)	PEU_W01 PEU_U01 PEU_U03	Evaluation of the project part

	PEU_K01 PEU_K02	
F3(prestress loss calculated)	PEU_W01 PEU_W02 PEU_U01 PEU_U03 PEU_K01 PEU_K02	Evaluation of the project part
F4 (calculations of limit states finished)	PEU_W01 PEU_W02 PEU_U01 PEU_U03 PEU_K01 PEU_K02	Evaluation of the project part
F5 (drawing and specification finished)	PEU_W01 PEU_W02 PEU_U01 PEU_U02 PEU_U03 PEU_K01 PEU_K02	Evaluation of the whole project with grade
P = 0,1xF1+0,2xF2+0,2xF3+0,2xF4+0,3xF5		
P (lecture)	PEU_W01 PEU_W02 PEU_K01	Colloquium

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Teng S., Kong F. K.: Reinforced and Prestressed Concrete: Eurocodes Taylor & Francis Ltd; 2009.
[2] Dolan Ch. W., Hamilton H. R.: Prestressed Concrete. Building, Design, and Construction. Springer Nature Switzerland AG 2019.
[2] Navy E. G.: Pre-stressed Concrete. A Fundamental Approach. Prentice Hall, Upper Saddle River, New Jersey 07458, 2000.

SECONDARY LITERATURE:

[1] Ghali A.: Circular storage tanks and silos. E & FN Spon, London 2000.
[2] Raju N. K., Pre-stressed concrete, 2008.
[3] Naaman A. E.: Prestressed Concrete. Analysis and design. Techno Press 3000, Michigan 2004.
[4] Fogarasi G., Pre-stressed concrete technology. Akademiai Kiado, Budapest. 1986.
[5] Beeby A. W., Narayanan R. S.: Designers' Guide to EN 1992-1-1 and EN 1992-1-2. Eurocode 2: Design of Concrete Structures. General Rules and Rules for Buildings and Structural Fire Design. Thomas Telford Publishing, London. 2005.
[6] Manual for the design of concrete building structures to Eurocode 2. The Institution of Structural Engineers, London. 2006.
[7] EN 1992-1-1: Eurocode 2: Design of concrete structures-Part 1-1: General rules and rules for buildings.
[8] EN 1992-3: Eurocode 2: Design of concrete structures-Part 3: Liquid retaining and containing structures.

SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)

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FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in English:	**Seminarium dyplomowe**
Name of subject in Polish:	**Master (MSc) thesis seminar**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level~~, uniform magister~~ studies*, full-time ~~/ part-time studies~~***
Kind of subject:	**obligatory / ~~optional / university-wide~~***
Subject code:	**CEB009863**
Group of courses:	**~~YES /~~ 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					~~Examination~~ / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points					**3**
including number of ECTS points for practical (P) classes					**2,7**
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)					**1,3**

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic theoretical knowledge and skills in accordance with the requirements of the field of study *building* of the second cycle program, including specialty Civil Engineering.
2. Can shape, model, analyze, and measure components of complex buildings.
3. Knows the applicable standards, guidelines and regulations of construction, including extended for studying a specialty.
4. Has abilities and computational efficiency in the design of building structures, including the use of advanced computer-aided techniques for the calculation and plotting.

SUBJECT OBJECTIVES

C1. Synthesis of knowledge from the completed studies and practical experience.
C2. Creation of education skills to assess the suitability and usability of various tools and sources of information to solve engineering problems.
C3. Creation of education abilities of independent development and demonstration of technical issues in the construction industry, using multimedia techniques.

C4. Acquiring ability to develop a master thesis and a critical and comprehensive look at technological solutions. C5. Learn how to prepare basic studies of a scientific or technical knowledge. C6. Developing skills of preparation, critical evaluation and presentation of experimental results and evaluation studies.

SUBJECT LEARNING OUTCOMES	
Relating to knowledge:	
PEU_W01	Has in-depth knowledge of issues related to the construction industry, in particular relating to diploma specialization.
PEU_W02	Has knowledge of the techniques and methods of guiding and participation in public discussion on the issue of the construction industry.
Relating to skills:	
PEU_U01	Has specific skills for solving problems in the construction industry, particularly in specialty Civil Engineering.
PEU_U02	Has the ability to collect and critically analyze, from a variety of sources, of information about the construction industry, in particular, of the realized diploma specialization.
PEU_U03	Is able to conduct properly design, implementation and make, using advanced multimedia technology, complex technical presentations in the area of construction, and in particularly of the specialty Civil Engineering.
PEU_U04	Has the ability, in accordance with scientific principles and using research techniques, to prepare and implement a preliminary work on a research leading to solutions of complex engineering problems that occur in the construction industry.
PEU_U05	Is able to prepare all the necessary information to present the essence of popular scientific or technical problems.
Relating to social competences:	
PEU_K01	Is able to work independently over the implementation of the forthcoming thesis.
PEU_K02	Has the ability to prepare and execute complex presentation and the ability to participate in discussions in a public forum on topics related to construction.
PEU_K03	Is aware of the social role of technical college graduate in defining and delivering to public the information and opinions on the achievements of technology and other aspects of engineering.

PROGRAMME CONTENT

	Form of classes - lecture	Number of hours
Lec1		
…		
	Total hours	

	Form of classes - class	Number of hours
Cl1		
…		
	Total hours	

	Form of classes - laboratory	Number of hours
Lab1		
…		

	Total hours	

Form of classes - project		Number of hours
Proj1		
…		
	Total hours	

Form of classes - seminar		**Number of hours**
Sem1	Introduction to the course, range of subject, course organization, the principles of evaluation. Methodology for the design and development of complex multimedia presentations using computer tools. Sources of information and how to collect them and analyze.	2
Sem2	Examples of the use of advanced software features in presentations related to the theme of the course - an analysis of the advantages and disadvantages of discussed presentations. Rules on technical presentation. Formulating questions and answers during the discussion in a public forum.	2
Sem3	Presentation of the principles of preparation and implementation of issues related to the conduct of basic research. Examples.	2
Sem4	Individual multimedia presentations related to the topic of theses (1st series) and discussion.	2
Sem5	Individual multimedia presentations related to the topic of theses (1st series) and discussion.	2
Sem6	Individual multimedia presentations related to the topic of theses (1st series) and discussion.	2
Sem7	Individual multimedia presentations related to the topic of theses (1st series) and discussion.	2
Sem8	Individual multimedia presentations related to the topic of theses (1st series) and discussion.	2
Sem9	Summary of the 1st series of presentations. Discussion.	2
Sem10	Individual multimedia presentations related to the topic of theses (2nd series) and discussion.	2
Sem11	Individual multimedia presentations related to the topic of theses (2nd series) and discussion.	2
Sem12	Individual multimedia presentations related to the topic of theses (2nd series) and discussion.	2
Sem13	Individual multimedia presentations related to the topic of theses (2nd series) and discussion.	2
Sem14	Individual multimedia presentations related to the topic of theses (2nd series) and discussion.	2
Sem15	Summary of the results of the seminar and credition.	2
	Total hours	**30**

TEACHING TOOLS USED	
N1.	Multimedia presentations - own and collegues.
N2.	Discussion of problems among students.
N3.	Evaluating of presentations - with justification.
N4.	Contact hours

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1 (seminar)	PEU_W01, PEU_W02, PEU_U01, PEU_U02, PEU_U03, PEU_U04, PEU_U05, PEU_K01, PEU_K02, PEU_K03	Multimedia presentations - series 1
F2 (seminar)	PEU_W01, PEU_W02, PEU_U01, PEU_U02, PEU_U03, PEU_U04, PEU_U05, PEU_K01, PEU_K02, PEU_K03	Multimedia presentations - series 2
F3 (technical discussion)	PEU_W01, PEU_U01, PEU_U02, PEU_K02	Activity and the value of the substantive vote in the discussions.
P = 0,35 x F1+0,35 x F2+0,2 x F3 +0,1 x obecność		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

Literature depending on theme in which student is preparing his diploma.

SECONDARY LITERATURE:

1. Żurek E.: Sztuka prezentacji czyli jak przemawiać obrazem (Płyta CD). Wyd. Poltex, 2008.
2. Grzybowski P., Sawicki K.: Pisanie prac i sztuka ich prezentacji. Wyd. Impuls, 2010.
3. Blein B.: Sztuka prezentacji i wystąpień publicznych. Wyd. RM, 2010.
4. Wiszniewski A.: Jak pisać skutecznie? Wyd. Videograf II, 2003..

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prof. dr hab. inż. Jan Bień, jan.bien@pwr.wroc.pl

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Zał. nr 5 do ZW 16/2020

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in English:	**Railways**
Name of subject in Polish:	**Koleje**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level, ~~uniform magister~~ studies*, full-time / ~~part-time~~ studies***
Kind of subject:	**obligatory / ~~optional / university-wide*~~**
Subject code:	**CEB004062**
Group of courses:	**~~YES~~ / 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)	**30**			**60**	
Form of crediting	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	~~Examination~~ / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**			**2**	
including number of ECTS points for practical (P) classes				**1,7**	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**1,1**			**1,1**	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Ability for English language use (understanding, writing and speaking) on B2 level.
2. General, basic knowledge on railroads.
3. Skills of reading and use of maps and technical drawings.
4. Skills of using normal cross sections and longitudinal sections of railway track.

SUBJECT OBJECTIVES

C1. Acquiring of basic skills to design the layouts of railway tracks and stations.
C2. Acquiring of basic skills to design the railway station drainage systems.
C3. Acquiring of knowledge on layout of railway tracks and stations.
C4. Acquiring of knowledge on various track structures.
C5. Acquiring of basic knowledge on railway works technology.

SUBJECT LEARNING OUTCOMES	
Relating to knowledge:	
PEU_W01	Knows and understands railway network structure, distinguishes between types of operating posts and knows their function.
PEU_W02	Knows railway infrastructure elements, their function and way of work.
PEU_W03	Distinguishes types of railway track structures, knows their pros and cons.
PEU_W04	Knows conditions of railway infrastructure work (loads and ambient conditions) and understands the matter of their proper drainage and protection.
PEU_W05	Knows basic technologic processes in railway technology.
Relating to skills:	
PEU_U01	Knows how to design a railway line in plane, in profile and in cross section.
PEU_U02	Knows how to design a track layout of a small station and the auxiliary objects for passenger and freight services.
PEU_U03	Knows how to design a drainage system of a railway line and station.
Relating to social competences:	
PEU_K01	Is able to work on completing tasks alone and in group
PEU_K02	Understands the need of collecting and passing to the society information and opinions on engineering activity

PROGRAMME CONTENT		
	Form of classes - lecture	**Number of hours**
Lec1	Definitions of the rail road. Basic facts of railway engineering history. Elements of railway infrastructure. Classification of railway lines.	2
Lec2	Elements of track. Technical standards of track.	2
Lec3	Railway track subgrade. Rules for shaping and material requirements. Elements of drainage system of railway lines and stations.	2
Lec4	Kinematics of the train move. Rail-wheel co-operation. Basic assumptions for track geometry calculations.	2
Lec5	Track geometry design in plane and in profile. Railway structure gauge.	2
Lec6	Tramway. History of city transportation. Elements of tramway track. Design of track and platforms.	2
Lec7	Continuous welded track. Track on grade crossing..	2
Lec8	Ballastless track. Track on bridges.	**2**
Lec9	Turnouts. Ladder track. Derailers. Trap points and bump stops. Turning tables and shift tables. Gauntlet track.	2
Lec10	Railways in Poland and in the world. Elements of railway infrastructure. Operation posts. Intermodal transport.	2
Lec11	Stations. Classification, functions, track alignments.	2
Lec12	Basic technologic processes in railway technology.	2
Lec13	Machines and devices in railway technology.	2
Lec14	Modernization of railway lines. Rules for design and applied technologies.	2
Lec15	Final test. Results disscussion.	2
	Total hours	30

Form of classes - class		Number of hours
Cl1		
…		
	Total hours	

Form of classes - laboratory		Number of hours
Lab1		
…		
	Total hours	

Form of classes - project		Number of hours
Proj1	Organization of work. Requirements and rules. Issuing of the data for the project. Description of the project scope. List of compulsory and auxiliary readings and lectures for the project, including local and international regulations.	2
Proj2	Railway line section in plane. Geometry of the track layout. Cant and cant ramp. Design of transition curves.	2
Proj3	Characteristic cross section of the track. Shaping of embankments at bridges and viaduct.	2
Proj4	Profile of railway line. Geometric correlation between plane, profile and cross section.	2
Proj5	Drainage design. Shaping of ditches in plane, profile and cross section.	2
Proj6	Design of protection layers in subgrade. Students work review (plane, profile).	2
Proj7	Resume of the first part of the project. Students work review (plane, profile, cross sections)	2
Proj8	Introduction to the design of railway siding. Plane layout, requirements and rules.	2
Proj9	Track alignment and track geometry in stations and marshalling yards.	2
Proj10	Number and length of marshalling yard and station tracks. Calculation of the main auxiliary tracks number.	2
Proj11	Loading fronts for freight services. Calculation of warehouse, stack square and loading ramp.	2
Proj12	Turnouts: kinds, geometry, dimensions, applications, special trackwork. Principles of track connection shaping.	2
Proj13	Elements of drainage system on marshalling yard and loading front – geometric design.	2
Proj14	Cross section of the marshalling yard and loading front.	2
Proj15	Resume of the second part of the project. Students work review.	2
	Total hours	**30**

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED	
N1.	Lecture: multimedia presentation, blackboard
N2.	Design: multimedia presentation, blackboard.
N3.	Design: exemplary design drawing, model of the railway station drainage system.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1 (project)	PEU_U01 PEU_U02 PEU_U03 PEU_W04	project assessment
F2 (project)	PEU_K01 PEU_K02	project assessment
P (project) = 0,65×F1 + 0,2×F2 + 0,15×systematic work (review of the design)		
P (lecture)	PEU_W01 PEU_W02 PEU_W03 PEU_W04 PEU_W05	final test

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Dz. U. nr 151.: Rozporządzenie Ministra Transportu i Gospodarki Morskiej w sprawie warunków technicznych, jakim powinny odpowiadać budowle kolejowe i ich usytuowanie with changes 2014, 2018

[2] Dz. U. nr 33.: Rozporządzenie Ministra Transportu i Gospodarki Morskiej z dnia 26 lutego 1996 r. w sprawie warunków technicznych jakim powinny odpowiadać skrzyżowania linii kolejowych z drogami publicznymi i ich usytuowanie (ze zmianami: Dziennik Ustaw Rzeczpospolitej Polskiej Nr 100 z 9.11.2000, pozycja 1082.

[3] TSI Infrastructure: Commission Regulation (EU) No 1299/2014 of 18 November 2014 on the technical specifications for interoperability relating to the 'infrastructure' subsystem of the rail system in the European Union Text with EEA relevance. *OJ L 356, 12.12.2014, p. 1–109*

[4] Bonnet, Clifford F.: Practical Railway Engineering. London: Imperial College Press, 2010

[5] Esveld C.: Modern Railway Track, 2nd ed. Zaltbommel: MRT-Productions, 2001.

SECONDARY LITERATURE:

[1] Id-1 (D-1) Warunki techniczne utrzymania nawierzchni na liniach kolejowych - PKP Polskie Linie Kolejowe S.A., Warszawa 2005; ze zmianami: 2006, 2010, 2015

[2] Id-3 (D-4) Warunki techniczne utrzymania podtorza kolejowego - PKP Polskie Linie Kolejowe S.A., Warszawa 2009.

[3] Standardy Techniczne - Szczegółowe warunki techniczne dla modernizacji lub budowy linii kolejowych do prędkości Vmax ≤ 200 km/h (dla taboru konwencjonalnego) / 250 km/h (dla taboru z wychylnym pudłem) – PKP PLK Warszawa 2009 - ze zmianami 2017, 2018

[4] Fahrwege der Bahnen im Nah- und Regionalverkehr in Deutschland = Local and regional railway tracks in Germany. VDV, Alba Fachverlag. Düsseldorf, 2007

[5] Jackson A.A.: The railway dictionary: worldwide railway facts and terminology. Stroud Sutton 2006

[6] Yi S.: Principles of railway location and design. Academic Press 2018
[7] Understanding track engineering. Lavenham Press 2014
[8] Freudenstein S.: Ballastless tracks. Ernst&Sohn 2018
[9] Indraratna B. et al.: Advanced rail geotechnology – ballasted track. CRC Press/Balkema 2011

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MEMBERS OF THE EDUCATIONAL TEAM (NAME AND SURNAME, E-MAIL ADDRESS)
Teachers and doctoral candidates from Railways Division, Chair of Roads, Bridges, Railways and Airports

Zał. nr 5 do ZW 16/2020

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in English:	**Bridges**
Name of subject in Polish:	**Mosty**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level~~, uniform magister~~ studies*, full-time ~~/ part-time studies~~***
Kind of subject:	**obligatory / ~~optional~~ / ~~university-wide~~***
Subject code:	**CEB008062**
Group of courses:	**~~YES~~ / 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 *			~~Examination~~ / crediting with grade *	
For group of courses mark (X) final course					
Number of ECTS points	**2**			**2**	
including number of ECTS points for practical (P) classes				**2.0**	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**1.3**			**1.3**	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
1. Identifies structural elements 2. Identifies parameters of a structure 3. Identifies physical values used in mechanics

SUBJECT OBJECTIVES	
C1.	Introduction to basic terms of bridge engineering
C2.	Introduction to modern construction methods
C3.	Introduction to structural analysis methods
C4.	Strengthening of work in group

SUBJECT LEARNING OUTCOMES	
Relating to knowledge:	
PEU_W01	Knows and understands basic ideas of bridge engineering
PEU_W02	Knows the layout of structural elements as well as non-structural elements
PEU_W03	Knows analysis methods and modelling of bridge structures
PEU_W04	Knows modern construction methods
PEU_W05	Knows selected methods of bridge testing
Relating to skills:	
PEU_U01	Properly distinguishes bridge elements
PEU_U02	Is able to describe selected construction methods
PEU_U03	Properly describes selected methods of bridge testing and structural modelling
PEU_U04	Is able to do basic structural analysis
PEU_U05	Makes the drawings of bridge structures according to the rules
PEU_U06	Is able to design the superstructure of girder span in the field of main girders and slab
Relating to social competences:	
PEU_K01	Is able to work alone or in group
PEU_K02	Is aware of a need of updating the knowledge related to bridge testing

PROGRAMME CONTENT		
	Form of classes - lecture	**Number of hours**
Lec1	Introduction, bridge infrastructure in Poland and Europe, basic terminology, bridge components.	2
Lec2	Bridge classification, static systems of bridges, case studies. Bridge supports.	2
Lec3	Bridge accessories, examples. Bridge bearings.	2
Lec4	General rules of structural analysis and dimensioning of bridge structures. Types of bridge loads, case studies.	2
Lec5	Numerical modelling and computer tools for structural analysis.	2
Lec6	Concrete bridges – classification and structural details.	2
Lec7	Concrete bridges – structural analysis, prefabricated bridges.	2
Lec8	Steel & composite bridges – classification and structural details.	2
Lec9	Steel & composite bridges – structural analysis.	2
Lec10	Masonry bridges – classification, structural details & analysis.	2
Lec11	Construction methods.	2
Lec12	Testing methods.	2
Lec13	Bridges defects, classification and case studies, causes of defect.	2
Lec14	Bridge exploitation and maintenance problems. Computer systems for management.	2
Lec15	Test.	2
	Total hours	**30**

	Form of classes - class	**Number of hours**
Cl1		
...		
	Total hours	

Form of classes - laboratory	**Number of hours**

Lab1		
...		
	Total hours	

Form of classes - project		Number of hours
Proj1	Introduction, formal information, distribution of project subjects, description of the project's scope.	2
Proj2	Basic design rules for bridge substructure, shaping the bridge surroundings (typical sizes of piers and abutments according to formal requirements), description of basis terminology.	2
Proj3	Design rules for bridge superstructure, determination of bridge span lengths, selection of bridge girder's height, dimensions of main structural elements of a bridge (slab, transverse beams), bridge accessories (pavements, barriers, railings, drainage, expansion joints), examples.	2
Proj4	Description of conceptual drawings – rules for drawing, descriptions, scales, thickness of lines, scope of the conceptual design.	2
Proj5	Initial calculations – scope, basic assumptions, methods of analysis, collecting of dead and live loads.	2
Proj6	Initial calculations – load transverse distribution, finding internal forces with application of influence lines.	2
Proj7	Initial calculations – dimensioning of the main girders at bending. Basic rules for designing of reinforcement (choice of material, thickness of bars and cover, distances between bars).	2
Proj8	Detailed calculations – bridge superstructure modelling by means of FEM, presentation of exemplary models.	2
Proj9	Detailed calculations – analysis of bridge main girders by means of FEM method: collection and application of dead and live loads, finding the internal forces.	2
Proj10	Detailed calculations – creation of envelopes of internal forces (bending moments and shear forces), loading scenarios and combinations.	2
Proj11	Detailed calculations – ultimate limit state of bridge girder at bending and shearing, envelopes of resistance.	2
Proj12	Technical drawings of a bridge girder – scope and rules for drawing; details of reinforcement design (anchorage length, bending radius of bars, hooks, overlapping, joining of bars).	2
Proj13	Technical description of the designed bridges.	2
Proj14	Individual consultations of student projects.	2
Proj15	Passing the projects.	2
	Total hours	**30**

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
N1. Lecture: presentations, slides, making the drawings on the blackboard N2. Project: presentations, slides, ma king the drawings and schemes on the blackboard, examples of calculations N3. Individual meetings

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1 (proj)	PEU_U04	Individual task – conceptual drawings
F2 (proj)	PEU_U05	Individual task – first stage of calculations
F3 (proj)	PEU_U06 PEU_K01	Individual task – detailed design
P=0.2xF1+0.1xF2+0.7xF3		
P (lect)	PEU_W01 PEU_W02 PEU_W03 PEU_W04 PEU_W05 PEU_K02	Test

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] 1 Parke G., Hewson N., *ICE manual of bridge engineering*, Thomas Telford Limited, 2008.
[2] Tonias D. E., Zhao J. J., *Bridge Engineering: Rehabilitation, and Maintenance of Modern Highway Bridges*. McGraw-Hill Professional. 2006.
[3] *Bridge engineering handbook* / ed. by Wai-Fah Chen and Lian Duan. 2000.
[4] Mondorf P., *Concrete Bridges*, Routledge, 2006.
[5] Ghosh U.K., *Design and Construction of Steel Bridges*, Taylor & Francis; 2006.
[6] Collings D., *Steel-Concrete Composite Bridges*, Thomas Telford, 2005.
[7] Hirt M., Lebet J.P. *Steel Bridges: Conceptual and Structural Design of Steel and Steel-Concrete Composite Bridges,* CRC Press, 2013.
[8] Hendy C.R., Smith D.A., *Designers' Guide to EN 1992 Eurocode 2: Design of Concrete Structures: Concrete bridges*, Thomas Telford, 2007.
[9] Hendy C. R., Murphy C. J., *Designers' Guide to EN 1993-2 Eurocode 3: Design of Steel Structures: Steel Bridges*, Thomas Telford, 2007.
[10] Hendy C.R., Johnson R.P., *Designers' Guide to EN 1994-2 Eurocode 4 : Design of Steel and Composite Structures: General Rules and Rules for Bridges*. Taylor & Francis; 2006.

SECONDARY LITERATURE:

[1] David J., Brown, Bridges – Three thousand Years of Defying Nature, Mitchell Beazley, Octopus Publishing Group, London 1993-2005

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

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dr inż. Mieszko Kużawa, mieszko.kuzawa@pwr.edu.pl

MEMBERS OF TEH EDUCATIONAL TEAM (NAME AND SURNAME, E-MAIL ADDRESS)
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FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in English:	**Praca dyplomowa**
Name of subject in Polish:	**Master (MSc) thesis**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level~~, uniform magister~~ studies*, full-time ~~/ part-time studies~~***
Kind of subject:	**obligatory ~~/ optional / university-wide~~***
Subject code:	**CEB099963**
Group of courses:	**~~YES /~~ NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					
Number of hours of total student workload (CNPS)				**540**	
Form of crediting	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points				**18**	
including number of ECTS points for practical (P) classes				**18,0**	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				**7,0**	

* delete as appropriate

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has an advanced theoretical knowledge and skills in accordance with the requirements of the field of study *building* of the second cycle of the program, including Civil Engineering specialty.
2. Can shape, model, analyze, and measure complex structural components of buildings.
3. Knows the applicable standards, guidelines and regulations for the design of buildings, including the extended in the range of building structures.
4. Has the ability and computational efficiency in design, including computer-aided calculation and plotting.
5. Has the ability to independently acquire, use, and analysis of scientific and technical information.

SUBJECT OBJECTIVES

C1. Synthesis of knowledge of the whole the second cycle studies and practical experience, especially in the chosen diploma specialty.
C2. Getting knowledge of the planning and realization of a variety, complex technical,

scientific and technical research. C3. Strengthening the knowledge of the principles of programming, modeling and solving complex engineering design tasks. C4. Learning students how to select and use advanced computational tools, including computer programs. C5. Strengthening skills of development the results and drawing conclusions. C6. Strengthening the ability to use and critical analysis of scientific and technical information.

SUBJECT LEARNING OUTCOMES	
Relating to knowledge:	
PEU_W01	Has a well-established and extended knowledge of the issues of the construction industry, particularly in the area of diploma specialization.
PEU_W02	Has a theoretically grounded knowledge of programming, modeling and solving complex design engineering tasks.
PEU_W03	Knows the rules for the application of advanced techniques and computer programs supporting the design and research processes.
Relating to skills:	
PEU_U01	Has detailed, developed skills in solving problems in the construction industry, in particular of the studying specialty.
PEU_U02	Has the ability to collect and critically analyze, from a variety of sources, of information in the field of construction, especially of the studying specialty.
PEU_U03	Can select the methods and tools to solve complex engineering tasks and basic research problems.
PEU_U04	Has the ability to document the work or research projects done by himself and their presentation.
PEU_U05	Is able to establish directions of further education and follow the process of self learning.
Relating to social competences:	
PEU_K01	Is able to set priorities for implementation of specified by himself or the others tasks or research projects and is responsible for his decisions.
PEU_K02	Has an internal belief in the need for the continuous self-development, including related to his profession.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1		
…		
	Total hours	

Form of classes - class		**Number of hours**
Cl1		
...		
	Total hours	

Form of classes - laboratory		**Number of hours**
Lab1		
…		
	Total hours	

Form of classes - project		Number of hours
Proj1		
…		
	Total hours	

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED	
N1.	Studies of literature and other sources of information.
N2.	Preparation and execution of calculations and / or experimental and / or case study analysis.
N3.	Analysis of the comparisons results, summary, formulation of conclusions, editorial preparation of the thesis.
N4.	Participation in consultations related to the thesis, summarizing discussions.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation (F – forming (during semester), P –concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
P1, P2, P3, P4	PEU_W01, PEU_W02, PEU_W03, PEU_U01, PEU_U02, PEU_U03, PEU_U04, PEU_U05, PEU_K01, PEU_K02	Rating the thesis by the supervisor and reviewer. Thesis defense. Diploma exam.
P1 – evaluation of the thesis by the supervisor and reviewer P2 – defense of the thesis P3 – evaluation of diploma exam		

PRIMARY AND SECONDARY LITERATURE
Literature depending on specialty in which the diploma is realized. Literature related to the thesis topic chosen independently by student and under the direction of the supervisor.
SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)
Thesis supervisor.
MEMBERS OF TEH EDUCATIONAL TEAM (NAME AND SURNAME, E-MAIL ADDRESS)
Thesis reviewer

Zał. nr 5 do ZW 16/2020

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in English:	**Underground structures – urban infrastructure**
Name of subject in Polish:	**Budownictwo podziemne – infrastruktura miejska**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level, ~~uniform magister~~ studies*, full-time / ~~part-time~~ studies***
Kind of subject:	**obligatory ~~/ optional~~ / ~~university-wide~~***
Subject code:	**CEB003962**
Group of courses:	**~~YES~~ / 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~~ *	Examination / crediting with grade *	Examination / crediting with grade *	~~Examination~~ / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**2**			**2**	
including number of ECTS points for practical (P) classes				**2,0**	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**1,0**			**1,2**	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student possesses knowledge of structural mechanics.
2. The student knows the principles of soil mechanics with relation to civil engineering.
3. The student knows standards of concrete structure designing.

SUBJECT OBJECTIVES

C1. Learning the principles of interaction: tunnel support – surrounding rock mass

C2. Gaining the different types of underground structures and various executing technologies.

C3. Skills acquisition of design of reinforced concrete tunnel support.

C4. Skills acquisition of advanced design of tunnel support located at great depth

C5. Skills acquisition of solving, interpreting and verifying of the results of analytical calculations.

C6.	Strengthening the ability to work on the task entrusted to and awareness of the need to seek new theoretical and practical solutions.

SUBJECT LEARNING OUTCOMES	
Relating to knowledge:	
PEU_W01	Student has an in-depth knowledge of analysis, design and construction of underground structures in urban infrastructure.
PEU_W02	Student has an in-depth knowledge of rock mechanics and tunnel support design.
Relating to skills:	
PEU_U01	The student can properly create a computational model of underground structure.
PEU_U02	The student can properly design all the elements of underground structure.
Relating to social competences:	
PEU_K01	The student can works independently or with a team..
PEU_K02	The student is aware of the need to continuously increase own knowledge in the field of design techniques of underground structures.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Introduction - the basic definition and classification of underground urban infrastructure: rapid transit systems, underground passages, road tunnels, tram tunnels.	2
Lec2	Definition and classification of underground space by the use, function and depth. Potential psychological problems associated with underground space. Designing of shallow underground structures.	2
Lec3	Specificity of loads acting on shallow underground structures. Evaluation of loads acting on tunnel lining.	2
Lec4	Specificity of loads acting on shallow underground structures – further information. A procedure of internal forces determination. A choice of proper static scheme and calculation of elastic constraints stiffness.	2
Lec5	Executing technologies of shallow tunnels. Methods of supporting the walls of deep excavations.	2
Lec6	Trenchless technologies of shallow tunnels execution – Milan method, Tunnel Boring Machines: presentation of different techniques for excavation face support.	2
Lec7	Specific features of deep tunnels. Characteristics of design approach for tunnels located in the rock mass. Scale effect with respect to mechanical properties of the rock mass. Advanced ventilation systems of long and deep tunnels.	2
Lec8	Longitudinal profile of deep tunnels and its implication for drainage and ventilation facility. Characteristics of minimum safety requirements for road and railway tunnels in accordance with EU Directives.	2
Lec9	Advanced systems of waterproofing of tunnel structure. Insulation membranes between temporary and final linings used in modern tunneling.	2
Lec10	Definition and estimation of the critical depth for excavation located in rock mass governed by: a) Coulomb - Mohr or b) Hoek – Brown failure criterion.	2

Lec11	Deformation earth pressure. The elastic-plastic problem of circular excavation at great depth - Part I: elastic deformation. Tunnel located above the critical depth.	2
Lec12	Deformation earth pressure. The elastic-plastic problem of circular excavation at great depth - Part II: plastic deformation. Tunnel located below the critical depth.	2
Lec13	Static earth load acting on tunnel support. Engineering methods for assessing static rock pressure. Role of tunnel support mechanical characteristics and time of final lining installation on “rock-tunnel” support interaction.	2
Lec14	Parametric evaluation of the quality of the rock mass. Rock Mass Classification systems: RQD, RMR, Q, GSI. Preliminary selection of the support type based on RMR, Q or GSI values.	2
Lec15	Tunneling techniques in rock masses. Tunneling shields, types of shields, excavation techniques, New Austrian Tunneling Method, drill and blast method, sequential excavation process in the conditions of the weak rock mass.	2
	Total hours	**15**

Form of classes - class		**Number of hours**
Cl1		
...		
	Total hours	

Form of classes - laboratory		**Number of hours**
Lab1		
...		
	Total hours	

Form of classes - project		**Number of hours**
Proj1	Presentation of the scope of the project, the completion and the available literature. Discussion of the design scope. Presentation of design procedure in case of structures located in the rock masses.	2
Proj2	Principles of cross-section design of tunnel support - Car tunnel. Factors influencing the geometry of tunnel cross-section. Discussion on methods of waterproofing of tunnel structure. Individual students work on projects.	2
Proj3	Principles of cross-section design of tunnel support - railway tunnel. Factors influencing the geometry of tunnel cross-section. Individual students work on projects.	2
Proj4	Practical use of geomechanics classification of rock mass: RMR and GSI. Presentation of Rock Mass Classification systems with special regard to GSI approach. Determination of deformation parameters of the rock mass with the use of GSI index and intact rock properties. Individual students work on projects.	2
Proj5	Presentation of Hoek-Brown failure criterion. Differences between intact rock (rock specimen) and rock mass with respect to the their	2

	mechanical behavior. Relations enabling estimations of failure criterion parameters based on the GSI classification. Determination of the properties of disturbed rock mass existing in the vicinity of underground excavation. Estimation of critical depth.	
Proj6	The elastic-plastic boundary value problem of circular excavation at great depth: elastic and elastic-plastic solution. Rock mass pressure acting on tunnel support as a function of plastic zone radii in two extreme cases: (a) excavation located above the critical depth, (b) excavation located below the critical depth.	2
Proj7	The value of rock mass pressure corresponding to maximum radii of plastic zone.	2
Proj8	Verification of the student calculations of rock mass pressure acting on tunnel support.	2
Proj9	Computational model of static interaction in the system: tunnel support – rock mass. Evaluation of parameters of computational model. Iterative procedure of internal forces evaluation.	2
Proj10	Strength designing of concrete tunnel support.	2
Proj11	Discussion on the students final design of tunnel support and verification of the internal forces of tunnel structure evaluated by students.	2
Proj12	Principles of proper ventilation preservation in tunnel: Pulsfort and Bendelius method. Determination of the minimum discharge of ventilation to keep the concentration of pollutant on the safe level. Calculation example.	2
Proj13	The problem of preserving the safety in tunnel. Elements of additional equipment in tunnel arising from the directives in force in the European Union.	2
Proj14	Drilling and blasting technologies in tunnel excavation execution. Description of tunneling works according to the rules of New Austrian Tunneling Method with assumption of the advance performed by the drill and blast technique.	2
Proj15	Presentation of the final design of tunnel support.	2
	Total hours	**30**

Form of classes - seminar		**Number of hours**
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
N1. Lecture: classic lecture and multimedial presentations N2. Project: solving of calculation example, multimedial presentation,

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1 (Project)	PEU_U01, PEU_U02, PEU_K01	Partial evaluation of students design of tunnel support
F2 (Project)	PEU_U01, PEU_U02, PEU_K01	Presentation of the final tunnel design.
P = 0,5xF1+0,4xF2+0,1xPARTICIPATION (projekt)		
F1 (lecture)	PEU_W01, PEU_W02, PEU_K02	Exam

PRIMARY AND SECONDARY LITERATURE
<u>**PRIMARY LITERATURE:**</u> [1] Chapman D., Metje N., Stärk A.: "Introduction to Tunnel Construction", Taylor and Francis Group, 2010. [2] Goel, Rajnish K., Bhawani S., Zhao K.: "Underground infrastructures: planning, design, and construction", Butterworth-Heinemann, 2012. [3] Bieniawski Z. T.: „Engineering Rock Mass Classifications", Wiley, 1989. [4] Hoek E.: Support of underground excavations in hard rock, 1995. [5] Megaw T.M.: Tunnels: planning, design, construction, 1983. [6] Kolymbas D.: Tunneling and tunnel mechanics: a rational approach to tunneling, 2005. <u>**SECONDARY LITERATURE:**</u> [1] Lunardi P.: Design and construction of tunnels, 2008.

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FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in English:	**Sustainable housing**
Name of subject in Polish:	**Budownictwo zrównoważone**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level~~, uniform magister~~ studies*, full-time ~~/ part-time studies~~***
Kind of subject:	**~~obligatory~~ / optional / ~~university-wide~~***
Subject code:	**CEB008263**
Group of courses:	**~~YES~~ / 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	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**			**2**	
including number of ECTS points for practical (P) classes				**2,0**	
including number of ECTS points for direct teacher-student contact (BK) classes	**0,6**			**0,6**	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
1. Graduation of civil engineering, environmental engineering architecture or city planning studies.
2. Has knowledge of building construction, technical drawings and general building design.
3. Knows standards, guidelines and regulations about construction and their detail design.
4. Has theoretical basis of detached house design and construction detail solutions.

SUBJECT OBJECTIVES
C1. Gain knowledge about design rules of modern, low energy demand, ecological residential and commercial buildings and their details.
C2. Getting acquainted with renewable energy usage possibilities.
C3. Getting acquainted with regulations of rational energy preservation with taking thermal, visual and acoustic comfort of different rooms into consideration.
C4. Getting basis of design team cooperation to connect form and function with rational energy usage in buildings.

SUBJECT LEARNING OUTCOMES	
Relating to knowledge:	
PEU_W01	knows the standards, guidelines and regulations referring to the design of buildings and their components
PEU_W02	possesses knowledge about the influence of building investments on the environment
PEU_W03	has extensive knowledge in the area of selected elements, constructions and building structures
Relating to skills:	
PEU_U01	is able to use advanced specialized tools when searching Internet databases and other sources which can be used to find both general information and other information related to civil engineering; is able to use information technology to communicate and know how to obtain software which is used to aid the work of a designer and the person organizing and managing building processes
PEU_U02	is able to choose a tool (analytical or numerical) in order to solve engineering issues; is able to use selected software which aid modeling and design processes in construction
PEU_U03	has skills to solve tasks referring to selected theoretical issues and also design elements, constructions and building structures
Relating to social competences:	
PEU_K01	is aware of the need to constantly upgrade professional and personal competence in the form of formal or informal education and also improves and develops knowledge in the area of modern processes and technology, related to civil engineering
PEU_K02	is aware of the importance and also understands non-technical aspects and consequences of engineering activity, including influence on the environment and responsibility for implemented decisions
PEU_K03	is able to work independently and cooperate in a team on a specific task; is responsible for both the safety of his work and his subjected team's work

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Course subjects and passing regulations talk through. Sustainable building design basic information. LCA – building life cycle, total building costs. Environmental influence of buildings.	2
Lec2	Building environmental impact methods. Social, economical and environmental aspects of sustainable building design. Law regulations	2
Lec3	Global and local greenhouse gas emission. Carbon dioxide reduction strategies. Energy production from different fuels. Emission factors. Fuel equity. The primal energy conversion coefficients.	2
Lec4	Classification of low-energy buildings. Building shape coefficient. Basic and advanced building design methods. Heat flow through windows and glazed facades.	2
Lec5	Building thermal mass. Ventilation system, heat recovery, ground-coupled heat exchanger	2
Lec6	Renewable energy resources in global and local scale. Usage in low-energy and passive buildings.	2
Lec7	Examples of low-energy and passive buildings. Applied solutions. Possible solutions to carry in buildings in polish climate.	2
Lec8	Final test	1
	Total hours	**15**

Form of classes - class		Number of hours
Cl1		
…		
	Total hours	

Form of classes - laboratory		Number of hours
Lab1		
…		
	Total hours	

Form of classes - project		Number of hours
Proj1	Project subjects and passing regulations talk through. Handing over design cases. Familiarize with work safety regulations.	1
Proj2	U-value calculations for building partition. Untypical cases	2
Proj3	Correct arrangement for rooms with different functions in horizontal and vertical plane. Daylight access.	2
Proj4	Building shape coefficient. Building thermal mass.	2
Proj5	Optimisation of heat gains and losses in buildings with different purpose.	2
Proj6	HVAC (heating, ventilation, air conditioning) and DHW (domestic hot water) systems	2
Proj7	Renewable energy sources. Usage possibilities in Poland and all over the world.	2
Proj8	Infrared thermography. Thermogram interpretation.	2
	Total hours	**15**

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED	
N1.	Lecture: multimedia presentation of lecture material, share of teaching materials through e-learning platforms, use of remote learning platforms (Zoom, MS Teams)
N2.	Project: multimedia presentation of project material. Solving problem with use of MS Office software, , share of teaching materials through e-learning platforms, use of remote learning platforms (Zoom, MS Teams)

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation F – forming (during semester), P – concluding (at the end of semester)	Learning outcomes number	Way of evaluating learning outcomes achievement
P1 (project)	PEU_U01 PEU_U02 PEU_U03 PEU_K01 PEU_K02 PEU_K03	Design case accomplishment
P2 (lecture)	PEU_W01	Colloquium - written test or on-line test

	PEU_W02 PEU_W03	

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: [1] Beggs C., Energy Management, Supply and Conservation. Elsevier, 2002. [2] Clark J., Energy Simulation in Building Design. Wiley Company, 2001. [3] Gratia E., DeHerde A.: Passive Solar Architecture. BRE, 2006. [4] Hens H., Buildings Physics – Heat, Air and Moisture. Ernst & Sohn, 2007. [5] Moss K., Heat and Mass Transfer in Buildings. Elsevier, 2007. [6] Twidell J., Weir T., Renewable Energy Resources. Taylor & Francis, 2006. **SECONDARY LITERATURE:**

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prof. dr hab. inż. Henryk Nowak, Department of Building Engineering, henryk.nowak@pwr.edu.pl
MEMBERS OF THE EDUCATIONAL TEAM (NAME AND SURNAME, E-MAIL ADDRESS)
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FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in English:	**Sztuczna inteligencja w inżynierii lądowej**
Name of subject in Polish:	**Artificial intelligence in civil engineering**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level~~, uniform magister~~ studies*, full-time ~~/ part-time studies~~***
Kind of subject:	**~~obligatory~~ / optional / ~~university-wide~~***
Subject code:	**CEB006063**
Group of courses:	**~~YES~~ / 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	~~Examination~~ / crediting with grade *		~~Examination /~~ crediting with grade *		
For group of courses mark (X) final course					
Number of ECTS points	**1**		**2**		
including number of ECTS points for practical (P) classes			**2,0**		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**0,6**		**0,6**		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
1. Basic knowledge in civil engineering – types of structures and processes
2. Skill in application of basic computer techniques

SUBJECT OBJECTIVES
C1. Learning the fundamental techniques used in computer tools with elements of artificial intelligence – applied in civil engineering
C2. Development of ability to design, computer implementation and testing of simple expert tools with elements of artificial intelligence

SUBJECT LEARNING OUTCOMES	
Relating to knowledge:	
PEU_W01	The student knows and understands methods of knowledge acquisition and representation in expert systems
PEU_W02	The student knows methodology of design, computer implementation and testing of knowledge-based expert systems with elements of artificial intelligence
Relating to skills:	
PEU_U01	The student has skill to independent acquisition of knowledge in civil engineering
PEU_U02	The student has skill to design, computer implementation and testing of simple expert tools with elements of artificial intelligence, supporting decisions in civil engineering
Relating to social competences:	
PEU_K01	The student is able to unaided solving the problems and is also prepared to a team-work (laboratory reports, laboratory exercises)

PROGRAMME CONTENT

	Form of classes - lecture	Number of hours
Lec1	Introduction to the lectures: aims, scope and plan of the course. Basic literature and examination rules. Artificial intelligence – what is this? Basic terms and definitions.	1
Lec2	Artificial intelligence in expert systems – classification, architecture, evolution, directions of development. Expert systems and range of their application in civil engineering.	2
Lec3	Technologies of knowledge acquisition and representation in computer systems. Knowledge bases and data bases. Expert functions in computer systems supporting management.	2
Lec4	Artificial neural networks – conception, architecture, training and testing techniques, applications.	2
Lec5	Fuzzy logic – fuzzy problems, linguistic variables, fuzzy reasoning procedures, testing, applications.	2
Lec6	Expert systems based on knowledge – design and implementation. Technology of hybrid networks in expert systems.	2
Lec7	Examples of artificial intelligence applications in civil engineering – expert tools supporting structure analysis and infrastructure management.	2
Lec8	Colloquium	2
	Total hours	**15**

	Form of classes - class	Number of hours
Cl1		
...		
	Total hours	

	Form of classes - laboratory	Number of hours
Lab1	General introduction: organization, crediting rules. Distribution of individual tasks, discussion of each task.	1
Lab2	Technologies of knowledge acquisition and computer representation – examples from selected fields of civil engineering.	2
Lab3	Technology of artificial neural networks creation – introduction to computer software.	2
Lab4	Practical design, training and testing of artificial neural networks.	2
Lab5	Individual task – conceptual design.	2
Lab6	Individual task – knowledge acquisition.	2

Lab7	Individual task – computer implementation and testing.	2
Lab8	Presentation of results and evaluation of the report.	2
	Total hours	**15**

Form of classes - project		**Number of hours**
Proj1		
…		
	Total hours	

Form of classes - seminar		**Number of hours**
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
N1. Lecture: multimedia presentations of all parts of the course programme, presentation of computer software supporting bridge management.
N2. Laboratory: multimedia presentations, software presentations, data preparation, data input and processing by means of computer systems, analysis and discussion of the results.
N3. Individual consultations.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
P (lecture)	PEU_W01, PEU_W02	Colloquium
P (laboratory)	PEU_U01, PEU_U02, PEU_K01	Final laboratory report, active work in laboratory

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] 1. Russell S., Norvig P., Artificial Intelligence: A Modern Approach, Prentice Hall, 2009.
[2] Samarasinghe S., Neural Networks for Applied Sciences and Engineering: From Fundamentals Complex Pattern Recognition, Auerbach Publications – Taylor & Francis Group, 2006.
[3] Wang P. P., Ruan D., Kerre E. E., Fuzzy Logic: A Spectrum of Theoretical and Practical Issues, Springer, 2007.

SECONDARY LITERATURE:

[1] 1. Gurney K., An Introduction to Neural Networks, Taylor & Francis e-Library, 2005.
[2] Liebowitz J., The Handbook of Applied Expert Systems, CRC Press, 1999.
[3] Nguyen H. T., Prasad N. R., Walker C. L., Walker E. A., A First Course in Fuzzy and Neural Control, CHAPMAN & HALL/CRC, 2003.

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Zał. nr 5 do ZW 16/2020

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in English:	**Effective properties of composites – introduction to micromechanics**
Name of subject in Polish:	**Właściwości efektywne kompozytów –wprowadzenie do mikromodelowania**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level~~, uniform magister~~ studies*, full-time ~~/ part-time studies~~***
Kind of subject:	**~~obligatory~~ / optional / ~~university-wide~~***
Subject code:	**CEB006863**
Group of courses:	**~~YES~~ / 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	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**		**2**		
including number of ECTS points for practical (P) classes			**2,0**		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**0,6**		**0,6**		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
1. The student has knowledge regarding continuous mechanics.
2. The student has knowledge and skills in the field of strength of materials.

SUBJECT OBJECTIVES
C1. Learning the methodology of multiscale modelling of composite materials.
C2. Learning the methodology of composite effective properties determination.
C3. Gaining an in-depth knowledge of continuous media mechanics and strength of materials..
C4. Strengthening the ability to work on the task entrusted to and awareness of the need to seek new theoretical and practical solutions.

SUBJECT LEARNING OUTCOMES	
Relating to knowledge:	
PEU_W01	The student has an in-depth knowledge of multiscale modelling.
PEU_W02	The student knows theoretical method of composite materials analysis
Relating to skills:	
PEU_U01	The student can perform upscaling using the multiscale technique.
PEU_U02	The student can estimate and determine effective properties of composite materials.
Relating to social competences:	
PEU_K01	The student is able to work on the implementation of tasks independently or in a team (individual preparation of reports and cooperative problem solving in the classroom)
PEU_K02	The student is aware of the need to increase knowledge in the field of composite theory.

PROGRAMME CONTENT

Form of classes - lecture		Number of hours
Lec1	Introduction. Principles of micro-macro approach	2
Lec2	Continuous micromechanics. Method of volume and weight averaging.	2
Lec3	Analytical methods of effective properties estimation. Single inclusion problem in diffusion and heat conduction problems.	2
Lec4	Maxwell, Mori-Tanaka and self-consistent estimation schemes.	2
Lec5	Solution of single inclusion problem in elasticity.	2
Lec6	Analytical effective properties estimation schemes for linearly elastic composites.	2
Lec7	Estimation of composite effective properties form digital image of its microstructure	2
Lec8	Final test	1
	Total hours	**15**

Form of classes - class		Number of hours
Cl1		
...		
	Total hours	

Form of classes - laboratory		Number of hours
Lab1	Introductory information. Presentation of basic feature of the FlexPDE software. Solving of simple examples.	2
Lab2	Solving diffusion problem in simple structure of periodic composite. Estimation of effective properties.	2
Lab3	Individual work of students. Performing own numerical calculation.	2
Lab4	Individual work of students. Preparation of laboratory reports.	2
Lab5	Numerical determination of Mori-Tanaka and Self-consistent estimates of effective properties.	2
Lab6	Individual work of students. Performing own numerical calculation.	2
Lab7	Individual work of students. Preparation of laboratory reports.	2
Lab8	The final verification of laboratory reports.	1
	Total hours	**15**

Form of classes - project		Number of hours
Proj1		
…		
	Total hours	

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED	
N1.	Classic lecture. Multimedial presentation.
N2.	Laboratory: classic and multimedial presentation regarding laboratory, presentation of computer software, examples of problem solution with computer software.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1(laboratory)	PEU_U01, PEU_U02, PEU_K01	Laboratory report.
F2(laboratory)	PEU_U01, PEU_U02, PEU_K01	Laboratory report.
P (laboratory) = P = 0,4xF1+0,4xF2+0,2xParticipation (Laboratory)		
P (lecture)	PEU_W01, PEU_W02, PEU_K02	Final test.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Milton G. W.: The Theory of Composites, Cambridge Univ. Press, 2002.
[2] Torquato S.: Random heterogeneous materials, Springer, 2000.
[3] Hornung U.: Homogenization and porous media, Springer, 1997.
[4] Łydżba D.: Effective properties of composites, Wrocław, 2011.

SECONDARY LITERATURE:

[1] Cherkaev A.: Variational methods for structural optimization, Springer, 2000.

SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)

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Zał. nr 5 do ZW 16/2020

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in English:	**Timber structures**
Name of subject in Polish:	**Konstrukcje drewniane**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level~~, uniform magister~~ studies*, full-time ~~/ part-time studies~~***
Kind of subject:	**~~obligatory~~ / optional / ~~university-wide~~***
Subject code:	**CEB006663**
Group of courses:	**YES / ~~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	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	~~Examination~~ / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**			**2**	
including number of ECTS points for practical (P) classes				**2,0**	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**0,6**			**0,6**	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
1. The student is able to identify and make a statement loads on components and building structures.
2. The student has knowledge of general mechanics, strength of materials, and general principles of shaping structures.
3. The student knows the rules and the guidelines and codes for the design of buildings and their components.
4. The student has a theoretical basis. He has the ability to calculating and construction elements and basic building structures of concrete, steel, timber and masonry structures.

SUBJECT OBJECTIVES
C1. Knowledge of anatomy of the Wood and rulet of timber grading in terms of the proper use of the structures.
C2. Knowledge of the principles for calculating of solid and complex elements made with solid and glued laminatem timber

C3.	Knowledge of the rules for the implementation of connectors for mechanical fasteners, car pentry joints and glued joints. The ability to determine the capacity and vulnerability connectors.
C4.	Knowledge of the principles of protection of timber structures against biological corrosion and fire.

SUBJECT LEARNING OUTCOMES

Relating to knowledge:

PEU_W01	Student knows contemporary, modern building materials and he knows the basic elements of manufacturing them.
PEU_W02	Student has expanded knowledge of analysis, design and calculating of timber structures.

Relating to skills:

PEU_U01	Student can design a modern timber structures, also glulam structures.
PEU_U02	Student can make a graphical project documentation in selected computer program.

Relating to social competences:

PEU_K01	Student is aware of the need to improve professional and personal skills. student complements and extends knowledge of modern processes and technologies related to civil engineering through formal and informal training
PEU_K02	Student knows and understands the consequences of non-technical aspects and engineering activities. Sstudent understands the impact of these decisions on the environment and he understands the responsibility for decisions.

PROGRAMME CONTENT

	Form of classes - lecture	Number of hours
Lec1	Examples of historical and contemporary objects made of timber. General discussion of the problems of design of timber structures	2
Lec2	Anatomy of the wood, the effect of anisotropy on the physical and mechanical properties of the material. Natural characteristics of wood and defects.. Specifying the basic mechanical properties. Customary target sizes of structural timber. Principles of visual and machine grading of wood, the grading class and strength class. Engineered wood products - the types and properties.	3
Lec3	Design of timber structures according to the PN-EN 1995. General rules, ultimate limit states, serviceability limit state, the basis of structural analysis.	2
Lec4	Connectors in timber structures. Joints timber-timber, plate- timber, steel-timber by using nails, screws, bolts, dowels, split-rings connectors, toothed-plates connectors, nail plates.	2
Lec5	The bases for calculating the fire resistance according to EN 1995. The requirements for fire resistance. The effect of interaction in case of fire. Methods for calculating the load capacity.	2
Lec6	Glued laminated timber. The parameters of the material, production, technology, connection details. Examples of applications.	2
Lec7	Historic timber structures. Biological corrosion in timber structures. Wood insects and wood-destroying fungi. Mistakes made during the realisation and exploitation of timber structures.	2
	Total hours	**15**

	Form of classes - class	Number of hours
Cl1		
...		
	Total hours	

Form of classes - laboratory		Number of hours
Lab1		
…		
	Total hours	

Form of classes - project		Number of hours
Proj1	Explanation of the examination. Set a schedule of classes and transitional periods. General introduction to the design of timber structures. Deal subjects design classes.	2
Proj2	Explanation of the project no. 1 Beams made with the use of mechanical fasteners. Explanation of the assignment – part 1. Designing of solid timber elements.	2
Proj3	Explanation of the project no. 1 Spaced columns with packs or gussets and lattice columns Explanation of the assignment – part 1. Designing of glued laminated timber elements.	2
Proj4	Consultations of calculations.	2
Proj5	Explanation of the assignment – part 2. Designing of connections.	2
Proj6	Consultations of calculations.	2
Proj7	Pass classes on the basis of completed projects	3
	Total hours	**15**

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
N1. Lecture: multimedia presentations N2. Project: presentation of selected computer-aided design software

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1 (project)	PEU_U01, PEU_U02 PEU_K02	project
F2 (project)	PEU_W02, PEU_U01.	test
F3		
P = 0.4×F1 + 0.5×F2 + 0.1× presence (project)		
P (lecture)	PEU_W01, PEU_W02 PEU_K01	test

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Borgström E. (ed) (2016) Design of timber structures. Volume 1: Structural aspects of timber construction. Swedish Forest Industries Federation, Swedish Wood, Stockholm.

[2] Borgström E. (ed) (2016) Design of timber structures. Volume 2: Rules and formulas according to Eurocode 5. Swedish Forest Industries Federation, Swedish Wood, Stockholm.

[3] Borgström E. (ed) (2016) Design of timber structures. Volume 3: Examples. Swedish Forest Industries Federation, Swedish Wood, Stockholm.

[4] Buczkowski W. i in. (2010) Budownictwo ogólne. Tom 4 – Konstrukcje budynków. Arkady, Warszawa.

[5] Kotwica E., Nożyński W. (2015) Konstrukcje drewniane – przykłady obliczeń. Stowarzyszenie Producentów Płyt Drewnopochodnych w Polsce, Szczecin.

[6] Kotwica J. (2011) Konstrukcje drewniane w budownictwie tradycyjnym. Arkady, Warszawa.

[7] Krajewski A. Witomski P. (2016) Ochrona drewna – surowca i materiału. Wydawnictwo SGGW, Warszawa.

[8] Mielczarek Z. (2014) Budownictwo drewniane. Arkady, Warszawa.

[9] Neuhaus H. (2017) Ingenieurholzbau. Grundlagen - Bemessung - Nachweise - Beispiele. Springer Vieweg, Wiesbaden.

[10] Nożyński W. (2001) Przykłady obliczeń konstrukcji budowlanych z drewna. WSiP, Warszawa.

[11] Porteous J., Kermani A. (2013) Structural Timber design to Eurocode 5. Blackwell Publishing, Oxford.

[12] Stefańczyk B. i in. (2010) Budownictwo ogólne. Tom 1 - Materiały i wyroby budowlane. Arkady, Warszawa.

[13] Normy:
PN-EN 1995-1-1:2010. Eurokod 5: Projektowanie konstrukcji drewnianych. Część 1-1: Postanowienia ogólne. Reguły ogólne i reguły dotyczące budynków.
PN-EN 1995-1-2:2008. Eurokod 5: Projektowanie konstrukcji drewnianych. Część 1-2: Postanowienia ogólne. Projektowanie konstrukcji z uwagi na warunki pożarowe.
PN-EN 14080:2013-07. Konstrukcje drewniane. Drewno klejone warstwowo i drewno lite klejone warstwowo. Wymagania.
PN-EN 338:2016-06. Drewno konstrukcyjne. Klasy wytrzymałości.
PN-B-01042:1999. Rysunek konstrukcyjny budowlany. Konstrukcje drewniane.

SECONDARY LITERATURE:

[1] Aicher S., Reinhardt H.-W., Garrecht H., Eds (2014) Materials and Joints in Timber Structures. Recent Developments of Technology. Springer, Dordrecht, Heidelberg, New York, London.

[2] Becker K., Blass H. (2006) Ingenieurholzbau nach DIN 1052. Einführung mit Beispielen. Ernst&Sohn, Berlin.

[3] Erler K. (2004) Alte Holzbauwerke: beurteilen und sanieren. Huss-Medien Verlag Bauwesen, Berlin.

[4] Herzog T., Natterer J., Schweitzer R. i in. (2013) Holzbau Atlas. Birkhäuser Verlag, Edition Detail, München.

[5] Jasieńko J. (2003) Połączenia klejowe i inżynierskie w naprawie, konserwacji i wzmacnianiu zabytkowych konstrukcji drewnianych. DWE, Wrocław.

[6] Larsen H., Enjily V. (2009) Practical Design of Timber Structures to Eurocode 5. Thomas Telford, London

[7] Mönck W., Rug W. (2008) Holzbau. Bemessung und Konstruktion.. Verlag Bauwesen, Berlin

[8] Thelandersson S., Larsen H.J., Ed. (2003) Timber Engineering. Wiley&Sons, London.

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5.	doktoranci

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in English: monumental	**Conservation and strengthening of heritage structures**
Name of subject in Polish:	**Konserwacja i wzmacnianie konstrukcji zabytkowych**
Main field of study (if applicable):	*Civil Engineering*
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level~~, uniform magister~~ studies*, full-time ~~/ part-time studies~~***
Kind of subject:	**~~obligatory~~ / optional / ~~university-wide*~~**
Subject code:	**CEB006763**
Group of courses:	**YES / ~~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	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**			**2**	
including number of ECTS points for practical (P) classes				**2,0**	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**0,6**			**0,6**	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has knowledge of general mechanics, strength of materials, and general principles of shaping structures.
2. Possesses the knowledge concerning traditional building construction including historical objects.
3. The student knows the rules and the guidelines and codes for the design of buildings and their components.
4. The student has a theoretical basis. He has the ability to calculating and construction elements and basic building structures of concrete, steel, timber and masonry structures.
5. Possesses the knowledge concerning building materials.

SUBJECT OBJECTIVES

C1. The knowledge concerning technology of strengthening of the elements of the traditional building.
C2. Understanding of the specific calculations of structures after strengthening.

C3. The knowledge concerning characteristic of contemporary strengthening materials, including composites. C4. The knowledge concerning moisture protections of existing building. C5. The knowledge concerning doctrine in the conservation of historical constructions.

SUBJECT LEARNING OUTCOMES
Relating to knowledge: PEU_W01 Pssesses the knowledge concerning methods and technology of strengthening of existing buildings, especially historical objects. PEU_W02 Possesses the knowledge concerning building materials using in strengthening of historical structures. **Relating to skills:** PEU_U01 Knows how to choose the appropriate technology of strengthening taking into account the technical state of the building. PEU_U02 Knows how to prepare the documentation of conservation and strengthening works. **Relating to social competences:** PEU_K01 Student is aware of the need to improve professional and personal skills. PEU_K02 Student knows and understands the consequences of non-technical aspects and engineering activities, including the specification of intervention on the historical objects.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Presentation of the range of lecture. Specification and classification of building destruction causes.	2
Lec2	Methods of diagnosis of building destruction causes	2
Lec3	Repair and strengthening of foundations.	2
Lec4	Repair and strengthening of masonry structures.	2
Lec5	Repair and strengthening of timber and glulam structures	2
Lec6	Repair and strengthening of floor structures.	2
Lec7	Technology of drainage and protection of the existing objects against moisture. Specification of conservation and strengthening of historical building. Crediting colloquy.	3
	Total hours	**15**

Form of classes - class		**Number of hours**
Cl1		
...		
	Total hours	

Form of classes - laboratory		**Number of hours**
La1		
...		
	Total hours	

Form of classes - project		**Number of hours**
Proj1	Conditions of course crediting. Subject area scope. Plan of the course. Distribution of projects themes.	2
Proj2	The examples of strengthening of foundation and masonry structures strenghtening.	2
Proj3	The examples of strengthening of timber structures.	2
Proj4	The examples of strengthening of floor structures.	2

Proj5	The examples of strengthening of vault structures.	2
Proj6	Individual project consultations. The rules of the final documentation.	2
Proj7	Pass classes on the basis of completed projects.	3
	Total hours	**15**

Form of classes - seminar		**Number of hours**
Se1		
...		
	Total hours	

TEACHING TOOLS USED
N1. Lecture: multimedia presentations N2. Project: presentation of examples

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1 (project)	PEU_W01 PEU_U01 PEU_U02 PEU_K01	Analysis of the projects.
F2 (project)	PEU_W01 PEU_U01 PEU_U02 PEU_K01	Presence
P = 0,85 x F1+0,15 x F2 (project)		
P (lecture)	PEU_W02 PEU_U02 PEU_K02	Test

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Masłowski E., Spiżewska D.,: „Wzmacnianie konstrukcji budowlanych", Arkady, Warszawa 2000

[2] Mitzel A., Stachurski W., Suwalski J.,: „Awarie konstrukcji betonowych i murowych", Arkady Warszawa 1973

[3] Proceedings of the conference „Structural Analysis of Historical Constructions"

SECONDARY LITERATURE:

[1] Proceedings of the conference "PROHITECH"

[2] Proceedings of the conference "MURICO"

SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)
prof. dr hab. inż. Jerzy Jasieńko, Katedra Konstrukcji Budowlanych (K10W02D06), jerzy.jasienko@pwr.edu.pl
MEMEBERS OF THE LECTURERS TEAM
1. prof. dr hab. inż. Jerzy Jasieńko, jerzy.jasienko@pwr.edu.pl, 2. dr inż. Łukasz Bednarz lukasz.bednarz@pwr.edu.pl 3. mgr inż. Witold Misztal, witold.misztal@pwr.edu.pl

4.	dr inż. Krzysztof Raszczuk, krzysztof.raszczuk@pwr.edu.pl

Zał. nr 5 do ZW 16/2020

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in English:	**Roads, streets and airports**
Name of subject in Polish:	**Drogi, ulice i lotniska**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level~~, uniform magister~~ studies*, full-time ~~/ part-time studies~~***
Kind of subject:	**obligatory / ~~optional~~ / ~~university-wide~~***
Subject code:	**CEB004162**
Group of courses:	**~~YES~~ / 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 *	Examination / crediting with grade *	Examination~~/~~ crediting with grade *	~~Examination~~ / crediting with grade *	Examination~~/~~ crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**2**			**2**	
including number of ECTS points for practical (P) classes				**2,0**	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**1,3**			**1,3**	

*delete if applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
1. Student knows the basics of mathematical statistics
2. Student knows the basics of roads’ and streets’ design
3. Student knows the basics of roads’ traffic signals design

SUBJECT OBJECTIVES
C1. Familiarizing the students with methodology of traffic forecasting, crossings design (intersections and interchanges), advanced signaling, airports’ elements
C2. Education skills of: traffic forecasting, crossings design (intersections and interchanges), advanced signaling, airports’ elements
C3. Strengthening the ability to conduct research in the group

SUBJECT LEARNING OUTCOMES	
Relating to knowledge:	
PEU_W01	Student knows how make traffic forecasting
PEU_W02	Student knows the rules of design the road's crossings (intersections and interchanges) and advanced signaling
PEU_W03	Student knows the rules of design the airports' elements
Relating to skills:	
PEU_U01	Student can forecast the traffic
PEU_U02	Student can design the road's crossings (intersections and interchanges) and advanced signaling
PEU_U03	Student can design the airports' elements
Relating to social competences:	
PEU_K01	Student can cooperate with the group in traffic analyses

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Classification. Basic terms and definitions, review and summary of current regulations.	2
Lec2	Prognoses and modelling of traffic. Methods of measuring and identifying traffic.	2
Lec3	Road's design. Multicriteria analyses. Requirements for the location in the road lane.	2
Lec4	Intersections	2
Lec5	Interchanges	2
Lec6	Traffic engineering – fundamentals	2
Lec7	Control the traffic. Signal planning	2
Lec8	The capacity of roads and junctions	2
Lec9	Elements of airports. Field planning	2
Lec10	Number, length and directions of airport's runways	2
Lec11	Street design	2
Lec12	Planning of public transport	2
Lec13	Calmed traffic. Pedestrians and Cyclists	2
Lec14	Pavements, materials, keeping of roads. Catalog and individual methods. Drainage methods.	2
Lec15	Test	2
	Total hours	**30**

Form of classes - class		**Number of hours**
Cl1		
...		
	Total hours	

Form of classes - laboratory		**Number of hours**
Lab1		
...		
	Total hours	

Form of classes - project		**Number of hours**
Proj1	Introduction	2

Proj2	Prognoses of traffic	2
Proj3	Routing calls from city to airport. Requirements for the location in the road lane.	2
Proj4	Choice of variant	2
Proj5	Location plan for the selected variant	2
Proj6	Intersection location plan	2
Proj7	Design of flexible pavement	2
Proj8	Signaling project - preliminary calculations	2
Proj9	Signaling project - accommodation	2
Proj10	Evaluation of traffic conditions for the intersection	2
Proj11	Complement existing work	2
Proj12	Calculate the length and direction of the runways at the airport	2
Proj13	Airfield location plan at the airport	2
Proj14	Project summary. Rules for the preparation of project documentation. Discussing formal and legal requirements.	2
Proj15	Mark	2
	Total hours	**30**

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
N1. multimedia presentation N2. personal computer, interactive whiteboard (calculations, drawings, descriptions)

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1 (project)	PEU_U01	report
F2 (project)	PEU_U02 PEU_K01	report
F3 (project)	PEU_U03	report
P (project) = F1 * 0,3 + F2 * 0,4 + F3 * 0,3		
P (lecture)	PEU_W01 PEU_W02 PEU_W03	test

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Robinson R., Road Engineering for Development, Taylor & Francis, 2004
[2] Wells A.T., Young S., Airport Planning and Management, McGraw-Hill Professional, 2004
[3] Roess R.P., Prassas E.S., McShane W.R., Traffic Engineering (3rd Edition), Prentice Hall, 2004
[4] OBWIESZCZENIE MINISTRA INFRASTRUKTURY I BUDOWNICTWA z dnia 23 grudnia 2015 r. w sprawie ogłoszenia jednolitego tekstu rozporządzenia Ministra Transportu i

Gospodarki Morskiej w sprawie warunków technicznych, jakim powinny odpowiadać drogi publiczne i ich usytuowanie, poz. 124, wraz z późniejszymi zmianami
[5] ROZPORZĄDZENIE MINISTRA TRANSPORTU, BUDOWNICTWA I GOSPODARKI MORSKIEJ z dnia 25 kwietnia 2012 r. w sprawie szczegółowego zakresu i formy projektu budowlanego, wraz z późniejszymi zmianami
[6] Rozporządzenie Ministra Infrastruktury z dnia 16.01.2002 r. w sprawie przepisów techniczno-budowlanych dotyczących autostrad płatnych. Dz.U.02.12.116, wraz z późniejszymi zmianami

SECONDARY LITERATURE:

[1] Manual of Uniform Traffic Control Devices (MUTCD) 2003
[2] Highway Capacity Manual (HCM) 2000
[3] Chosen articles from „Journal of Transportation Engineering”

SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)

Katedra Dróg, Mostów, Kolei i Lotnisk
Maciej Kruszyna, maciej.kruszyna@pwr.edu.pl

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Zał. nr 5 do ZW 16/2020

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in English:	**Construction techniques and processes**
Name of subject in Polish:	**Technologia robót budowlanych**
Main field of study (if applicable):	**Civil Engineering**
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level~~, uniform magister~~ studies*, full-time ~~/ part-time studies~~***
Kind of subject:	**obligatory / ~~optional / university-wide~~***
Subject code:	**CEB008662**
Group of courses:	**~~YES~~ / 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	Examination ~~/ crediting with grade~~ *	Examination / crediting with grade *	Examination / crediting with grade *	~~Examination~~ / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**			**2**	
including number of ECTS points for practical (P) classes				**2,0**	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**0,7**			**1,2**	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
1. The student has knowledge on building materials and theory of structures.
2. The student is capable to design and elaborate structural analysis of basic building structures.
3. The student is familiar with organization of production processes in construction industry.

SUBJECT OBJECTIVES
C1. to transfer the knowledge on construction techniques and processes
C2. to train competencies for identification and resolving of considerable problems concerning execution of construction processes which are part of a complex construction project
C3. the prepare the alumni for self-dependent managerial positions focused on construction works and supervision of teams in construction industry
C4. to get the ability for self-study and continuous learning of new problems being permanently created in construction practice, corresponding to development of building materials and building technology.

SUBJECT LEARNING OUTCOMES	
Relating to knowledge:	
PEU_W01	the student knows modern building materials and products as long as scope of their application on a construction site.
PEU_W02	the student has advanced knowledge on performing the main type of construction works (earthworks, concrete works, assembly of structure, finishing works).
PEU_W03	the student has advanced knowledge on production processes which are used in housing and industrial objects construction.
PEU_W04	the student has advanced knowledge on some selected types of complex construction works, which are specially demanded on a present building market (as: glazing facades, etc.).
Relating to skills:	
PEU_U01	can plan and prepare the investment process for execution phase, including time planning of works, planning the machinery employment, programming of the site work brigades.
PEU_U02	can identify the technical risks which may the project be faced to during the execution of a given design specification and also can define the technical tools for reducing or eliminating the risk.
Relating to social competences:	
PEU_K01	the student is aware of need of permanent increasing of professional and personal competencies by means of formal and not formal training exercises on new construction technology problems.
PEU_K02	the student is aware about importance of technical and non-technical aspects and effects of engineering activities, like their influence on the environment and responsibility allocated to it.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Advanced problems on earthworks: protection of deep excavations, dewatering of excavations, construction of embankments, soil platforms for supporting foundations, quality control testing, machinery.	3
Lec2	Methods of construction the modern retaining structures in construction. Top-down method of construction the building structures with deep foundations.	2
Lec3	Advanced problems on concrete construction works: formworks, transportation placing the concrete-mix, compacting and curing technics, quality control.	2
Lec4	Industrial RC floor technology	2
Lec5	Advanced problems on structural assembly. Stability of structures during assembly phase.	2
Lec6	Technology of erection the structural glazed facades.	2
Lec7	General roles of fire protection in construction. Active and passive methods application in building construction.	2
	Total hours	**15**

Form of classes - class		**Number of hours**
Cl1		
...		
	Total hours	

Form of classes - laboratory	**Number of hours**

Lab1		
…		
	Total hours	

	Form of classes - project	**Number of hours**
Proj1	Presentation of the overall scope of the project exercise which consist of: planning of all construction works / site processes needed to construct the building object defined individually for each student. Detailed guidance for all required parts of the project report content.	4
Proj2	Concept plan. Breakdown of the whole construction project into stages.	4
Proj3	Machinery and work brigades selection and allocation.	2
Proj4	Evaluation of time and cost of the planned works.	4
Proj5	Gantt chart of works. Critical activities.	2
Proj6	Detailed specification of particular site works operations, including specification of eventual temporary structures and scaffoldings needed for execution of planned operations.	4
Proj7	Detailed engineering drawings presenting all stages of the construction works execution. Text part of specification of the works.	4
Proj8	Presentation of reports with group discussion	2
Proj9	Final presentation of reports with final evaluating (final grades)	2
	Total hours	**30**

	Form of classes - seminar	**Number of hours**
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
LECTURE N1. Regular lecture with multi-media presentation. Possible distant "on-line" performing of the course. Presentation of construction site case studies. Presentation of selected data taken from real projects completed before. N2. Contact hours for students. **PROJECT** N3. Presentation of the scope and step-by-step the whole process of elaborating the report. Possible distant "on-line" performing of the project course. N4. Presentation performed by students, demonstrating the intermediate project exercise results. N5. Contact hours for students.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
P (lecture)	PEU_W01, PEU_W02, PEU_W03 PEU_W04	EXAMINATION
P (project)	PEU_U01	Check of the final report, considering as a

	PEU_U02	supplement, the student's verbal individual presentation of some report issues. Possible distant "on-line" quiz.

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: 1. Allen E., Fundamentals of building construction: materials and methods. John Willey&Sons Ltd., 2019. 2. Chudley R., Greeno R., Advanced Construction Technology, PEARSON, 2012. 3. Concrete construction engineering handbook (ed. Nawy G.) CRC Press, Taylor & Francis Group, 2008. 4. Du Preez A., Civil and Construction Technology, PEARSON, 2009. 5. Emmitt S., Gorse Ch.A., Barry's advanced construction of buildings. Wiley-Blackwell Publ. 2014. 6. Fleming E., Advanced Construction Technology. John Willey&Sons Ltd., 2014. 7. Illingworth J. R., Construction methods and planning. Chapman & Hall, 2000. 8. Temporary Works – Principles of Design and Construction. Ed.: Grant M., Pallett P.F..ICE Publ. 2012

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MEMBERS OF THE EDUCATIONAL TEAM (NAME AND SURNAME, E-MAIL ADDRESS)
Teachers from Department of Building Engineering (K07W02D06)

Zał. nr 5 do ZW 16/2020

FACULTY OF FUNDAMENTAL PROBLEMS OF TECHNOLOGY
CHAIR OF EXPERIMENTAL PHYSICS
FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in English:	**Physics of modern materials**
Name of subject in Polish:	**Fizyka nowoczesnych materiałów**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level, ~~uniform magister~~ studies*, full-time / ~~part-time~~ studies***
Kind of subject:	**obligatory / optional / university-wide***
Subject code:	**FZP007163**
Group of courses:	**~~YES /~~ 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	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
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)	**0,5**				

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
Competences at mathematical analysis and general physics confirmed by the completed 1st degree studies of technical major.

SUBJECT OBJECTIVES

C1 To posses the fundamental knowledge on physical effects determining the properties of modern materials and the knowledge necessary for proper understanding of the physical process in the nano-scale, and the applications of the modern materials.
C2 To posses fundamental skills of theoretical predictions, design and modelling of the physical properties of modern materials and nanomaterials.
C3 To posses and consolidate the competences allowing for the independent judgment on the influence of the discussed material technologies to the economy, social life and

ecology.

SUBJECT LEARNING OUTCOMES	
Relating to knowledge:	
PEU_W01	Possesses fundamental knowledge in quantum physics and physics of advanced materials and nanomaterials necessary to understand the physical processes determining the new properties of these systems.
Relating to skills:	
PEU_U01	Can solve simple calculational tasks in quantum physics and physics of advanced materials and nanomaterials.
PEU_U02	Can apply practically and technically the acquired knowledge on the modern materials.
PEU_U03	Is able to extend the knowledge on the modern materials using the information available in nowadays scientific publications.
Relating to social competences:	
PEU_K01	Understands the social, informative and technical meaning of the learned processes regarding the modern materials
PEU_K02	Is aware of the wide interconnection between different branches of the modern material technologies and their relation to the currently conducted fundamental studies, and to respective physical sciences

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Modern materials – review, history, nano-scale, current challenges and application-related demands	1
Lec2	Elements of condensed matter theory and and its relationship to electrical conductivity and optical properties; basic concepts; band gap; electrical conductivity; doping; absorption and emission of light; band gap engineering; semiconductor multicomponent alloys; manufacturing techniques and types of nanomaterials.	2
Lec3	Techniques for testing the structural characteristics and morphology of materials at the nano scale (electron microscopy, scanning electron microscopy, X-ray diffraction, mass spectrometry, etc.).	2
Lec4	Artificially fabricated periodic structures; atomic crystals and photonics crystals; spatial limitation for light; photonic crystals and manufacturing techniques; sample applications of nanostructures and advanced materials (lasers, alternative sources of energy, optical sensors, fiber optic sensors, etc.)	2
Lec5	Heat transport phenomena in volume stable solids, multi-layered and quasi-cristals; heat transfer by radiation and convection; thermal radiation and its use; methods of measurement of thermal conductivity and temperature.	2
Lec6	Carbon nanomaterials – fabrication, physical properties and applications: a. carbon nanotubes; b. graphen – two-dimensional carbon crystal; c. two-dimensional crystals of other materials; d. other carbon-based structures.	2
Lec7	Nanometals and nanofibres:	2

	a. Fabrication technologies; b. Physical properties; c. Application.	
Lec8	Other modern materials: a. dielectrics of high and low dielectric permittivity; b. superconductors; c. composites; d. concretes modified. Crediting colloquy	2
	Total hours	**15**

TEACHING TOOLS USED
N1. Informative lecture and multimedia presentation. N2. Consultations. N3. Independent student work and self-preparation to the course completion.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
P (lecture)	PEU_W01, PEU_U01, PEU_U02, PEU_U03	Colloquy

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Fundamentals of physics part 5, D. Halliday, R. Rescnick, J. Walker

[2] Low-dimensional semiconductor structures: Fundamentals and device applications, K. Bernham, D. Vvedensky

SECONDARY LITERATURE:

[1] B. Bhushan (Ed.), Springer Handbook on Nanotechnology.

[2] M. F. Ashby, P. J. Ferreira, D. L. Schodek, Nanomaterials, Nanotechnologies and Design.

[3] R. Cotterill, The material world.

[4] D. Vollath, Nanoparticles – Nanocomposites – Nanomaterials. An Introduction for Beginners.

[5] Y. Gogotsi, V. Presser, Carbon Nanomaterials.

[6] Theodore L. Bergman, Frank P. Incropera, Adrienne S. Lavine, Fundamentals of Heat and Mass Transfer, John Wiley&Sons

[7] K. Saraswat, Lectures on Low-k dielectrics, Stanford University: http://web.stanford.edu/class/ee311/NOTES/Interconnect%20Lowk.pdf

[8] K. Kurzydłowski, M. Lewandowska, "Nanomateriały inżynierskie. Konstrukcyjne i funkcjonalne.

SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)

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Zał. nr 5 do ZW 16/2020

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in English:	**Mathematics – selected topics**
Name of subject in Polish:	**Matematyka – wybrane zagadnienia**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level~~, uniform magister~~ studies*, full-time ~~/ part-time studies~~***
Kind of subject:	**obligatory ~~/ optional / university-wide~~***
Subject code:	**CEB008061**
Group of courses:	**~~YES /~~ 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	Examination ~~/ crediting with grade~~ *	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**	**1**			
including number of ECTS points for practical (P) classes		**0,6**			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**0,6**	**0,6**			

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
1. The student has knowledge of mathematical analysis in the following areas: basic concepts of topology, differential and integral calculus of functions of one variable, differential and integral calculus of functions of several variables.
2. Knows the basic types of ordinary differential equations and elementary methods of integration. From the first order equations - equation with separated variables, homogeneous equations, linear equations, Bernoulli equation. With a range of higher order differential equations - the theory of linear equations. Knows the basic methods of solving systems of ordinary differential equations - elimination method and the method of Euler.
3. Knows the basic concepts, theorems and methods of linear algebra, algebra of polynomials and analytic geometry.

SUBJECT OBJECTIVES	
C1.	To familiarize students with the most common partial differential equations of second order used in mechanics.

C2.	The acquisition by students of elementary methods of solving partial differential equations.
C3.	Acquisition of intuition about the relationship of mathematically formulated boundary value problems with problems solved in structural mechanics.
C4.	To familiarize students with contemporary, based on the theorems of functional analysis, methods of formulation and solving boundary value problems.
C5.	To familiarize students with the mathematical foundations of the finite element method.

SUBJECT LEARNING OUTCOMES	
Relating to knowledge:	
PEU_W01	gain knowledge in the basics of the theory of partial differential equations
PEU_W02	recognize elements of contemporary mathematical analysis
PEU_W03	gaining knowledge about modern methods of solving boundary value problems
Relating to skills:	
PEU_U01	properly distinguish between types of equations and boundary value problems
PEU_U02	has the ability to bring to a canonical form of linear equations of order 2, can use a Fourier method, correctly distinguishes between types of equations and boundary value problems
PEU_U03	gaining basic skills in differentiation distribution
PEU_U04	gaining basic skills in the formulation and numerical solution of complex boundary problems
Relating to social competences:	
PEU_K01	can work to resolve the tasks independently and in a team (participation in discussions on auditorium exercises in analyzing problems reported by other students)
PEU_K02	learn to think logically, clearly formulate issues and to resolve them within a specific theory and the specific assumptions

PROGRAMME CONTENT		
	Form of classes - lecture	**Number of hours**
Lec1	Motto: "We will not talk unnecessary things" (Stanislaw Ignacy Witkiewicz Shoemakers) Basic concepts: guide to the basic concepts of topological conventions signs, basic definitions, classification - linear equations, half-linear quasi-linear examples.	1
Lec2	Linear partial differential equations of second order on the plane Classification, characteristic equation, performance, bringing hyperbolic, parabolic and elliptical to a canonical form.	2
Lec3	The d'Alembert and Fourier solution of the equation string by d'Alembert method, solution of the equation strings and heat flow equation Fourier method (separation of variables).	2
Lec4	Laplace equation physics issues leading to the Laplace equation, harmonic functions, removing the fundamental solution, maximum principle, uniqueness of solutions.	2
Lec5	Normed spaces linear spaces, normed metric spaces, functional spaces, Banach space,	2

	unitary space, Hilbert space, the Pythagorean theorem, theorem on orthogonal projection.	
Lec6	<u>Sobolev spaces</u> compactly supported functions, linear functionals, distribution, distribution derivatives, Sobolev space, spatial properties of H^1.	2
Lec7	<u>Generalized solutions of elliptic equations II row</u> Weak formulation of boundary value problems, Lax-Milgram theorem, application of Lax-Milgram theorem.	2
Lec8	<u>Methods of variational equations</u> The method of least squares orthogonal projection method, Galerkin method, Ritz method.	2
	Total hours	**15**

Form of classes - class		Number of hours
Cl1	Solving problems of the simplest methods of integration of partial differential equations	1
Cl2	Imports of second order linear equations to canonical form	2
Cl3	Imports of second order linear equations to canonical form Solving boundary value problems by the method of separation of variables	2
Cl4	Solving the boundary problems containing the Laplace equation	2
Cl5	Solving the problems relating to properties of normed spaces	2
Cl6	Solving the problems relating to properties of Sobolev space	2
Cl7	Solving problems concerning the application of Lax-Milgram theorem (proof uniqueness of solutions). Solving problems using Galerkin and Ritz methods.	2
Cl8	Solving problems using Galerkin and Ritz methods. Colloquium (45 minutes)	2
	Total hours	**15**

Form of classes - laboratory		Number of hours
Lab1		
…		
	Total hours	

Form of classes - project		Number of hours
Proj1		
…		
	Total hours	

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
N1. Lecture: traditional form - definitions, theorems and proofs in all written on the blackboard.

N2. Lectures and exercises: longer examples presented theorems and methods. N3. Classes: Discussion within a group of students of different abilities to solve problems. N4. Prepared lists and tasks on the website [2] for independent solution and opportunities for presentation and discussion exercises. The complete solution will be served at exercises, and some posted on the [2].

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1 (classes)	PEU_W01 PEU_W02 PEU_W03 PEU_U01 PEU_U02 PEU_U03 PEU_U04 PEU_K01 PEU_K02	assess the activities of students in solving problems formulated at the list of tasks
P1 (classes)	PEU_W01 PEU_W02 PEU_W03 PEU_U01 PEU_U02 PEU_U03 PEU_U04 PEU_K02	final assessment on the basis of the final test (45 minutes), including assessments for the activity
P2 (lecture)	PEU_W01 PEU_W02 PEU_W03 PEU_U01 PEU_U02 PEU_U03 PEU_U04 PEU_K02	Final Exam - tasks to solve

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] 1. R.V. Churchill, J.W.Brown, Fourier Series and Boundary Value Problems, McGraw-Hill Book Company, New York 1978.

[2] http://www.ib.pwr.wroc.pl/wpula

SECONDARY LITERATURE:

[1] W. Puła, Mathematics. A Short introduction to Ordinary and Partial Differentia Equqtions, Politechnika Wrocławska, 2011.

SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)

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FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in English:	**BIM in Civil Engineering**
Name of subject in Polish:	**BIM w konstrukcjach budowlanych**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level~~, uniform magister~~ studies*, full-time ~~/ part-time studies~~***
Kind of subject:	**obligatory / ~~optional~~ / ~~university-wide~~***
Subject code:	**CEB007961**
Group of courses:	**~~YES~~ / NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			**60**		
Number of hours of total student workload (CNPS)			**120**		
Form of crediting	Examination / crediting with grade *	Examination / crediting with grade *	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points			**4**		
including number of ECTS points for practical (P) classes			**4,0**		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)			**3,3**		

*delete if applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
1. Knowledge of design principles, in particular in hydro- and geotechnics. 2. Knowledge of materials and technologies used in construction, in particular in hydro- and geotechnics. 3. Knowledge of assessment methods for the maintenance of earth hydrotechnical structures. 4. Knowledge of design supporting software as well as basics of CAD tools.

SUBJECT OBJECTIVES
C1. Acquiring knowledge of basic computer methods in hydro and geotechnics and the use of BIM. C2. Gaining knowledge in the field of three-dimensional soil reconstruction. C3. Acquiring knowledge in design and modeling of geometry in 2D and 3D. C4. Acquiring knowledge in the field of parametric modeling. C5. Ability to work in team.

SUBJECT LEARNING OUTCOMES

Knowledge:
PEU_W01 One knows and is able to use computer software in hydro and geotechnical design.
PEU_W02 One knows the theoretical basis for creating a 3D reconstruction of a substrate.
PEU_W03 One knows the methods of design and modeling of hydrotechnical and special earth structures.
Skills:
PEU_U01 One is able to use computer software to support design process.
PEU_U02 One is able to model, design and characterize selected constructions.
Social skills:
PEU_K01 One is able to work individually and in a team on a project.

PROGRAMME CONTENT

Form of classes - lecture		Number of hours
Lec1		
…		
	Total hours	

Form of classes - class		Number of hours
Cl1		
...		
	Total hours	

Form of classes - laboratory		Number of hours
Lab1	Introduction (course credit rules, office hours, literature). Discussion of BIM principles in historical context, in particular in hydrotechnics, geotechnics and special construction. Discussion of the design methods available for the engineers.	4
Lab2	History of CAD to BIM transition. Benefits of using BIM. Communication and data exchange in the investment process.	4
Lab3	Overview of available computer software. Problems of multidimensionality in design, normalization and standardization problems.	4
Lab4	Tools and functions supporting design. Introduction to software in hydro- and geotechnics. Basics of work in a selected program (menu overview, presentation of examples). Configuration.	4
Lab5	Introduction to the geographical information system. Basics of the selected GIS software.	4
Lab6	Introduction of theoretical foundations for modeling a substrate (reconstruction based on point information -wells). Theoretical basics of the kriging technique. Rules or selection of correlation radius and semi-variogram functions.	4
Lab7	Creating probable layer systems in the subsoil - 2D problem.	4
Lab8	Creating probable layer systems in the subsoil - 3D problem.	4
Lab9	Modeling of 3D geotechnical structures.	4
Lab10	Modeling of 3D geotechnical structures.	4
Lab11	Performing numerical calculations on the prepared model. Analysis of results. Attempt to optimize the original solution.	4
Lab12	Performing numerical calculations on the prepared model. Analysis of results. Attempt to optimize the original solution.	4
Lab13	Preparation of electronic project documentation. BIM elements in the scope of investment life cycle. Investment cost optimization analysis.	4
Lab14	Visualization and animation of the results.	4

Lab15	Summary and evaluation of the students.	4
	Total hours	**60**

Form of classes - project		Number of hours
Proj1		
…		
	Total hours	

Form of classes - seminar		**Number of hours**
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
N1. multimedia presentation N2. personal computer, interactive whiteboard (calculations, drawings, descriptions)

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation F – forming (during semester), P –concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F (laboratory)	PEU_W01, PEU_W02, PEU_W03, PEU_U01, PEU_U02, PEU_K01.	report
L (laboratory) = 0,9xF+0,1x PRESENCE		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Kasznia, D., Magiera, J., & Wierzowiecki, P. (2018). BIM w praktyce: standardy, wdrożenie, case study. Wydawnictwo Naukowe PWN.

[2] Gwóźdź, R., Gwóźdź-Lasoń, M., Lach, K., & Urbański, A. (2016). „Podstawy projektowania geotechnicznego: wprowadzenie do nowych technologii w geotechnice praca zbiorowa". „The Geotechnical Design: an introduction to new technologies in geotechnics: collective work".

[3] Zimmermann, T., Truty, A., Urbański, A., & Podleś, K. (2008). Z-Soil user manual. Zace Services, Switzerland.

[4] GEO5 User's manual. Fine Ltd. Prague 2016.

[5] Team, Q. D. (2016). QGIS geographic information system. Open source geospatial foundation project.

SECONDARY LITERATURE:

[6] Barvashov, V. A. Information Systems in Geotechnics-BIM Geotechnics Boldyrev GG, Doctor of Technical Sciences, Director for Research and Innovation, NPP Geotek LLC, Penza, Russia, g-boldyrev@ geoteck.ru Barvashov VA Ph. D., Leading Researcher, NIIOSP named after NM Gersevanova, Moscow.

[7] Graser, A. (2013). Learning QGIS 2.0. Packt Publishing Ltd.

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Zał. nr 5 do ZW 16/2020

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in English:	**Metal structures - objects**
Name of subject in Polish:	**Konstrukcje metalowe - obiekty**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level, ~~uniform magister~~ studies*, full-time / ~~part-time~~ studies***
Kind of subject:	**obligatory / ~~optional / university-wide*~~**
Subject code:	**CEB007661**
Group of courses:	**~~YES~~ / 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~~ *	Examination / crediting with grade *	Examination / crediting with grade *	~~Examination~~ / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**2**			**2**	
including number of ECTS points for practical (P) classes				**2,0**	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**1,1**			**1,1**	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Is able to determine: the cases of actions, calculation of their intensity, making of their right combination for an individual building systems.
2. Has a knowledge of the mechanics of buildings, strength of materials, shaping of elements and connections used in metal structures.
3. Is able to design and calculate connections according to PN-EN 1993-1-1, PN-EN 1993-1-5, PN-EN 1993-1-8.
4. Has a knowledge of the modelling of structures in MES and the ability to use computer software.

SUBJECT OBJECTIVES

C1. To acquaint students with primary structure and the skeleton of industrial buildings, long span coverings, typical structures of tanks, siloses for bulk materials, chimneys, towers masts and multi-storey buildings, and English appropriate terminology.

C2. To acquaint students with the rules of setting the static schemes for mentioned above systems regarding their specify of actions, determining the internal forces by simplified and accurate methods of static calculations.

C3.	Training of dimensioning of steel cross-sections and members.
C4.	Developing of skills of the rational shaping of different steel structural members, division on field components, calculation of shop and site connections.
C5.	Developing of skills of description of building design and executive design, descriptive part, calculation and graphical part for different steel structures based on the example of the space regular structure.
C6.	Training of the cooperation and integration of Polish and foreign students in exchange of experience, knowledge and team work.
C7.	To deepen and strengthen the knowledge of the English terminology appropriate for different types of steel structures.

SUBJECT LEARNING OUTCOMES	
Relating to knowledge:	
PEU_W01	Has an enlarged knowledge of: advanced topics of the strength of materials, analysis and shaping of complex steel structures, calculation of adequacy of connections of different types.
PEU_W02	Knows and understands the rules of analysis of static schemes and stability for complex strut and skin structures by simplified methods (substitutional simple schemes) and accurate methods (computer programs).
Relating to skills:	
PEU_U01	Is able to shape the overall geometry and the cross-sections for different types of steel structures and to set their assembling components based on the static and strength analysis.
PEU_U02	Has the ability to model and design the complex structural elements in the building and executive design.
PEU_U03	Develop the skills of designing steel structures according to Eurocode3 in English.
Relating to social competences:	
PEU_K01	Shows a willingness to improve professional and personal skills, extends the knowledge of technical English language.
PEU_K02	Appreciates the importance of mutual support and teamwork skills, communicates effectively in technical English vocabulary related to civil engineering.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Primary structure of industrial buildings	2
Lec2	Skeleton members and cladding	2
Lec3	Bracings of industrial buildings - types and geometry	2
Lec4	Dead and imposed loads	2
Lec5	Dimensioning of main members of industrial buildings	2
Lec6	Dimensioning of main members of industrial buildings (continuation)	2
Lec7	Anchorage of main and secondary columns in the foundations	2
Lec8	Construction of long - span coverings – flat and barrel structures	2
Lec9	Construction of long - span coverings – domes	2
Lec10	Construction of long - span coverings – cable structures	2
Lec11	Tangs for liquids and silos for bulk materials	2
Lec12	Chimneys – actions, construction, design	2
Lec13	Towers – actions, construction, design	2
Lec14	Masts – actions, construction, design	2
Lec15	Skeletons of multi – storey buildings	2
	Total hours	**30**

Form of classes - class		Number of hours
Cl1		
...		
	Total hours	

Form of classes - laboratory		Number of hours
Lab1		
…		
	Total hours	

Form of classes - project		Number of hours
Proj1	Edition of tasks related to the space covering – discussion of rules and conditions of gaining the credit- general characteristics of steel space structures	2
Proj2	Discussion of static schemes of space structures	2
Proj3	Discussion and presentation of geometry of the space structures	2
Proj4	Dead and imposed loads acting on roof coverings	2
Proj5	Simplified calculations of space structures based on the beam and plate analogy	2
Proj6	Simplified calculations of space structures based on the beam and plate analogy (continuation)	2
Proj7	Accurate static computation based on computer programs (creation of models)	2
Proj8	Dimensioning of strut elements under axial or/and axial and bending – creation of zones	2
Proj9	Types of joints used in space structures – patent and other constructions	2
Proj10	Options of joints related to the overall geometry and assembly concept	2
Proj11	Presentation and analyses of existing student works	2
Proj12	Discussion of general rules related to the executive design for steel structures	2
Proj13	Discussion of general rules of execution of assembling and shop drawings for steel structures	2
Proj14	Discussion of current issues related with the points (proj6 - proj13)	2
Proj15	Successive testing of students' skills and the level of progress in the execution of the given task (proj6 – proj13)	2
	Total hours	**30**

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
N1. Lecture: informative lecture, problem lectures, multimedia presentation N2. Project: traditional and multimedia presentation, consultations

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation (F – forming (during semester), P –concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1 (project)	PEU_U01	Evaluation of calculation and graphical parts of the design
	PEU_U02	
	PEU_U03	
F2 (project)	PEU_W02	Activity during problem discussions
P=0,6xF1+0,4xF2 (project)		
P (lecture)	PEU_W01	Examination
	PEU_W02	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Gaylord E.H.,Gaylord Ch.N., Stallmeyr J.E., Design of steel structures, Mc Graw-Hill, Inc., 1992
[2] Newman A., Metal building systems, design and specifications, Mc Graw-Hill., New York 1997
[3] Łubiński M., Żółtowski W., Konstrukcje metalowe, część 2, Arkady, Warszawa 2004
[4] Biegus A., Stalowe budynki halowe, Arkady, Warszawa 2003
[5] Rykaluk K., Konstrukcje stalowe. Kominy, wieże, maszty, Oficyna Wydawnicza PWr, Wrocław 2005
[6] Trahair N.S. and others, The behaviour and design of steel structures to EC3, Fourth edition, Taylor & Francis Group, London and New York 2008
[7] Makowski Z.S., Analysis, Design and Construction of braced Barrel Vaults, Elsevier Applied Science Publishers, London 1985

SECONDARY LITERATURE:

[1] Bródka J. I inni., Przekrycia strukturalne, Arkady, Warszawa 1985
[2] Nooshin H., Third International Conference on Space Structures, London 1984

SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)

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FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in English:	**Selected topics in structural mechanics**
Name of subject in Polish:	**Statyka budowli – wybrane zagadnienia**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level, ~~uniform magister~~ studies*, full-time / ~~part-time~~ studies***
Kind of subject:	**obligatory ~~/ optional / university-wide*~~**
Subject code:	**CEB008461**
Group of courses:	**~~YES~~ / NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**30**	**15**	**15**		
Number of hours of total student workload (CNPS)	**60**	**30**	**30**		
Form of crediting	Examination ~~/ crediting with grade~~ *	~~Examination~~ / crediting with grade *	~~Examination /~~ crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**2**	**1**	**1**		
including number of ECTS points for practical (P) classes		**0,7**	**0,7**		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**1,2**	**0,6**	**0,6**		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has knowledge and skills in the determination of internal forces (internal) and the rules for their labeling for plane rod systems statically determinate.
2. The student knows solving methods of statically determinate rod systems and can effectively determine the reactions and internal forces (internal) in the rod system.
3. The student has a theoretical basis and the ability to apply the principle of virtual work to determine static variables in statically determinate systems such as beams, frames and trusses.

SUBJECT OBJECTIVES

C1. Learning the methodology of determining displacements in statically determinate systems and gaining the skills of displacement determination in plane rod systems from mechanical and non-mechanical loads.

C2. Learning the methodology of solving of statically indeterminate systems by the force method and develop skills of determining internal forces (internal) in flat rod systems from mechanical and non-mechanical loads.

C3.	Learning the methodology of solving of geometrically indeterminate systems by the displacement method and gaining skills of determining internal forces (internal) in plane rod systems subjected to non-mechanical loads.
C4.	Learning the methods of determining the influence lines and gaining skills of their determination in the case of plane rod systems; statically determinate and indeterminate.
C5.	Gaining skills of solving simple rod structural systems using analytical methods as well as modeling, solving and verifying the results using computer computational software.
C6.	Gaining awareness of the continuing education need to improve own competences in the modern computer programs for structural analysis issues.

SUBJECT LEARNING OUTCOMES	
Relating to knowledge:	
PEU_W01	The student has an in-depth knowledge of principles of structural mechanics with respect to statically determinate and indeterminate bar structures.
PEU_W02	The student knows solving methods of internal forces and displacements of statically determinate and indeterminate plane bar structures subjected to mechanical and not mechanical loads.
PEU_W03	The student knows methods of influence line determination for statically determinate and indeterminate bar systems
Relating to skills:	
PEU_U01	The student can perform static analysis of plane bar structures statically determinate and indeterminate which can be subjected to mechanical or non-mechanical loads.
PEU_U02	The student can determine influence lines of bar structures statically determinate and indeterminate.
PEU_U03	The student can properly define computational model of plane bar structures and their components, and carry out analysis of internal forces and displacements determination.
Relating to social competences:	
PEU_K01	The student is able to work on the implementation of tasks independently or in a team (individual preparation of reports and cooperative problem solving in the classroom)
PEU_K02	The student is aware of the need to increase knowledge in the field of contemporary techniques and programs for calculation of building structures.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Introduction. Discussion of the topic subject. Principles of virtual work for rod systems. Reciprocity theorems. Elastic constrains.	2
Lec2	Determination of displacement field in plane rod structures subjected to mechanical load. Methods for effective numerical integration of internal forces charts. Examples.	2
Lec3	Impact of support displacements and temperature variation on the movement of statically determinate systems. Examples.	2
Lec4	The force method for plane rod systems. Theoretical basis. Derivation of the canonical equations.	2
Lec5	Determination of the displacement field of the rod system using the method of forces. Examples.	2
Lec6	The force method. Determination of internal forces induced by	2

	mechanical loading. Verification of the correctness of the solution. Examples.	
Lec7	Determination of the displacement field induced by support's displacement using the force method. Examples.	2
Lec8	Determination of the displacement field induced by temperature variation using the force method. Examples.	2
Lec9	Displacement method. Theoretical foundations.	2
Lec10	Displacement method. Transformation's rules according to the theory of first-order. Formulation of the canonical equations of displacement method. Verification of the correctness of the solution.	2
Lec11	Displacement method. Determination of internal forces induced by mechanical loads. Examples.	2
Lec12	Displacement method. Determination of internal forces induced by non-mechanical loads. Examples.	2
Lec13	Method of influence line determination in statically determinate and indeterminate rod structures. Theoretical foundations.	2
Lec14	Influence line determination using static approach. Examples.	2
Lec15	Influence line determination using kinematic approach. Examples.	2
	Total hours	**30**

Form of classes - class		**Number of hours**
Cl1	Preliminary information. Introduction into force method. Solving a simple example presenting methodology of governing system of equations forming according to the force method.	2
Cl2	The force method: determination of internal forces induced by mechanical loads. Computational examples.	2
Cl3	The force method: determination of internal forces induced by non-mechanical loads. Computational examples.	2
Cl4	Displacement method – introduction. Computational example presenting the main idea of the displacement method.	2
Cl5	Displacement method: determination of internal forces induced by mechanical loads. Computational examples.	2
Cl6	Displacement method: determination of internal forces induced by non-mechanical loads. Computational examples.	2
Cl7	Influence lines: kinematic and static approach. Computational examples.	2
Cl8	Influence lines. Further computational examples.	1
	Total hours	**15**

Form of classes - laboratory		**Number of hours**
Lab1	Introductory information. The theme of the 1st laboratory exercise. The calculation example with presentation of the computer software. Performing own calculations with computer computational software and results discussion.	2
Lab2	Further calculations with the computational program based on the force method. Calculation example.	2
Lab3	The 1st laboratory exercise. The case of support displacement and temperaturę variation. Performing own numerical calculation.	2
Lab4	Test verifying the student knowledge regarding the 1st laboratory exercise. The theme of 2nd laboratory exercise. Displacement method. Calculation example. Performing own numerical calculation.	2

Lab5	Numerical calculation of rod structure using the computer software based on the displacement method. The mechanical loading case.	2
Lab6	Numerical calculation of rod structure using the computer software based on the displacement method. The case of support displacement and temperaturę variation.	2
Lab7	The computer software of influence line determination. The final test.	2
Lab8	The final verification of laboratory reports.	1
	Total hours	**15**

Form of classes - project		**Number of hours**
Proj1		
…		
	Total hours	

Form of classes - seminar		**Number of hours**
Sem1		
…		
	Total hours	

TEACHING TOOLS USED	
N1.	Classic lecture. Multimedial presentation.
N2.	Laboratory: classic and multimedial presentation regarding laboratory, presentation of computer software, examples of problem solution with computer software..
N3.	Consulting. Teaching materials prepared by the teacher.
N4.	Class: classic and multimedial presentation, solving the examples.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1(laboratory)	PEU_U01, PEU_U02, PEU_U03, PEU_K01	Test verifying knowledge regarding 1st laboratory exercise. Active participation during class.
F2(laboratory)	PEU_U01, PEU_U02, PEU_U03, PEU_K01	Test verifying knowledge regarding 2nd laboratory exercise. Active participation during class.
P (laboratory) = F1 x 1/2 + F2 x 1/2		
F1(class)	PEU_U01, PEU_U02, PEU_U03, PEU_K01	Test verifying student knowledge of force method. Active participation during class.
F2(class)	PEU_U01, PEU_U02, PEU_U03, PEU_K01	Test verifying student knowledge of displacement method. Active participation during class.
P (class) = F1 x 1/2 + F2 x 1/2		
P (lecture)	PEU_W01,	Final written exam – questions on theory and

	PEU_W02, PEU_W03, PEU_K02	practical problems.

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: [1] 1. Przemieniecki S., Theory of Structural Analysis, MacGraw-Hill, New York, 1968. [2] Meller M., English through civil engineering, Politechnika Koszalińska – Wyd. Uczelniane, 1998. [3] Mase G.E., Theory and problems of continuum mechanics, MacGraw-Hill, New York, 1970. [4] Pilkey W.D., Wunderlich W., Mechanics of structures. Variational and computational methods, CRC Press, Boca Raton, 1994. **SECONDARY LITERATURE:** [1] 1. Ross C.T.F., Finite element methods in structural mechanics, 1985. [2] Reddy J.N., Applied functional analysis and variational methods in engineering, MacGraw-Hill, New York, 1986.

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Zał. nr 5 do ZW 16/2020

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in Polish:	**Konstrukcje betonowe – obiekty**
Name of subject in English:	**Concrete Structures - objects**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level, ~~uniform magister~~ studies*, full-time ~~/ part-time~~ studies***
Kind of subject:	**obligatory / ~~optional / university-wide~~***
Subject code:	**CEB007561**
Group of courses:	**~~YES~~ / 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~~ *	Examination / crediting with grade *	Examination / crediting with grade *	~~Examination~~ / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**2**			**2**	
including number of ECTS points for practical (P) classes				**2,0**	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**1,1**			**1,1**	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student possesses the knowledge of general mechanics, mechanics (strength) of materials and the rules of general designing of building constructions.
2. Student is able to define correctly the construction and their elements calculation models, that are used for analytical and computer analysis of complex constructions.
3. He knows the principles of forming, dimensioning and constructing complex reinforced concrete structur of the building and engineering objects.
4. He is able to use selected computer software that enables to design selected complex reinforced concrete constructions.

SUBJECT OBJECTIVES

C1. Familiarizing students with the rules of designing complex reinforced concrete constructions as a rational joint of beams, columns, shells, plates and beam-walls.

C2. Forming the ability of independent modelling and analyzing complex, diversified reinforced concrete structures using analytical and computer calculations.

C3. Familiarizing students with the principles of forming, calculating and constructing main reinforced concrete elements forming up: the supporting construction of volume general building

and engineering building objects such as industrial buildings and multi-storey framework buildings as well as roofs, walls, bottoms and foundation of liquids tanks, silos and reinforced concrete tower buildings. C4. Reaffirming the ability of an effective cooperation in a project team including the multi-field character of project process.

SUBJECT LEARNING OUTCOMES
Relating to knowledge: PEU_W01 Student knows and comprehends the rules of idealizing, numerical modelling and analyzing the complex reinforced concrete structures. PEU_W02 Student possesses profoundly wide knowledge of analysis, dimensioning and constructing the complex reinforced concrete structures. PEU_W03 Student is familiar with the principles of static work under the influence of diversified loads over the beam and column reinforced concrete constructions, slab reinforced concrete constructions, beam-walls reinforced concrete constructions and shell reinforced concrete constructions. **Relating to skills:** PEU_U01 Student is able to classify and analyze analytically or numerically the complex reinforced concrete structures in relation to varied forces, and consequently, to critically assess the obtained results. PEU_U02 Student is able to design the complex reinforced concrete constructions and prepare a necessary project documentation. **Relating to social competences:** PEU_K01 Student is aware of importance of non-technical aspects in an engineer's work as well as of indispensability of continuous learning. PEU_K02 Student effectively cooperates with a project team and respects the safety regulations to protect himself and the project team members during work.

PROGRAMME CONTENTS		
Form of classes - lecture		**Number of hours**
Lec1	Forming principles and outline of the analysis of a column-and-girder-frame construction of the industrial buildings with overhead traveling cranes.	2
Lec2	Forming, analyzing and constructing reinforced and prestressed single- and multi-span two-way reinforced concrete slabs.	2
Lec3	Forming, analyzing and constructing solid web girders and prestressed roof trusses.	2
Lec4	Designing overhead crane girders and single- or double-tee columns in industrial reinforced concrete buildings.	2
Lec5	Forming and designing the construction of the multi-storey framework reinforced concrete buildings.	2
Lec6	Designing column-and-girder constructions. Reinforcing the slab floor against punching.	2
Lec7	Forming, analyzing and constructing reinforced concrete beam- walls; designing folded plate covers.	2
Lec8	Outline of the principles of forming and usage of the reinforced concrete shells as the thin-walled constructions, used in volume general building and industrial building objects.	2
Lec9	General rules of forming the thin-walled covers. Designing monolithic and prefabricated reinforced concrete domes.	2
Lec10	Designing underground, on-the-ground and tower reinforced concrete tanks for liquids.	2
Lec11	Designing the underground and on-the-ground box-shaped (rectangular shaped) tanks for liquids used in municipal and industrial building	2

Lec12	An outline of forming and designing cooling towers, reinforced concrete chimneys and other reinforced concrete tower objects. Technological background of thin-walled reinforced concrete constructions' erection.	2
Lec13	Forming slender and corpulent silo bins as well as silo batteries in corn elevators. Principles of setting loads in silos and the outline of studies on the influence of loose materials on the silo's construction elements.	2
Lec14	Designing silos and bunkers with the diversified heights, detached and blocked ones.	2
Lec15	Technological aspects of designing thin-walled constructions made of concrete; the rules of performing proofed expansion joints and working joints.	2
	Total hours	**30**

Form of classes - class		Number of hours
Cl1		
...		
	Total hours	

Form of classes - laboratory		Number of hours
Lab1		
…		
	Total hours	

Form of classes - project		Number of hours
Proj1	Handing out the project topics in a field of complex reinforced concrete constructions in the form of domes and cylindrical and rectangular shaped tanks for liquids.	2
Proj2	Conditions for preparation of two initial geometrical construction variants; talking over a choice of construction materials and technological background of discussed construction variants.	2
Proj3	Approval of variant choice for a project use; talking over the rules of creating calculation models used for static analysis performed with the help of the following methods: analytical, Finite Element Method (FEM) or simplified methods	2
Proj4	Presenting the rules of compiling loads in a construction and defining the extreme inner forces. Describing the characteristics of defining the loads in tanks for liquids.	2
Proj5	Talking over static calculations with the use of analytical methods and FEM for the selected construction variant. Checking up the results applying the simplified methods.	2
Proj6	Selection of the parts of the analysed constructions for further analysis and dimensioning. Discussion over the rules of preparing building and working drawings of thin-walled reinforced concrete structures.	2
Proj7	Taking over the results of statical analysis and characteristics of thin-walled elements' dimensioning, taking into consideration ultimate and serviceability limit states	2
Proj8	Discussion over the typical mistakes and faults in analysis and preparation of the construction drawings.	2
Proj9	Discussion over the dimensioning results of the selected parts of a construction.	2

Proj10	Initial evaluation of the submitted drafts of reinforcement members.	2
Proj11	Discussion over the characteristics of outlining the thin-walled cross-sections and forming trusses and connection zones of construction component elements.	2
Proj12	Evaluation of cross-section geometry, insert placement and submitted assembly and working drawings	2
Proj13	Talking over the rules of applying technical characteristics and guidelines on gathering the final project documentation.	2
Proj14	Final evaluation of submitted working drawings.	2
Proj15	Collection of the projects. Crediting with notes. Final summing-up.	2
	Total hours	**30**

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
N1. Lecture – Informative lecture, problem-solving lecture, multimedia presentations. N2. Project – Discussing over the project requirements, overview of possible solutions , consultations

EVALUATION OF SUBJECT EDUCATIONAL RESULTS ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational result numer (reference)	Method of evaluating educational result achievement
P (project)	PEU_W01 PEU_W02 PEU_W03 PEU_U01 PEU_U02 PEU_K02	Completion of a project and its presentation
P (lecture)	PEU_W01 PEU_W02 PEU_W03 PEU_U01 PEU_U02	Exam
P (laboratory etc.) =		
P (lecture) =		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Nawy E., Concrete Construction Engineering. Handbook. CRC Press, New York 2008.
[2] Limbrunner G. F., Agdhayere A. O., Reinforced Concrete Design. Prentice Hall, New Jersey 2010.
[3] Kobiak J., Stachurski W., Konstrukcje żelbetowe, t. 2, t. 4. Arkady, Warszawa 1987, 1991.
[4] Grabiec K., Żelbetowe konstrukcje cienkościenne. PWN, Warszawa - Poznań 1999.
[5] Stachowicz A., Ziobroń W., Podziemne zbiorniki wodociągowe. Obliczenia statyczne i

kształtowanie. Arkady, Warszawa 1986.
[6] Halicka A., Franczak D., Projektowanie zbiorników żelbetowych. Tom I. Zbiorniki na materiały sypkie. Wydawnictwo Naukowe PWN, Warszawa 2011.
[7] Łapko A., Jensen B. C., Podstawy projektowania i algorytmy obliczeń konstrukcji żelbetowych. Arkady, Warszawa 2005.

SECONDARY LITERATURE:

[1 Budownictwo Przemysłowe, t. XIII. Zbiorniki, zasobniki, silosy, kominy i maszty. Arkady, Warszawa 1966.
[2] Starosolski W., Konstrukcje żelbetowe, t. 2. Wydawnictwo Naukowe PWN, Warszawa 2008.
[3] Sekcja Konstrukcji Betonowych KILiW PAN, Podstawy projektowania konstrukcji żelbetowych i sprężonych według Eurokodu 2. Dolnośląskie Wydawnictwo Edukacyjne, Wrocław 2006.
[4] Zybura A., Konstrukcje żelbetowe wg Eurokodu 2. Atlas rysunków. Wydawnictwo Naukowe PWN, Warszawa 2010.
[5] Satereh M., Darvas R., Concrete Structures, Prentice Hall, New Jersey 2007.

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Zał. nr 5 do ZW 16/2020

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in English:	**Selected topics in geo-engineering – Foundations**
Name of subject in Polish:	**Wybrane zagadnienia geoinżynierii – Fundamenty**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st /~~ 2nd level, ~~uniform magister~~ studies*, full-time / ~~part-time~~ studies***
Kind of subject:	**obligatory ~~/ optional / university-wide~~***
Subject code:	**CEB007361**
Group of courses:	**~~YES~~ / 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**			**30**	
Form of crediting	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	~~Examination~~ / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**			**1**	
including number of ECTS points for practical (P) classes				**1,3**	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**0,5**			**1,1**	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

P1. Fundamentals of bearing constructions in civil engineering, fundamentals of strength of materials and soil mechanics.
P2. Basic types of foundations for different simple geoengineering conditions, geotechnical categories GC1 and GC2, construction processes of foundations, functional and environmental aspects of foundations depending on the type of object, loadings, soil conditions and water in soils.
P3. Principles of soil-structure interacion for undeformable foundations, embedded walls, retaining structures; calculation of the bearing capacity, stability of slopes, calculation of soil and water pressure.
P4. Design of basic concrete elements, like beams, footings and columns; reinforcement calculation.
P5. Solving of the simplest linear ordinary differential equations with constant coefficients.

SUBJECT OBJECTIVES

C1. Ability in modelling of the soil-structure interaction for deformable foundations on deformable

subsoil; contact stresses redistribution, changes of internal forces, mining influences as a static excitation. C2. Knowledge of mathematical solutions to simple deformable foundations on the elastic subsoil, the Winkler model and the elastic halfspace; application of differential equations. C3. Building an engineering intuition in prediction of internal forces in foundations, non-uniform settlements and rational analysis of structures interacting with the subsoil. C4. Gaining knowledge in more complex problems of the earth pressure prediction, generalizations of the Coulomb solution. C5. Developing knowledge and ability of application of methods of the earth pressure reduction, stability improvement, shaping of retaining walls. C6. Understanding necessity of safety in geotechnical design – design approaches with partial safety factors due to the Eurocode EC7-1. C7. Developing skills in design of foundations.

SUBJECT LEARNING OUTCOMES	
Relating to knowledge:	
PEU_W01	student gains a theoretical knowledge in applications of ordinary differential equations towards calculation of deformable foundation beams, as well as piles and walls embedded in soils, a better understanding of the method of virtual forces (the Bleich method) - being a prototype for the boundary element method,
PEU_W02	understands a theoretical background of the method of partial safety factors in geoengineering, uses the design approaches required by the Eurocode EC7-1 – the GEO stability criteria in this group,
PEU_W03	understands problems of soil-structure interaction on the example of elastic subsoils, knows how to design retaining constructions transmitting large loadings on the soil – particularly non-vertical forces, gets a background to identify poor engineering solutions,
Relating to skills:	
PEU_U01	student can define and apply appropriate calculation models for deformable foundations and deformable soils, analyses internal forces in foundations and combinations of such actions (also for mining excitations),
PEU_U02	can interpret the special role played by elastic fixities of constructions in the soil, is aware of fundamental shortcomings in commercial codes of CAD for CE designers,
PEU_U03	becomes skillful in modelling of the soil-structure interaction problems, can calculate more complex foundations within the geotechnical category 2 and 3,
Relating to social competences:	
PEU_K01	student improves the ability to work alone and in a group of designers (due to discussions with other students during class-projects and with the teacher),
PEU_K02	drills in logical thinking, clear formulation of theses and requirements, concentration on given tasks – within a given theory and set margins of assumptions.

PROGRAMME CONTENT		
	Form of classes - lecture	**Number of hours**
Lec1	<u>Examples of the soil-foundations interaction</u>: Role of the foundation stiffness, influence of a superstructure stiffness and the subsoil compressibility on contact forces and structural behaviour	1
Lec2	<u>Linear calculation models of the subsoil compressibility</u>: Global models – the Winkler subsoil, the Pasternaka one, the Kerr one *etc.*, local models – the elastic halfspace, finite elastic layers; rational selection of the most adequate linear model, real-soil behaviour and application limits of the linear models; values of parameters of the models	2
Lec3	<u>Calculation of simple foundations resting on the linear elastic subsoil</u>: Foundation beams – the fundamenal solution, the basic solutions, boundary	

	conditions, the metod of Bleich (virtual forces applied outside the real beam), examples and applications; beams, piles, walls, foundation grids, foundation slabs	2
Lec4	<u>Elements of the mining geoengineering:</u> Types of mining deformations and the prediction methods, parameters of the ground surface subsidence, mining categories, tolerance of engineering objects to deformations, the simplest construction principles; practical examples	3
Lec5	<u>Types and construction of retaining structures:</u> Massive (gravity) retaining walls, light (cantilever) retaining walls, structures embedded in soil, reinforced-soil retaining structures; general stability criteria ULS(GEO) and SLS due to Eurocode EC7-1	1
Lec6	<u>Earth pressure theories:</u> The Coulomb-Mohr solutions, the Rankine-Mohr approach, the Coulomb-Poncelet method for the active earth pressure, the Coulomb-Poncelet method for the passive earth pressure, the Rankine-Mohr approach, the Prandtl solution; the Caquot & Kerisel charts of earth pressure coefficients (EC7.1)	3
Lec7	<u>Practical cases of the earth pressure calculations:</u> Angular cantilever walls; role of cohesion - the method of corresponding states of stresses; bearing capacity GEO against the soil heave **Final test #1 (45min)**	2
Lec8	<u>Geoengineering faults and failures:</u> Insufficient geotechnical data, misinterpretation of soil behaviour, design errors, not correct construction processes, unexpected changes of conditions and poor recognition of environmental influences, faults during the repair/rescue action; A case history – The Leaning Tower of Pisa. **Final test #2 (45min)**	2
	Total hours	**15**

Form of classes - class		**Number of hours**
Cl1		
...		
	Total hours	

Form of classes - laboratory		**Number of hours**
Lab1		
…		
	Total hours	

Form of classes - project		**Number of hours**
Proj1	<u>Design Project #1 – Foundation beam on a mining area</u>: project scope, design situation, analysis, project data, calculation methods	1
Proj2	foundation length estimation (linear soil reaction, beam bending moments)	1
Proj3	foundation width estimation (ULS-GEO for a layered subsoil); shaping of the beam transversal cross section	2
Proj4	numerical solving of the finite beam resting on a layered elastic subsoil – ZEM_SIN code	2
Proj5	numerical solving of the finite beam resting on a homogenized elastic subsoil – ZEM_SIN code; comparison of results, conclusions	3
Proj6	analysis of mining deformations and mining forces (ZEM_SIN)	2

Proj7	combination of actions, concrete design; construction drawings	3
Proj8	Project defense/project acceptance - an evaluation test	2
Proj9	Design Project # 2 – Cantilever retaining wall: project scope, design situation, analysis, project data, calculation methods input shaping, setting of loadings	2
Proj10	the Rankine earth pressure, checking of the stability ULS-GEO	2
Proj11	the Poncelet earth pressure, checking of the stability ULS-GEO	2
Proj12	concrete design of the wall and the foundation slab (cantilevers)	2
Proj13	construction details, construction drawings	2
Proj14	Project defense/project acceptance - an evaluation test	2
Proj15	final acceptance	2
	Total hours	**30**

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
N1. Lecture: recalling practical examples from geotechnical expertise, sketches and drawings. N2. Lecture and Project: more complex calculation examples can be downloaded from the author's web site [5]. N3. Project: individual consulting, discussion of problems in a group of students. N4. Providing students with the original computer program ZEM_SIN for downloading from the lecturer's website [8], N5. List of problems and calculation tasks for a self-study can be downloaded from the author's web site [5] – some of them are accompanied by hints, answers or full solutions.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation (F – forming (during semester), P –concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1 (Project)	PEU_W01 PEU_W02 PEU_W03 PEU_U01 PEU_U03 PEU_K01 PEU_K02	Systematical – every week – checking of the student's progress during classes and consulting hours
P1 (Project)	PEU_W01 PEU_W02 PEU_W03 PEU_U01 PEU_U03 PEU_K01 PEU_K02	Final defense of each of two projects; detailed questions about the project, discussion of student's errors or mistakes; project corrections and improvements.
P1 (Lecture)	PEU_W01 PEU_W02 PEU_W03	Two final tests during two last lectures; wide spectrum of questions and calculation tasks (theoretical, practical, interdisciplinary and

	PEU_U01 PEU_U02 PEU_U03 PEU_K02	holistic ones)

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: [1] Bond A., Harris A., Decoding Eurocode 7. *Taylor & Francis*, 2008. [2] Cernica J., Geotechnical engineering: Foundation design. *John Wiley & Sons*, 1995. [3] Henry J., Foundation engineering, 1990. [4] Lancellotta R., Geotechnical engineering, *A.A. Balkema*, 1995*; Spon Press*, 2008. [5] Reese L.C., Isenhower W.M., Wang S.-T., Analysis and design of shallow and deep foundations. *John Wiley & Sons*, 2006. [6] Eurocode EC7-1. Geotechnical design, Part 1. **[7]** www of world-leading foundation companies. **[8]** http://www.ib.pwr.wroc.pl/brzakala **SECONDARY LITERATURE:** [9] Selvadurai A.P.S., Elastic analysis of soil-foundation interaction, *Elsevier*, 1979. [10] Other Eurocodes and national codes in CE. [11] http://www.ib.pwr.wroc.pl/brzakala

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Zał. nr 5 do ZW 16/2020

DEPARTMENT OF HUMANITIES AND SOCIAL SCIENCES
FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in Polish:	**Etyka w biznesie**
Name of subject in English:	**Ethics in business**
Main field of studies:	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level~~, uniform magister~~ studies*, full-time ~~/ part-time studies~~***
Subject type :	**~~obligatory /~~ optional / university-wide***
Subject code	**FLH020461**
Group of courses:	**~~YES~~ / NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in the University (ZZU)					**15**
Number of hours of total student workload (CNPS)					**60**
Form of crediting	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For a group of courses mark (X) for the final course					
Number of ECTS points					**2**
including number of ECTS points for practical (P) classes					**1,5**
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)					**0,6**

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Text interpretation ability
2. Basic abilities in performing analysis and synthesis

\SUBJECT OBJECTIVES

C1. Analysis of the significance and role of ethics in modern business
C2. Resolve problems relating to social responsibility to the surroundings
C3. The appearance and analysis of the situation in which ethical problems may arise
C4. Sensitize students to the ethical problems

SUBJECT LEARNING OUTCOMES	
Relating to knowledge:	
PEU_HUM_W08	Student has knowledge necessary to understand economic, legal, social and beyond technical factors of engineering activities and their using in engineering practice.
Relating to skills:	
PEU_HUM_U01	Student is able to obtain information from the literature, databases and other carefully selected sources, also in English or another foreign language recognized as the language of international communication in the area studied direction; can integrate the information obtained, to make its interpretation, as well as to draw conclusions and formulate reasoned opinions.
Relating to social competences:	
PEU_HUM_K05	Student properly recognizes and settles dilemmas connected with professional activity.

PROGRAMME CONTENT		
Form of classes - seminar		**Number of hours**
Se 1	Introduction to business ethics	1
Se 2	Ethics in economic activity	1
Se 3	Protection of intellectual property versus ethics	1
Se 4	Economic crises as a source of change in moral values	2
Se 5	Ethical trade	1
Se 6	Corporate Social Responsibility	2
Se 7	Ecoethic	2
Se 8	Ethics in Marketing	2
Se 9	Areas of of modern ethical finance	1
Se10	Manipulation, corruption, lies and abuses in business	2
	Total hours:	**15**

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation F – forming (during semester), P – concluding (at semester end)	Educational outcome number	Method of evaluating educational outcome achievement
F1	PEU_HUM_W08 PEU_HUM_U01	Activity on the lectures, presentation
F2	PEU_HUM_W08 PEU_HUM_K05	Activity on the lectures, presentation
P=F1+F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] B. Klimczak, Etyka gospodarcza, Wrocław 1996.
[2] P. M. Minus, Etyka w biznesie, Warszawa 1995.
[3] E. Sternberg, Czysty biznes. Etyka biznesu w działaniu, Warszawa 1998.

SECONDARY LITERATURE:

[1] G. D. Chrissides, J. H. Kaler, Wprowadzenie do etyki biznesu, Warszawa 1999.
[2] A. Chaufen, Kradzież a rozwój gospodarczy, Warszawa 2006.
[3] C. Porębski, Czy etyka się opłaca, Kraków 1997.
[4] Podstawy marketingu, pod red. J. Altkorna, Kraków 2004.
[5] M. Bąk, P. Kulawczuk, A. Szcześniak, Strategia polskiego biznesu wobec korupcji, Warszawa 2001.

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)
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DIDACTIC TEAM MEMBERS (NAME AND SURNAME, E-MAIL ADDRESS)
Dr Jerzy Kordas, Department of Humanities and Social Sciences, jerzy.kordas@pwr.wroc.pl

Zał. nr 5 do ZW 16/2020

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in English:	**Construction project management**
Name of subject in Polish:	**Zarządzanie przedsięwzięciami budowlanymi**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level~~, uniform magister~~ studies*, full-time ~~/ part-time studies~~***
Kind of subject:	**obligatory / ~~optional / university-wide*~~**
Subject code:	**CEB008563**
Group of courses:	**~~YES~~ / 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	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**	**2**			
including number of ECTS points for practical (P) classes		**1,5**			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**0,6**	**0,6**			

*delete if applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
1. The student has the knowledge on construction technology and organization
2. The student is capable to elaborate the time schedule, bill of quantity and cost plan of construction projects.
3. The student knows the basic roles of structural design of construction objects

SUBJECT OBJECTIVES	
C1.	to transfer the knowledge on construction project management
C2.	to train competencies for identification and resolving of considerable problems concerning execution of construction processes
C3.	the prepare the alumni for self-dependent managerial positions focused on construction works and supervision of teams in construction industry
C4.	to get the ability for self-study and continuous learning of new problems solving.

SUBJECT LEARNING OUTCOMES	
Relating to knowledge:	
PEU_W01	the student knows procedures of construction projects management, has the knowledge on organization and management of complex construction projects, has the knowledge on evaluation of project economy, supervision of projects, and computer-aided planning of projects.
PEU_W02	the student has knowledge on performing the business in construction industry, does understand basic roles of company finance and knows cost control procedures as long as project time management
PEU_W03	the student knows basic role of construction law regulations and corresponding administration procedures, including environmental regulations, power energy regulations, waste management law, geological law and knows the basic roles of facility management.
Relating to skills:	
PEU_U01	can plan and prepare the investment process for execution phase, including tendering, managing of construction project and fundaments facility management
PEU_U02	can use the advanced tools for internet and other sources searching the building information, can use the IT tools for interpersonal communication and can get and use the software needed for effective organization and management of construction projects.
PEU_U03	can elaborate the time schedule of works, as long as the bill of quantity; also, can evaluate the economy of construction project.
PEU_U04	can evaluate the risk allocated to execution of a construction project
Relating to social competences:	
PEU_K01	the student is aware of need of permanent increasing of professional and personal competencies by means of formal and not formal training exercises on new construction technology problems.
PEU_K02	the student can think and act in entrepreneurial way.

PROGRAMME CONTENT		
	Form of classes - lecture	***Number of hours***
Le1	Management models of a construction process. Regulations and administrative procedures related to the construction process. Obligations and rights of project participants.	1
Le2	The investment process: local urban plan, arrangements, documents, administrative decisions. Feasibility study for construction projects. Principles and scope of a feasibility study.	2
Le3	Tender procedures. Types of tenders. Private and public orders. Management of a tender procedure. Insurance in the investment construction process. Commodity exchanges.	2
Le4	Tenders and contracts in construction industry. FIDIC contract model.	2
Le5	The use of scheduling and network planning in management of engineering investment.	2
Le6	Evaluation of engineering projects effectiveness (NPV, IRR). Cost control of projects.	2
Le7	Construction project progress analysis using Earned Value Method	2
Le8	Crediting test.	2
	Total hours	**15**

Form of classes - classes		Number of hours
Cl 1	Planning the organization of a construction project structure. Planning of the structure of a construction contracting company.	1
Cl 2	Selected administration procedures obligatory in the construction project management	2
Cl 3	Selected parts of the feasibility study of a construction investment project	2
Cl 4	Engineering clauses in contracts for works in construction.	2
Cl 5	Planning of works with application of critical paths and the cost plan ("S" curve).	2
Cl 6	Calculation of Net Present Value and Internal Rate of Return for construction investment projects.	2
Cl 7	Calculation of forecasted final date and final cost of construction projects with use of Earned Value Method.	2
Cl 8	Crediting test.	2
	Total hours	**15**

Form of classes - class		Number of hours
Cl1		
...		
	Total hours	

Form of classes - laboratory		Number of hours
Lab1		
…		
	Total hours	

Form of classes - project		Number of hours
Proj1		
…		
	Total hours	

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED	
N1.	Regular lecture with multi-media presentation. Possible on-line course with use of dedicated software packages. Presentation of construction case studies. Presentation of annual report data of real construction companies.
N2.	Demonstration of some recognizable software packages for project management.
N3.	Contact hours for students.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
	PEU_W01	final semester quiz: in class or distance quiz "on-

	PEU_W02	line”
	PEU_W03	
	PEU_U01	
	PEU_U02	
	PEU_U03	
	PEU_U04	
	PEU_W01	
	PEU_W01	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] A Guide to the Project Management Body of Knowledge, Project Management Institute, 2017.
[2] Code of Practice: Project Management for construction and development. Blackwell Publ. 2014
[3] Ferry D. J., Brandon P. S., Ferry J. D., Cost Planning of Buildings. Blackwelll Science, 2014.
[4] Fewings P., Construction Project Management – an integrated approach. Taylor&Francis, 2019.
[5] Harris F., McCaffer, Modern Construction Management. Blackwell Sci. Publ. 2013
[6] Sears S.K., Sears G.A., Clough R.H., Rounds J.L., Segner R.O., Project Management – A Practical Guide to Field Construction Management. Wiley, 2015.
[7] Walker A., Project Management in Construction. Wiley-Blackwell. 2015

SECONDARY LITERATURE:

[1] Fisk E. R., Construction project administration. Pearson 2014
[2] Gould F. E., Managing the construction process. Pearson 2012
[3] Kerzner H., Project Management – A Systems Approach to Planning, Scheduling and Controlling. Wiley, 2013.
[4] Winch G.M., Managing Construction Projects. Wiley-Blackwell. 2010.

SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)

Andrzej Czemplik, PhD, CE, PE, Department of Building Engineering (K07W02D06), andrzej.czemplik@pwr.edu.pl

MEMBERS OF TEH EDUCATIONAL TEAM (NAME AND SURNAME, E-MAIL ADDRESS)

Teachers from Department of Building Engineering (K07W02D06)

Zał. nr 5 do ZW 16/2020

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in English:	**Methods of applied statistics (geostatistics)**
Name of subject in Polish:	**Metody statystyki stosowanej (geostatystyka)**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level~~, uniform magister~~ studies*, full-time ~~/ part-time studies~~***
Kind of subject:	**~~obligatory /~~ optional ~~/ university-wide~~***
Subject code:	**CEB006963**
Group of courses:	**~~YES /~~ 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	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination ~~/~~ crediting with grade *	~~Examination~~ / crediting with grade *	Examination ~~/~~ crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**			**2**	
including number of ECTS points for practical (P) classes				**2,0**	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**0,6**			**0,6**	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Possesses the knowledge required in the programme of secondary school, connected with mathematics and information science (computer science).
2. Possesses the knowledge concerning the mathematics, mathematical statistics and information science foundations.
3. Possesses the skills of basic making of mathematical statistics tools and basic information techniques.

SUBJECT OBJECTIVES

C1. Gaining of the knowledge concerning geostatistics foundations (grounds), representing the branch of applied (spatial) statistics, getting acquainted with basic descriptions, definitions and notions applied in geostatistics, such as for example: variogram, covariance, autocorrelation, variograms modeling, cross-validation, kriging, cokriging, interpolation, estimation, simulation, Gaussian models.

C2. Making acquaintance with basic models and techniques applied in linear stationary

	geostatistics and non-linear, non-stationary geostatistics.
C3.	Forming up of skills of carrying out of multidimensional structural (variographic) analysis of variation of parameters (regionalized variables), describing the studied regionalized phenomena and of performing of interpolation and estimation of averages values Z* of these parameters, in regular elementary grid.
C4.	Learning of carrying out of multidimensional structural analysis of variation of the studied phenomena and of using of interpolation and estimation techniques and performing of the evaluation of their applying meaning.

SUBJECT LEARNING OUTCOMES	
Relating to knowledge:	
PEU_W01	Possesses the knowledge concerning an applied geostatistics foundations, taking into account of basic empirical measures of spatial variation and interpolation and estimation techniques, and also concerning their meaning in technical sciences and Earth sciences.
PEU_W02	Knows the foundations (grounds) of subject area (problems) related to the investigating of regionalized phenomena in various areas of knowledge (for instance: civil engineering, geodesy, mining, environment engineering, geology, environment protection) and he understands their meaning during the elaborating and the developing of area (2D), spatial and spatial-time (3D and 4D) geostatistical models.
Relating to skills:	
PEU_U01	Knows how to carry out the evaluation of basic statistics and to calculate isotropic and directional variograms of the studied parameters and determine character and degree their variation, how to describe and characterize an anisotropy of variability of the considered parameters.
PEU_U02	Knows how to calculate variograms, block-diagrams, raster and isoline maps, and on the ground of maps he knows how to perform delineating grid sections along the sections lines, and moreover he knows how to carry out interpretation of the results of geostatistical analyses.
PEU_U03	Knows how to perform grid sections using the generated sets and how to carry out on their ground , for instance, an initial analysis of soil-water conditions for the needs of civil engineering or also geological-mining conditions for the needs of mining.
PEU_U04	Knows how to serve a specialistic geostatistical software, contained in special packet of geostatistical software and knows how to use adequate computer programs, how to copy, elaborate and interpret the results of spatial analyses (geostatistical studies) and how to prepare projects.
Relating to social competences:	
PEU_K01	Knows how to work independently and together with team for the realizing of undertaken task.
PEU_K02	Knows how to use of the grounds of knowledge connected with obliging assumptions existing in geostatistics and how to use suitable analytical algorithms.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Conditions of course crediting. Literature contents. Introduction to geostatistics, basic descriptions, definitions and notations (geostatistics, regionalized phenomena, variogram, covariance, autocorrelation, interpolation, estimation, simulation).	1
Lec2	Basic informations connected with theory of linear stationary geostatistics and non- linear and non-stationary geostatistics.	1
Lec3	Structural analysis of variation of the studied parameters using of variogram function, covariance function and autocorrelation function.	2
Lec4	Modeling of empirical variograms by means of analytical theoretical functions (“geostatistical models”).	1

Lec5	Cross-validation of assumed theoretical models of empirical variograms.	1
Lec6	Investigating of an anisotropy of the studied parameters variation, using the directional variogram function.	1
Lec7	Estimating by applying with quick interpolation and estimation techniques.	3
Lec8	Geostatistical simulations.	1
Lec9	Practical aspects of applying with kriging techniques and simulation methods.	1
Lec10	Fields (areas) of applications of geostatistical methods in country and abroad.	1
Lec11	Crediting colloquy.	2
	Total hours	**15**

Form of classes - class		Number of hours
Cl1		
...		
	Total hours	

Form of classes - laboratory		Number of hours
Lab1	Subject area scope. Literature contents. Principles of BHP. Conditions of course crediting. Compliance of basic geostatistical descriptions, definitions and notations. The elaborating of thematical data bases (2D, 3D), making the ground for geostatistical calculations.	1
Lab2	Geostatistical studies (2D, 3D) of geological-engineering parameters variation of soils and underground waters.	2
Lab3	Geostatistical studies (2D, 3D) of environmental and chemical parameters variation of underground waters.	2
Lab4	Integration of content of data bases containing geological-engineering and environmental parameters values, concerning soil-water environments, i.e soils and underground waters.	2
Lab5	Spatial analyses (2D, 3D) of variation of parameters of mineral resources deposits.	2
Lab6	Processing and modeling of geological-mining parameters (data) in mining (3D).	2
Lab7	Non-stationary case study, presented for instance as an analysis of geological and seismic data.	2
Lab8	Image filtering presented on the example of the analysis of geological and engineering, environmental, climatic, reservoir and material parameters.	1
Lab9	Course crediting.	1
	Total hours	**15**

In the frame of the project – computer exercises (15 hours) with applying of the packet of statistical and geostatistical programs of ISATIS – the version of Isatis 2013.1, dongle key USB connected with the software Isatis purchased in the Firm Geovariances, Avon, Ecole des Mines de Paris, France.

Form of classes - project		Number of hours
Proj1		
…		
	Total hours	

Form of classes - seminar		Number of hours
Sem1		

…		
	Total hours	

TEACHING TOOLS USED
N1. Lecture – Multimedial presentations. Word presentation. Explanation of some definitions on the black-board. Replying to inquiries of students. N2. Project (realized in computer laboratory) – carrying out of thematical projects on computers and reports on the ground of distributed didactic materials and the prepared data bases deriving from own sources (thematic data bases). Word and multimedial presentation, explanation of some definions on the black-board. Direct collaboration and discussion with Students.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1 (computer laboratory)	PEU_WO1, PEU_UO1	Average evaluation on the ground of projects.
F2 (computer laboratory)	PEU_WO1, PEU_UO1, PEU_KO1	Activity during courses.
F3 (computer laboratory)	PEU_WO1, PEU_UO1, PEU_KO1	Participation (presence) in project courses realized in computer laboratory.
F7 (lecture)	PEU_WO1, PEU_UO1	Colloquy
F8 (lecture)	PEU_WO1, PEU_UO1	Presence during lectures.
P (laboratory etc) =		
P (lecture) =		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Armstrong M., Basic Linear Geostatistics. Berlin: Springer, 1998, s. 153.
[2] Armstrong M. & Dowd P. A. Editors. Geostatistical Simulations. Kluver Academic Publisher, Dordrecht, p.265, 1994.
[3] Chiles J. P., Delfiner P., Geostatistics: Modeling Spatial Uncertainity. N. Y.: Wiley, (Wiley series in probability and statistics), 1999.
[4] Clark I. & Harper W.V., Practical Geostatistics 2000. Ecosse North America L1c Columbus Ohio, USA, p.342.
[5] Isaaks E., Srivastava R.Mohan, Introduction to Applied Geostatistics. New York Oxford, Oxford University Press, 1989.
[6] Lantuejoul C., Geostatistical Simulation, Models and Algorithms. Berlin: Springer, 2002.
[7] Namysłowska-Wilczyńska B., Geostatystyka Teoria – Zastosowania. Oficyna Wydawnicza Politechniki Wrocławskiej. Wrocław 2006 r., s. 265.
[8] Rivoirard J., Introduction to Disjunctive Kriging and Non-linear Geostatistics. Oxford: Clarendon, 1994.
[9] Wackernagel H., Multivariate Geostatistics, An Introduction with Applications. 2 nd edition, Springer – Verlag Berlin Heidelberg New York, 1998, s. 256.

SECONDARY LITERATURE:

[1] Deutsch C. & Journel A, 1998, GSLIB: Geostatistical Software Library and User's Guide. Oxford University Press, New York, Oxford. p. 369.
[2] ISATIS, Isatis Software Manual. Geovariances & Ecole des Mines de Paris, Avon Cedex, France,

January 2001, s. 585.
[3] Mucha J.: Metody geostatystyczne w dokumentowaniu złóż., Akademia Górniczo- Hutnicza, Wydział Geologii, Geofizyki i Ochrony Środowiska, Katedra Geologii Kopalnianej, Kraków 1994., s. 155.
[4] Mucha J.: Struktura zmienności zawartości [Zn] i [Pb] w Śląsko-Krakowskich złożach rud Zn-Pb. Studia, Rozprawy, Monografie nr 108, Wydawnictwo Instytutu Gospodarki Surowcami Mineralnymi i Energią PAN, Kraków 2002, s. 149.
[5] Namysłowska-Wilczyńska B., Zmienność złóż rud miedzi na monoklinie przedsudeckiej w świetle badań geostatystycznych. Prace Naukowe Instytutu Geotechniki i Hydrotechniki Politechniki Wrocławskiej 64, Seria: Monografie 21, Wrocław 1993, s. 207.

SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)
Prof. dr hab. Barbara Namysłowska-Wilczyńska, Katedra Geotechniki, Hydrotechniki, Budownictwa Podziemnego i Wodnego, Barbara.Namyslowska-Wilczynska@pwr.wroc.pl

Zał. nr 5 do ZW 16/2020

DEPARTMENT OF HUMANITIES AND SOCIAL SCIENCES
FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in Polish:	**Etyka inżynierska**
Name of subject in English:	**Engineering Ethics**
Main field of studies:	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level~~, uniform magister~~ studies*,** **full-time ~~/ part-time studies~~***
Kind of subject:	**~~obligatory /~~ optional / university-wide***
Subject code	**FLH020361**
Group of courses:	**~~YES~~ / 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	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Crediting with grade*
For group of courses mark (X) final course					
Number of ECTS points					**2**
including number of ECTS points for practical (P) classes					**1,5**
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)					**0,6**

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
Basic knowledge from the field of humanities and social sciences.

SUBJECT OBJECTIVES
C1. Obtaining knowledge on general and professional ethics.
C2. Learning how to identify and analyze moral dilemmas related to engineering professions.
C3. Introducing and analyzing the content of professional codes of ethics for engineers.

SUBJECT LEARNING OUTCOMES	
Relating to knowledge:	
PEU_HUM W08	Students obtain knowledge on recognized standards of professional ethics and basic knowledge on the concept of intellectual property.
Relating to skills:	
PEU_HUM U01, U02	The student is capable of using essential ethical literature independently and is able to work with normative texts on professional ethics, i.e. codes of ethics. Based on the knowledge of different ethical theories, the student is able to identify ethical dilemmas in engineering practice and use them as models helpful in indentifying patterns of ethical conduct.
Relating to social competences:	
PEU_HUM K01, K02, K05	The student is aware of the importance of non-technical aspects of engineering of a chosen specialty and understands the consequences of engineering activity in terms of its environmental and social impact as well as their responsibility for making decisions; the student understands the need for constant learning; the student correctly identifies and analyzes dilemmas related to their profession.

PROGRAMME CONTENT		
	Form of classes - Seminar	**Number of hours**
Sem 1	Introduction: morality, ethics, law.	1
Sem 2	Main ethical theories: criteria for justification of moral judgments; the structure of a moral dilemma.	2
Sem 3	The status, goals and functions of professional engineering ethics.	2
Sem 4	Structure and functions of professional codes of ethics for engineering professions.	2
Sem 5	Professional obligations and responsibilities of engineers in ethical perspective.	2
Sem 6	Engineers responsibility toward society.	2
Sem 7	Ethical dilemmas in engineering professions: case study analyses.	2
Sem 8	Intellectual property; copyrights. Ethical and legal dilemmas, case study analyses.	2
	Total hours	**15**

TEACHING TOOLS USED
N1: Multimedial presentation.
N2: Report.
N3: Discussion.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational outcome number	Method of evaluating educational outcome achievement
F1	PEU_HUM W08 PEU_HUM U01 PEU_HUM K01, K05	Presentation in a multimedial or report form.
F2	PEU_HUM U01, U02 PEU_HUM K02, K05	Prepared participation in discussion.
P=F1+F2	PEU_HUM W08 PEU_HUM U01, U02 PEU_HUM K01, K02, K05	Weighted average of evaluation F1 (2/3 of concluding mark) and evaluation F2 (1/3 of concluding mark).

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Chyrowicz B., O sytuacjach bez wyjścia w etyce, Kraków 2008
[2] Budinger T.F., Budinger M. D., Ethics of Emerging Technologies: Scientific Facts and Moral Challenges, Hoboken, New Jersey 2006.
[3] Galewicz W. [red.], Moralność i profesjonalizm. Spór o pozycję etyk zawodowych, Kraków 2010.
[4] Harris C., Pritchard M., Rabins M., Engineering Ethics. Concepts and Cases, Wadsworth 2009.
[5] Sieńczyło-Chlabicz J [red.], Prawo własności intelektualnej, Warszawa 2009.

SECONDARY LITERATURE:

[1] Chyrowicz B. [red.], Etyka i technika w poszukiwaniu ludzkiej doskonałości, Lublin 2004.
[2] Jonas H., Zasada odpowiedzialności. Etyka dla cywilizacji technologicznej, tłum. M. Klimowicz, Kraków 1996.
[3] Małek M. Mazurek E., Serafin K., Etyka i technika. Etyczne, społeczne i edukacyjne aspekty działalności inżynierskiej, Wrocław 2014.
[4] Ossowska M., Normy moralne. Próba systematyzacji, Warszawa 2003.

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

Dr Monika Małek-Orłowska monika.malek@pwr.edu.pl

Zał. nr 5 do ZW 16/2020

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in English:	**Hydraulics in Civil Engineering**
Name of subject in Polish:	**Hydraulika w budownictwie**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level, ~~uniform magister~~ studies*, full-time / ~~part-time~~ studies***
Kind of subject:	**obligatory / ~~optional~~ / ~~university-wide~~***
Subject code:	**CEB007861**
Group of courses:	**~~YES~~ / 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	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	~~Examination~~ / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**			**1**	
including number of ECTS points for practical (P) classes				**1,0**	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**1,0**			**0,6**	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
1. Student possesses knowledge of the areas of mathematics and physics, basic hydraulics, geology and hydrogeology.
2. Student possesses knowledge of the basic property of the solid body and liquids.

SUBJECT OBJECTIVES	
C1.	Gaining knowledge in the range of hydraulics laws, with hydrostatics and hydrodynamics
C2.	Gaining knowledge in the range of pressure pipe flow and open channel flow, in steady and unsteady movement.
C3.	Gaining knowledge in the range of porous media water flow.
C4.	Gaining knowledge in the range of hydraulic calculations including: hydrostatic force acting on the flat and curved surfaces, simple hydraulic systems calculation, open channel designing, determining of bridges and culverts cross-sections, designing of solid and temporary dewatering systems,.
C5.	Gaining knowledge of realizing laboratory measurements in the range of hydrostatics and hydrodynamics.

SUBJECT LEARNING OUTCOMES	
Relating to knowledge:	
PEU_W01	Knows and understands the basic hydraulics laws in the range of hydrostatics and hydrodynamics, with the equations describing laminar and turbulent flows of compressible and non compressible fluid (Navier-Stokes and Reynolds equations)
PEU_W02	Knows theory of laminar and turbulent flow in pressured pipes, with Bernoulli's equation, equations for friction and local loss of head calculation.
PEU_W03	Gaining knowledge in range of open channel flow calculations, with Chezy equation, calculations principles of most hydraulically efficient cross-section, knows theory of critical movements.
PEU_W04	Knows theory of porous media flow and gaining knowledge in range of simplified hydraulic filtration model.
PEU_W05	Gaining knowledge in range of hydro-engineering structures, with siphons and syphons, bridges and culverts.
Relating to skills:	
PEU_U01	Gaining skills of hydrostatic force calculation on flat and curved surfaces, buoyancy force of submerged solid body.
PEU_U02	Gaining skills of orifices outflow and weir discharge calculation.
PEU_U03	Gaining skills of simple water system calculation, consists of series or parallel pipes.
PEU_U04	Gaining skills of open channel project.
PEU_U05	Gaining skills of horizontal or vertical drainage system calculation of building trench.
PEU_U06	Gaining skills of small bridge or culvert cross-section calculation.
PEU_U07	Gaining skills of laboratory and ground measurements in the range of flow velocity and discharge, stage or depth of water flow
Relating to social competences:	
PEU_K01	Is able to work individually on the realization of strict designing problem or in the team during realizing of ground or laboratory measurements.
PEU_K02	Is conscious of necessity knowledge widening in the range of contemporary technologies in hydraulics and computer programs for designing of hydro-engineering structures.

PROGRAMME CONTENT		
	Form of classes – lecture	**Number of hours**
Lec1	Short history of hydraulics as the science. Fundamental physical properties of water. Newton' law. Forces in fluid field. Pressure definition and its properties. Hydrostatics force on flat and curved surfaces. Buoyancy – Archimedes's law.	2
Lec2	Principles of fluid flow. Types of fluid motion in pipes and open channels. Basic hydraulics equations – continuity equation, energy equation, and momentum equation. Reynold's experiment. Water flow in pipes. Friction factor for laminar and turbulent flow.	2
Lec3	Water flow in closed conduits or pipes, local head losses. Designing of simple pressured pipes. Designing of siphons and syphons – calculating examples. Partially full closed conduits.	2
Lec4	Designing of the most hydraulically efficient open channels. Calculating of stage – discharge relation for natural river cross-section. Numerical models of open channel flow. Specific energy definition with open channel flow. Critical water flow in open channels. Calculating examples.	2
Lec5	Gradually and rapidly varied flow. Hydraulic jump as the example of rapidly varied flow. Differential equation of gradually varied flow in open channels – artificial and natural ones. Unsteady water flow in closed conduits and in open channels.	2

Lec6	Water outflow through orifices. Weirs and their classification in the range of constructional solutions and hydraulics of the water flow. The principles of weirs calculations. Calculation of road culverts. Spillways and stilling basins of the dams creating storage reservoirs. Control cross-sections of hydro-engineering structures.	2
Lec7	Ground and laboratory measurements, of pressure, water stages, water depths, velocity or flow discharge. The principles of ground water flow. Darcy's and Dupuit's Law. Laminar and turbulent ground water flow.	2
Lec8	Class test	1
	Total hours	**15**

Form of classes – class		Number of hours
Cl1		
...		
	Total hours	

Form of classes – laboratory		Number of hours
Lab1		
...		
	Total hours	

Form of classes - project		Number of hours
Proj1	Hydrostatic force calculation on flat and curved surfaces, determining of direction of acting and point of force imposing.	2
Proj2	Project of water supply system of construction site, with determining of water requirement, the choice of source of water uptake, the choice of diameter of supply pipe.	2
Proj3	Project of sewage system, with waste water balance, choice of waste water receipt, the choice of diameter of sewage conduit.	2
Proj4	Discharge calculation in open channels. Project of optimal cross-section of an open channel.	2
Proj5	Determining of flow condition on the chosen length of natural river, with water passing through bridge or culvert cross-section with HEC-RAS numerical model.	7
	Total hours	**15**

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
N1. Laptop with Power Point for multimedia presentation. N2. Computer programs in computer laboratory of Institute of Geotechnics and Hydrotechnics, for realizing of project exercises.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1 (lecture)	PEU_W01 ÷ PEU_W05	
P = F1 (lecture)		Written test – questions on theory and practical problems.
E2 (project)	PEU_U01 ÷ PEU_U07	
P = F2 (project)		Customize of the multi elemental project.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

1. A. Chadwick, J. Morfett, M. Borthwick. Hydraulics in Civil and Environmental Engineering. Taylor & Francis Group – Spon Press. London 2004.
2. M. Kay. Practical Hydraulics. Taylor & Francis Group – Routledge. New York 2008.
3. R.J. Houghtalen, N.F.C. Hwang, A. Akan Osman. Fundamentals of Hydraulic Engineering Systems. Pearson Education, Inc. New Jersey 2010.

SECONDARY LITERATURE:

1. A. Prakash. Water resources engineering kandbook of essential methods and design. ASCE Press 2004.
2. R.M. Khatsuria. Hydraulics of Spillway and Energy Dissipators. Marcel Dekker 2005.

SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)

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Zał. nr 5 do ZW 16/2020

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

e of subject in English: **Modern testing methods for non-destructive inspection of building structures**
e of subject in Polish: **Nowoczesne metody badań nieniszczących konstrukcji budowlanych**
Main field of study (if applicable): **Civil Engineering**
Specialization (if applicable): **Civil Engineering**
Profile: **academic / ~~practical~~***
Level and form of studies: **~~1st~~ / 2nd level~~, uniform magister~~ studies*, full-time ~~/ part-time studies~~***
Kind of subject: **~~obligatory~~ / optional / ~~university-wide~~***
Subject code: **CEB006163**
Group of courses: **~~YES~~ / 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	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	~~Examination~~ crediting with grade *	Examination / crediting with grade *	Examination-/ crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**		**2**		
including number of ECTS points for practical (P) classes			**2.0**		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**0.6**		**0.6**		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student possesses knowledge of the areas of basic aspects of building structures, building materials and concrete structures.
2. The student knows the principles of building materials and testing their strength parameters.

SUBJECT OBJECTIVES

C1. Introduction of modern testing methods for quality control of building materials and structures during their erection.
C2. Introduction of modern testing methods for quality control of existing building structures.
C3. Learning modern testing systems for NDT examination of building structures.
C4. Developing skills of basic and advanced testing procedures for building structures examination necessary for evaluation of their technical conditions.
C5. Strengthening the ability to work in a team and making students aware of the need to constantly expand knowledge of modern testing methods for building structures examination.

SUBJECT LEARNING OUTCOMES	
Relating to knowledge:	
PEU_W01	The student knows and understands the specific implementation of quality control of building materials and structures during their erection.
PEU_W02	The student knows and understands the specific implementation of quality control of existing building structures with particular attention focused on the evaluation of their technical conditions.
Relating to skills:	
PEU_U01	The student is able to plan and carry out test procedures components of building structures and interpret the results of the evaluation of their quality and mechanical properties.
PEU_U02	The student can evaluate the technical condition of building structures using modern non-destructive testing methods.
PEU_U03	The student has the skills necessary to use modern non-destructive testing systems.
Relating to social competences:	
PEU_K01	The student can work independently or in a team task.
PEU_K02	The student is aware of the need to constantly expand knowledge of both traditional and modern testing methods for building structures examination.

PROGRAMME CONTENT		
	Form of classes - lecture	**Number of hours**
Lec.1	Introduction, aims, scope and plan of the subject. Brief history review of the development of testing methods addressed for building structures.	**2**
Lec.2	Characteristics of modern testing methods for non-destructive evaluation of “in-situ” concrete compressive strength (LOK-Test, CAPO-Test, COMA-Test, Schmidt's hammer) and tensile strength using “pull-off” measurements (DYNA, Bond-Test).	**2**
Lec.3	Nondestructive evaluation of “in-situ” compressive strength – case study	**2**
Lec.4	Characteristics of modern testing methods for non-destructive evaluation of corrosion risk assessment of building structures (Rainbow-Test, Aquamerck Test, Rapie Chloride Test, Corrosion Mapping Systems – Bloodhound, Galva Pulse).	**2**
Lec.5	Modern testing methods for non-destructive examination of structural integrity of building structures („Impact-Echo”, Impulse Response).	**2**
Lec.6	Modern testing methods for non-destructive examination of structural integrity of building structures – case study	**2**
Lec.7	Modern methods for locating and identifying the reinforcing steel bars (Cover-Master, Profometer, Ground Penetrating Radar, radiography) and “in-situ” nondestructive evaluation of concrete water permeability by means of GWT method.	**2**
Lec.8	Final examination test	**1**
	Total hours	**15**

	Form of classes - class	**Number of hours**
Cl1		
...		
	Total hours	

Form of classes - laboratory		Number of hours
Lab1	Introduction. Safety regulations. General description of non-destructive testing methods. Introduction to laboratory exercises with ultrasonic measurements	2
Lab2	Short test nr 1. Exercises no 1 - ultrasonic measurements. Determination of ultrasonic pulse velocity in different building materials.	2
Lab3	Short test nr 2. Principles of the concrete compressive strength evaluation by means of rebound measurements. Introduction to laboratory exercises. Overview of available testing systems and measurement techniques. Interpretation of obtained results.	2
Lab4	Short test nr 3. Exercises no 2 - rebound measurements.	2
Lab5	Exercises no 3 – Evaluation of the concrete compressive and tension strength by means of "pull-out" and "pull-off" measurements.	2
Lab6	Exercises no 4 - Localization and identification of the reinforcing steel bars in concrete structures. Non-destructive cover the thickness layer measurements.	2
Lab7	Exercises no 5 - Non-destructive moisture measurements of different materials.	2
Lab8	Short test nr 4. Summary and final recognition.	1
	Total hours	**15**

Form of classes - project		Number of hours
Proj1		
…		
	Total hours	

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
N1. LECTURE: classic lecture, multimedia presentations, educational films, on-line education N2. LABORATORY: practical laboratory tests, preparation of test reports, discussion of the results obtained, on-line consultation N3. Consultation, including on-line consultation.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation (F – forming (during semester), P –concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1 (L1-L2)	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Short test no 1
F2 (L2-L3)	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Short test no 2, Assessment of the Exercises no 1 Discussion of the results obtained
F3 (L4-L5)	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Short test no 3, Assessment of the Exercises no 2 Discussion of the results obtained
F4 (L5-L8)	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Short test no 4, Assessment of the Exercises no 3, 4 and 5 Discussion of the results obtained
P (laboratory) = 0,60 x average rating of short tests results+ 0.4 x average rating of test reports evaluation		
P (lecture)	PEU_W01 PEU_W02 PEU_U01 PEU_U02 PEU_K02	Crediting with grade basing on the final examination test

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Sansalone M.J., W.B. Streett W.B., Impact-Echo Nondestructive Evaluation of Concrete and Mansory, Buullbrier Press, 1977.

[2] Schickert G., Wiggenhauser H., Non-Destructive Testing in Civil Engineering. Berlin, 1995.

[3] Bungey J.H., Millard S.G., M.G., Testing of Concrete in Structures, 4th Edition, Taylor&Francis, London and New York, 2006.

[4] Breysse D., Non-Destructive Assessment of Concrete Structures: Reliability and Limits of Single and Combinated Techniques, State of the Art, Report of the RILEM Technical Committee 207-INR, Springer Dordrecht Heidelberg London New York, 2012

SECONDARY LITERATURE:

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MEMBERS OF TEH EDUCATIONAL TEAM (NAME AND SURNAME, E-MAIL ADDRESS)

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Zał. nr 5 do ZW 16/2020

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in Polish:	**Budownictwo Mieszkaniowe**
Name of subject in English:	**Appartment Building**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level~~, uniform magister~~ studies*, full-time ~~/ part-time studies~~***
Kind of subject:	**obligatory / ~~optional~~ / ~~university wide~~***
Subject code:	**CEB004462**
Group of courses:	**~~YES~~ / 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	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination-/ crediting with grade *	~~Examination~~ / crediting with grade *	Examination-/ crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**2**			**1**	
including number of ECTS points for practical (P) classes				**1,0**	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**1,1**			**0,6**	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has knowledge of the building engineering of the first degree of engineering studies, especially in building structures and concrete structures.
2. The student has knowledge of basic mechanics and strength of materials necessary for the design of buildings.
3. The student knows the standard requirements relating to loads for buildings and design of the building structures.

SUBJECT OBJECTIVES

C1. Learning the principles of architectural and structural requirements for designing multi-storey apartment buildings.
C2. Introduction of structural characteristic of concrete large slab systems with particular attention pied on the possibilities of their modernization and renovation.
C3. Introduction of technological and structural solutions used in modern apartment building systems based on the monolithic technology.
C4. Developing personal skills for determining loading regimes and internal forces in multi-storey stiffening walls weakened by internal openings.

SUBJECT LEARNING OUTCOMES

Relating to knowledge:

PEU_W01 The student knows and understands the specific structural and functional requirements of modern apartment building engineering.

PEU_W02 The student knows and understands the principles of design and calculation concerning multi-storey buildings which structures are basing on prefabricated and monolithic concrete technology.

Relating to skills:

PEU_U01 The student is able to identify loading regimes acting on the high multi-storey stiffening walls and define resulting internal forces with particular emphasis on the walls weakened by internal openings.

PEU_U02 The student can do structural calculation of load-bearing and stiffening walls in multi-storey apartment buildings and make an assessment of their spatial rigidity.

Relating to social competences:

PEU_K01 The student can work independently or in a team task (making relevant report of project).

PEU_K02 The student is aware of the need to constantly expand knowledge of traditional and modern structural solutions for multi-storey apartment buildings. He is also interesting in expanding knowledge concerning modern systems for modernization such structures and testing their technical conditions.

PROGRAMME CONTENT		
	Form of classes - lecture	**Number**
Lec1	Introduction, aims, scope and plan of the subject. Brief history review of the development of industrialized building engineering in Poland and Europe. Fire regulations.	**2**
Lec2	General structural and functional requirements specific to modern apartment building engineering.	**2**
Lec3	Principles of loading regimes acting on the high multi-storey buildings with particular emphasis on wind load conditions.	**2**
Lec4	Principles of determining internal forces in multi-storey concrete structures with particular attention pied on the walls weakened by internal openings.	**4**
Lec5	Overview of concrete large panel systems existing in Polish apartment building engineering. For example, description of W-70, WK-70 and WWP systems. Information concerning possibilities of technical and technological transformations of this type structures. Foreign large-panel building.	**4**
Lec6	Verification of multi-spatial rigidity of high concrete buildings including calculation of foundation plate rotation.	**2**
Lec7	Overview of modern concrete monolithic technology designed for multi-storey apartment buildings. For example, description of PERI, NOE, ULM.A and DOCA technology.	**4**
Lec8	Overview of potential risks and conditions to ensure the safety of residential high-rise buildings.	**2**
Lec9	Modern system solutions for windows and doors	**2**
Lec10	Modern material systems and solutions for finishing works.	**2**

Lec11	Modern systems and solutions for renovation and modernization of multi-family residential buildings, with particular emphasis on thermo-modernization systems.	**2**
Lec12	Final examination test.	**2**
	Total hours	**30**

Form of classes - class		Number of hours
Cl1		
...		
	Total hours	

Form of classes - laboratory		Number of hours
Lab1		
…		
	Total hours	

Form of classes - project		Number of hours
Proj1	Introduction. Characteristic of the project. Schedule and organization of the project work. Issue of individual student subjects and discussion of their scope.	**2**
Proj2	Principles of design and dimensioning of the typical floor drawings.	**2**
Proj3	Identification of typical rigid systems and and calculation of geometrical characteristics of individual structural walls.	**2**
Proj4	Principles of determining wind load regimes for high-rise buildings. Identification of the other loads occurring in multi-storey apartment buildings. Consultation of student projects.	**2**
Proj5	Description of procedures for determining internal forces in multi-storey, concrete walls weakened by internal openings. Consultation of student projects.	**2**
Proj6	Principles of spatial rigidity assessment in multi-storey apartment buildings. Consultation of student projects.	**2**
Proj7	Consultation of student projects.	**2**
Proj8	Assessment of student projects and final recognition.	**1**
	Total hours	**15**

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED	
N1.	LECTURE: classic lecture, multimedia presentations, educational films, on-line education
N2.	PROJECT: discussion of selected aspects related to designing multi-storey apartment buildings, discussion of proposed design solutions, project realization as a team work, on-line consultation
N3.	Consultation of student projects, including on-line consultation.

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

P (project)	PEU_U01 PEU_U02 PEU_K01	The final evaluation of the project, including on-line evaluation
P (lecture)	PEU_W01 PEU_W02 PEU_U01 PEU_U02 PEU_K02	Crediting with grade basing on the final examination test or on-line examination test.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Petersson H., Analysis of Loadbearing Walls in Multi-storey Buildings, Chalmers University of Technology, Goeteborg, 1974.

SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)

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Zał. nr 5 do ZW 16/2020

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in English:	**Advanced computer aided engineering**
Name of subject in Polish:	**Zaawansowane komputerowe wspomaganie projektowania**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level, ~~uniform master's~~ studies*, full-time / ~~part-time~~ studies***
Kind of subject:	**obligatory / ~~optional / university-wide*~~**
Subject code:	**CEB007761**
Group of courses:	**~~YES~~ / 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	Examination / crediting with grade *	Examination / crediting with grade *	~~Examination /~~ crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points			**2**		
including number of ECTS points for practical classes (P)			**2,0**		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)			**1,2**		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Able to identify and to define loads acting on complex building structures.
2. Knows standards and the guidelines and regulations for the design of buildings and their components.
3. Has a developed theoretical knowledge and skills for dimensioning and construction of elements and complex building structures.
4. Has the ability to model complex 2D and 3D structures using FEM.

SUBJECT OBJECTIVES

C1. Developing and strengthening ability of applying methods of modeling and design of complex, spatial constructions using computer programs.
C2. Understanding the theoretical foundations of computer modeling of complex buildings and the interpretation and verification of results, including the issues of non-linearity and dynamic range.

C3. Acquiring the ability to select and use the software used in design practice for solving spatial complex buildings.

SUBJECT LEARNING OUTCOMES	
Relating to knowledge:	
PEU_W01	Knows and understands the principles of computer-aided modeling, calculation and dimensioning of complicated spatial structures and solving mechanics and structural analysis of 2D and 3D in the linear and non-linear statics, dynamics and stability.
Relating to skills:	
PEU_U01	Can select and use computer programs for analysis and design of complex structures.
PEU_U02	Can model in the environment of the finite element method, defines calculation model; can define and perform advanced linear and non-linear analysis of complex 2D and 3D engineering structures.
PEU_U03	Can properly interpret and critically evaluate the results of numerical analysis of complex engineering structures.
Relating to social competences:	
PEU_K01	Able to work on the implementation of tasks independently or in a team project (team preparation and presentations, giving classes, reports from projects); is responsible for the accuracy of the results of the work and its correct interpretation.
PEU_K02	Is aware of the need to increase knowledge in the field of contemporary techniques and software for the design of building structures.

PROGRAMME CONTENT

	Form of classes - lecture	Number of hours
Lec1		
…		
	Total hours	

	Form of classes - class	Number of hours
Cl1		
...		
	Total hours	

	Form of classes - laboratory	Number of hours
Lab1	Introduction: Training on health and safety rules. Discussion of the completion rules. Set a schedule of classes. Overview and introduction to computational programs used in relation to the 2D and 3D problems.	1
Lab1	Analysis of the possibilities of using engineering design software to support the verification of the results of laboratory tests.	1
Lab2	Presentation of the principles of computer modeling using FEM of complex engineering structures – examples for 3D bar structures, plates and shields.	2
Lab3	Presentation of the principles of computer modeling using FEM of complex engineering structures – examples for shells and solid structures.	2

Lab4	Modelling and analysis of complex building and engineering structures – examples prepared and presented by students – 3D bar structures.	2
Lab5	Modelling and analysis of complex building and engineering structures – examples prepared and presented by students – plate structures.	2
Lab6	Modelling and analysis of complex building and engineering structures – examples prepared and presented by students – shell structures.	2
Lab7	Modelling and analysis of complex building and engineering structures – examples prepared and presented by students – solid structures.	2
Lab8	Solving examples of complex building and engineering structures – verification test.	2
Lab9	Modeling and solving examples of complex constructions in terms of research - design of plates and shields (eg. Lusas, Robot).	2
Lab10	Modeling and solving examples of complex constructions in terms of research - design of shells and solids (eg. Lusas, Robot).	2
Lab11	Construction optimization problems – introduction to modeling (eg. Solver, Robot).	2
Lab12	Construction optimization problems of bar structures – solving examples (eg. Solver, Robot).	2
Lab13	Construction optimization problems of bar structures – solving examples (eg. Solver, Robot).	2
Lab14	Shape and topology optimization problems (eg. ESO).	2
Lab15	Summary. Discussion. Final verification. Completion.	2
	Total hours	**30**

	Form of classes - project	**Number of hours**
Proj1		
…		
	Total hours	

	Form of classes - seminar	**Number of hours**
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
N1. Laboratory: student teams multimedia presentations: defining and solving of problems using software; analysis and discussion of results. N2. Common solving of design problems. N3. Contact hours.
Stationary or on-line education

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

end)		
F1	PEU_W01, PEU_U01, PEU_U02, PEU_U03	Verification tests – solution of examples during lab and at home.
F2	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02	Team presentation and report of own/team design problem solutions.
P = 0,4xF1+0,55xF2+0,05xPRESENCE		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Zienkiewicz O. C., Taylor R. L., Zhu J. Z., The Finite Element Method, Sixth Edition, McGraw-Hill, 2005.

[2] McCormack J., Structural Analysis Using Classical and Matrix Methods, John Wiley & Sons, 2007.

[3] Rombach G. A., Finite-element design of concrete structures, Practical problems and their solutions, ICE publishing, 2011.

[4] Arora J. S., Optimum design, McGraw-Hill, Inc., 1989 (ex.).

[5] Xie**,** Yi Min, Steven**,** Grant P., Evolutionary Structural Optimization, Springer, 1997.

[6] Muñoz-Rojas**,** Pablo Andrés (Ed.), Optimization of Structures and Components, Springer, 2013.

[7] Program manuals (Robot, Lusas, Advanced Steel, Tekla, etc.).

[8] https://www.autodesk.pl/

SECONDARY LITERATURE:

[9] Open access lectures and journals from the Internet.
http://www.solid.lth.se/research/structural-optimization/

[10] *Elsevier*; http://www.elsevier.com
https://www.journals.elsevier.com/computers-and-structures
https://www.journals.elsevier.com/case-studies-in-structural-engineering
https://www.journals.elsevier.com/engineering-structures
https://www.journals.elsevier.com/finite-elements-in-analysis-and-design
https://www.journals.elsevier.com/automation-in-construction
https://www.journals.elsevier.com/advances-in-engineering-software
https://www.journals.elsevier.com/computer-methods-in-applied-mechanics-and-engineering
https://www.journals.elsevier.com/structures
https://www.journals.elsevier.com/journal-of-building-engineering
https://www.journals.elsevier.com/archives-of-civil-and-mechanical-engineering

[11] *Springer*; https://www.springer.com/gp
https://link.springer.com/journal/158
(Structural and Multidisciplinary Optimization)
https://www.springer.com/new+%26+forthcoming+titles+%28default%29/journal/11527
(Materials and Structures)

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Załącznik nr 6 do ZW 121/2020

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in English:	**Computational mechanics**
Name of subject in Polish:	**Metody komputerowe**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level~~, uniform magister~~ studies*, full-time ~~/ part-time studies~~***
Kind of subject:	**obligatory / ~~optional / university-wide~~***
Subject code:	**CEB005362**
Group of courses:	**~~YES~~ / 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	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**		**2**		
including number of ECTS points for practical (P) classes			**2,0**		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**0,5**		**1,1**		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
1. The student has extended knowledge of linear algebra and analysis as a base of structural analysis.
2. The student has knowledge of structural mechanics, strength of materials and theory of elasticity.
3. The student has basic knowledge of computational methods.

SUBJECT OBJECTIVES
C1. Presentation of energy functionals as a base of computer methods formulation (FEM).
C2. FEM algorithm presentation for thin plate.
C3. Presentation of finite elements used in plates and shells analysis.
C4. Presentation of FEM in geometrically nonlinear and dynamic problems.
C5. FDM extension for thin plates.
C6. Presentation of BEM algorithm.
C7. To set skills of error estimation, results interpretation and verification of computational methods.

SUBJECT LEARNING OUTCOMES	
Relating to knowledge:	
PEU_W01	The student knows theoretical bases of computer algorithms for complex civil engineering structures analysis.
PEU_W02	The student knows FEM discrete modeling techniques for civil engineering structures.
PEU_W03	The student knows FDM algorithm for thin plates.
PEU_W04	The student knows theoretical basis of BEM.
Relating to skills:	
PEU_U01	The student is able to build plate, shells and complex shell-beam FEM discrete models.
PEU_U02	The student uses advanced FEM software dedicated to civil engineering structures analyses.
Relating to social competences:	
PEU_K01	The student is responsible for results reliability and correct interpretation of solution.
PEU_K02	The student has a conviction about necessity of knowledge continuous extension in field of contemporary software dedicated to civil engineering structures analyses.

PROGRAMME CONTENT

	Form of classes - lecture	**Number of hours**
Lec1	Introduction. Computer methods classification.	1
Lec2	FDM for thin plates. Finite difference operators.	2
Lec3	FDM for thin plates. Boundary conditions. Examples	2
Lec4	Lagrange functional for thin plate – FEM algorithm.	2
Lec5	Finite elements for plates modelling: compatible and incompatible rectangular elements.	2
Lec6	Triangular incompatible element. Flat triangular shell element.	2
Lec7	FEM in geometrically nonlinear problems. Nonlinear equilibrium equation. Marking test	2
Lec8	FEM in geometrically nonlinear problems. Buckling analysis. Marking test – retake.	2
	Total hours	**15**

	Form of classes - class	**Number of hours**
Cl1		
...		
	Total hours	

	Form of classes - laboratory	**Number of hours**
Lab1	Initial information. Introduction to FEM software used during course.	2
Lab2	Presentation of FEM software to simple problems of theory of elasticity – plate static and buckling analysis.	2
Lab3	Presentation of FEM software to simple problems of theory of elasticity – Solution of cylindrical shell.	2
Lab4	Exercise 1 – geometrical model.	2
Lab5	Exercise 1 – discrete model, load and support.	2
Lab6	Exercise 1 – model solution, results presentation and interpretation.	2
Lab7	Exercise 1 – individual students practice	2
Lab8	Exercise 1 – reports presentation. Computer test	2
Lab9	Exercise 2 – geometrical and discrete model, load and support.	2
Lab10	Exercise 2 – model solution, results presentation and interpretation.	2
Lab11	Exercise 2 – individual students practice	2

Lab12	Exercise 2 – reports presentation. Computer test	2
Lab13	BEM algorithm for plane problems. FEM in structural dynamics.	2
Lab14	Computer test – Exercise 1 – retake.	2
Lab15	Computer test – Exercise 2 – retake.	2
	Total hours	**30**

Form of classes - project		Number of hours
Proj1		
…		
	Total hours	

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED	
N1.	Lecture: traditional form.
N2.	Laboratory: multimedia presentations, FEM software, traditional form.
N3.	Office hours.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
P (laboratory)	PEU_W02, PEU_W03, PEU_U01, PEU_U02, PEU_K01, PEU_K02.	student own modelling with FEM software, test
P (lecture)	PEU_W01, PEU_W02, PEU_U01, PEU_K01, PEU_K02.	test

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

1. O. C. Zienkiewicz, R. L. Taylor, J. Z. Zhu, The Finite Element Method, Sixth Edition, McGraw-Hill 2005.
2. Bathe J-K., Finite Element Procedures, Part 1-2, Prentice Hall 1995.
3. Banerjee P. K., Butterfield R., Boundary element methods in engineering science, McGraw-Hill 1981.

SECONDARY LITERATURE:

1. C. A. Brebbia, J. C. F. Telles, L. C. Wrobel, Boundary Elements Techniques, Springer-Verlag, Berlin 1984.
2. Washizu Kyuichiro, Variational methods in elasticity and plasticity, Pergamon Press, 1982.

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Załącznik nr 6 do ZW 121/2020

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name of subject in English:	**Theory of elasticity and plasticity**
Name of subject in Polish:	**Teoria sprężystości i plastyczności**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level, ~~uniform magister~~ studies*, full-time / ~~part-time~~ studies***
Kind of subject:	**obligatory / ~~optional / university-wide~~***
Subject code:	**CEB008361**
Group of courses:	**~~YES~~ / 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)	**30**	**30**			
Form of crediting	~~Examination~~ / crediting with grade *	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**1**	**1**			
including number of ECTS points for practical (P) classes		**0,4**			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**1,1**	**0,6**			

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
1. The student has necessary knowledge of selected topics of mathematics and physics as a base of structural analysis.
2. The student has knowledge of structural mechanics and strength of materials.
3. The student has knowledge of partial differential equations and Fourier series.

SUBJECT OBJECTIVES
C1. Introduction to three dimensional problem of theory of elasticity
C2. Presentation of physical basis and assumptions in plane problems.
C3. Presentation of assumptions, equations and analytical solutions in Kirchhoff theory of thin plates
C4. Presentation of assumptions, equations and analytical solutions in Kirchhoff-Love theory of thin shells
C5. Introduction to theory of plasticity. Presentation of limit load theory for thin plates.
C6. To set a conviction about necessity of knowledge continuous extension in field of theory of elasticity and plasticity.

SUBJECT LEARNING OUTCOMES	
Relating to knowledge:	
PEU_W01	The student knows and understands the equilibrium, geometrical and physical relations for linear-elastic, isotropic body.
PEU_W02	The student knows and understands the differences between linear and nonlinear descriptions and isotropic anisotropic bodies.
PEU_W03	The student knows and understands assumptions, internal forces definitions and boundary conditions in plates and shells.
PEU_W04	The student knows and understands the differences between bending and membrane shells theories.
PEU_W05	The student knows and understands basic terms of theory of plasticity, definitions and theorems of limit load theory.
Relating to skills:	
PEU_U01	The student recognizes properly plane problems and thin plates or shells issues.
PEU_U02	The student is capable of use analytical solutions for selected discs, plates and membrane shells problems.
PEU_U03	The student is capable of evaluate limit load for plates using kinematic approach.
Relating to social competences:	
PEU_K01	The student has a conviction about necessity of knowledge continuous extension in field of theory of elasticity and plasticity.

PROGRAMME CONTENT		
	Form of classes - lecture	**Number of hours**
Lec1	Introduction. Index notation. Stress tensor: differential equilibrium equation	2
Lec2	Stresses tensor (cont.): kinetic boundary conditions, transformation, invariants, principal stresses and directions.	2
Lec3	Continuous body motion: Lagrange and Euler description, strain tensors, compatibility equations. Linear elastic material models. General Hooke’s law. Theory of elasticity equations set. Lame and Beltrami-Mitchell equations.	2
Lec4	Elastic strain energy. Total potential energy. Virtual work principle. Lagrange theorem. Stable and unstable equilibrium.	2
Lec5	Plane problems. Airy stress function for plane stress.	2
Lec6	Plane problem in polar coordinates – application of Airy stress function, third order differential equation for axial symmetry case.	2
Lec7	Thin plates. Kirchhoff theory: assumptions, stresses and internal forces, equilibrium equations, boundary conditions.	2
Lec8	Analytical solutions for plates. Rectangular plate – Navier approach.	2
Lec9	Plate stability. Second order bending theory.	2
Lec10	Annular plates. Fourth and third order differential equations for axial symmetry case.	2
Lec11	Thin shells. Assumptions. Geometrical description. Stresses distribution and internal forces. Bending theory application for cylindrical container.	2
Lec12	Membrane theory for shells of revolution. Equilibrium equations. Analytical solutions for spherical and conical geometry and axis-symmetrical load.	2
Lec13	Basis of theory of plasticity: plastic body models, general plasticity conditions, plasticity conditions for plates, Definitions and theorems of limit load theory.	2
Lec14	Lecture summary. Examples of test tasks.	2
Lec15	Test	2

	Total hours	30

Form of classes - class		Number of hours
Cl1	Index notation – application examples.	1
Cl2	Stress tensor components transformation. Invariants, principal stresses and directions calculation.	2
Cl3	Application of Airy stress function in solution of plane stress problems.	2
Cl4	Plane problem in polar coordinates – stress concentration caused by a circular hole.	2
Cl5	Navier solution for plates.	2
Cl6	Hyperboloid membrane shell – different geometry parameterization	2
Cl7	Kinematic approach to limit load evaluation for rectangular and circular plates.	2
Cl8	Test.	2
	Total hours	**15**

Form of classes - laboratory		Number of hours
Lab1		
...		
	Total hours	

Form of classes - project		Number of hours
Proj1		
…		
	Total hours	

Form of classes - seminar		Number of hours
Sem1		
…		
	Total hours	

TEACHING TOOLS USED
N1. Lecture: traditional form. N2. Classes: analytical solutions of lecture related problems. N3. Office hours.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
P (classes)	PEU_W01, PEU_W03, PEU_W05, PEU_U01 PEU_U02, PEU_U03.	test
P (lecture)	PEU_W01, PEU_W03,	test

	PEU_W05, PEU_U01 PEU_U02, PEU_U03.	

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: 1. Stephen P. Timoshenko and J.N. Goodier, Theory of Elasticity, McGraw-Hill, 1970. 2. A.I. Lurie and A.K. Belyaev, Theory of Elasticity (Foundations of Engineering Mechanics), Springer, 2005. **SECONDARY LITERATURE:** 1. Y. C. Fung, Foundation of Solid Mechanics, Prentice-Hall, New Jersey 1965. 2. Kyuichiro Washizu, Variational methods in elasticity and plasticity, Pergamon Press, 1982.

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Załącznik nr 6 do ZW 121/2020

FACULTY OF CIVIL ENGINEERING	
SUBJECT CARD	
Name of subject in Polish:	**Dynamika**
Name of subject in English:	**Dynamics**
Main field of study (if applicable):	***Civil Engineering***
Specialization (if applicable):	**Civil Engineering**
Profile:	**academic / ~~practical~~***
Level and form of studies:	**~~1st~~ / 2nd level~~, uniform magister~~ studies*, full-time ~~/ part-time studies~~***
Kind of subject:	**obligatory ~~/ optional~~ / ~~university-wide~~***
Subject code:	**CEB007962**
Group of courses:	**~~YES~~ / 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~~ *	Examination / crediting with grade *	~~Examination~~ / crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	**2**		**1**		
including number of ECTS points for practical (P) classes			**1,0**		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**0,7**		**0,6**		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student possesses knowledge of the areas of mathematics and physics necessary for the analysis of dynamics of structures.
2. The student knows the principles of analysis of bar structures statics.
3. The student has the necessary knowledge of structure designing and strength of materials.
4. The student has the necessary knowledge of the dynamics of one-degree-of-freedom systems (ones consisting of mass points, stiff discs and/or deformable bars).

SUBJECT OBJECTIVES

C1. Gaining an in-depth knowledge of dynamic loads and the evaluation of civil engineering structures’ vibrations.
C2. Learning the principles of solving the eigenproblem for multiple-degree-of-freedom systems (discrete or discretized).
C3. Learning the principles of solving the problem of harmonic forced vibration for multiple-degree-of-freedom systems(discrete or discretized).
C4. Gaining basic knowledge of designing dynamically loaded structures.

SUBJECT LEARNING OUTCOMES	
Relating to knowledge:	
PEU_W01	The student has an in-depth knowledge of engineering problems in structure dynamics.
PEU_W02	The student knows the principles of analysis of natural vibration of discrete systems and discretized bar structures.
PEU_W03	The student knows the principles of harmonically forced vibrations analysis, using both the direct method and the modal transformation method.
PEU_W04	The student has knowledge of the basic types of exciting vibration of civil engineering structures
Relating to skills:	
PEU_U01	The student can create a discrete dynamic computation model of a bar system.
PEU_U02	The student can formulate equations of motion of discrete bar systems using the Force Method and Displacement Method
PEU_U03	The student can solve eigenproblems of discrete dynamic systems.
PEU_U04	The student can determine the full dynamic load of the structure.
PEU_U05	The student can determine the envelopes of the dynamic cross-section forces under harmonic excitation.
PEU_U06	The student can determine the analytical solution of an equation of motion of a one-degree-of-freedom system in special cases of excitation.
Relating to social competences:	
PEU_K01	The student is conscious of the need for furthering their knowledge of the dynamics of civil engineering structures through ongoing self-study.
PEU_K02	The student is conscious of the possibility that vibration of the designed structures can have negative effects.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec1	Aims, scope and plan of the subject. Overview of the engineering problems in structural dynamics.	1
Lec2	Dynamic degrees of freedom and generalized coordinates. Continuous and discrete dynamic models of deformable bar structures. Examples of determining the number of dynamic degrees of freedom of discrete bar systems, the degree of static and geometric (kinematic) indeterminacy. Geometric indeterminacy in the dynamic sense.	2
Lec3	Second order Lagrange's equations. Systems of coordinates and their transformations. The energetic balance and the matrix equation of motion of a discrete system. Elastic bonds in discrete bar systems, the definition of the displacement and stiffness matrices. Examples of calculating the displacement matrix in statically determinate and indeterminate systems.	2
Lec4	Examples of calculating the stiffness matrices in geometrically determinate and indeterminate systems. Examples of forming an equation of motion of a discrete system: a beam supporting structure for a rotating motor. Examples of determining the mass matrix and the generalized vector of the exciting forces in discrete bar systems.	2
Lec5	The eigenproblem of a discrete system. Example of analysis of the natural vibration of a simply supported beam with three dynamic degrees of freedom, the eigenforms of the vibration. Free vibration of the discrete system. Damping in civil engineering structures. Models of damping and the force transferred to foundations in discrete systems.	2
Lec6	The kinetostatic method. The principles of designing dynamically excited structures. The state of strain and state of strength. The idea of dynamic	2

	envelopes of cross-section forces . Harmonically excited steady-state vibration in discrete systems (direct method). Example of determining the dynamic envelopes of cross-section forces for a bar system with a discrete mass distribution.	
Lec7	The Orthogonality Priniple of natural vibration, the modal transformation method. Harmonic excitation in a one-degree-of-freedom system. The use of the modal transformation method for analysing harmonically excited steady-state vibration in multi-degree-of-freedom systems. The dynamics of a stiff solid on elastic ground.	2
Lec8	The use of the modal transformation method for analysing harmonic vibration of a block foundation. Special cases of excitation in a one-degree-of-freedom system: inertial excitation and kinematic excitation.	2
	Total hours	**15**

Form of classes - class		**Number of hours**
Cl1		
...		
	Total hours	

Form of classes - laboratory		**Number of hours**
Lab1	Aims, scope and plan of the subject.	1
Lab2	Elements of the matrix and vector calculus.	2
Lab3	One-degree-of-freedom systems.	2
Lab4	Arranging the elastic and damping bonds (in parallel, in series and mixed).	2
Lab5	Superposition of vibration. Beat.	2
Lab6	Discrete systems – beams and frames. The force method and the displacement method. Eigenproblem – eigenfrequency and eigenforms. Harmonically forced vibrations. Dynamic envelopes of the cross-section forces.	2
	Total hours	**15**

Form of classes - project		**Number of hours**
Proj1		
…		
	Total hours	

Form of classes - seminar		**Number of hours**
Sem1		
…		
	Total hours	

TEACHING TOOLS USED	
N1.	classic lecture
N2.	multimedial presentation
N3.	Examples of problem solution with the use of computer programs.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F (computer laboratory)	PEU_U01 PEU_U02 PEU_U03 PEU_U04 PEU_U05 PEU_U06	Active participation during class
P (lecture)	PEU_W01-PEU_W04 PEU_U01- PEU_U06 PEU_K01, PEU_K02	Written test – questions on theory and practical problems.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Z. WÓJCICKI, J. GROSEL, Structural Dynamics, WUT (PRINTAP Łódź, Wrocław 2012, Structural dynamics | Grosel, Jacek; Wójcicki, Zbigniew - Europeana Collections http://www.studia.pwr.wroc.pl/materialy/526/civil_engineering.html

[2] Teaching materials, http://www.studies.pwr.wroc.pl/teaching_materials/448/civil_engineering.html

SECONDARY LITERATURE:

[1] J. LANGER, Dynamika budowli, Oficyna Wydawnicza PWr, Wrocław, 1980

[2] T. CHMIELEWSKI, Z. ZEMBATY, Podstawy dynamiki budowli, ARKADY, Warszawa, 1998

[3] M. KLASZTORNY, Mechanika. Statyka. Kinematyka. Dynamika., DWE, Wrocław 2000.

[4] R. LEWANDOWSKI, Dynamika konstrukcji budowlanych, Wyd. Polit. Poznańskiej, Poznań 2006.

[5] Z. OSIŃSKI, Tłumienie drgań, PWN, Warszawa, 1997.

[6] S. KALISKI, Mechanika techniczna, drgania i fale, PWN, Warszawa,1986.

[7] R. GUTOWSKI, W.A. SWIETLICKI, Dynamika i drgania układów dynamicznych, PWN, Warszawa, 1986.

[8] G. RAKOWSKI i in., Mechanika Budowli – ujęcie komputerowe, t.2, Arkady 1992.

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