PROGRAM OF STUDIES

FACULTY: **Faculty of Mechanical Engineering**

MAIN FIELD OF STUDY: **Mechanics and Machine Building**

BRANCH OF SCIENCE: **Engineering and Technology**

DISCIPLINE / DISCIPLINES:
D1: **Mechanical Engineering (major discipline)**
D2: *
D3: *
D4: *

EDUCATION LEVEL: **second-level studies**

FORM OF STUDIES: **full-time studies**

PROFILE: **general academic**

LANGUAGE OF STUDY: **english**

IN EFFECT SINCE: **2023/2024**

Content:
- Assumed learning outcomes – attachment no. 1 to the program of studies
- Program of studies description – attachment no. 2 to the program of studies
- Plan of studies - attachment no. 3 to the program of studies

*delete as applicable

FACULTY: Faculty of Mechanical Engineering
MAIN FIELD OF STUDY: Mechanics and Machine Building
EDUCATION LEVEL: second-level studies
PROFILE: general academic

Location of the main-field-of study:

BRANCH OF SCIENCE: Engineering and Technology
DISCIPLINE / DISCIPLINES: Mechanical Engineering (major discipline)

Explanation of the markings:

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"
S (faculty symbol) _W.., S (faculty symbol) _W.., S (faculty symbol) _W.., … - specialization learning outcomes related to the category "knowledge"
S (faculty symbol) _U.., S (faculty symbol) _U.., S (faculty symbol) _U.., … - specialization learning outcomes related to the category "skills"
S (faculty symbol) _K.., S (faculty symbol) _K.., S (faculty symbol) _K.., … - specialization learning outcomes related to the category "social competences"
… _inż. – learning outcomes related to the engineer competence

* delete as applicable

Main field of study learning outcomes	Description of learning outcomes for the main-field-of study: Mechanics and Machine Building After completion of studies, the graduate:	Reference to PRK characteristics		
		Universal first degree characteristics (U)	Second degree characteristics typical for qualifications obtained in higher education (S)	
			Characteristics for qualifications on 6 / 7* levels of PRK	Characteristics for qualifications on 6 and 7 levels of PRK, enabling acquiring engineering competences
KNOWLEDGE (W)				
KMBM_W01	has specialized knowledge in mathematics necessary to describe and analyze mechanical systems, machines and devices and describe the processes occurring in them	P7U_W	P7S_WG	
KMBM_W02	has specialist knowledge in the field of analytical mechanics, in particular in the modelling of the dynamics of mechanical systems of machines and devices and vibration analysis	P7U_W	P7S_WG	
KMBM_W03	has theoretically based specialist knowledge in the field of strength, fracture mechanics and the principles of its application to assess the criticality of defects and estimate the "life" of structures	P7U_W	P7S_WG	
KMBM_W04	has specialist knowledge necessary to design, construct, manufacture, operate, program and launch machines, devices and processes	P7U_W	P7S_WG	P7S_WG_inż.
KMBM_W05	has specialist knowledge in the field of modern materials, their development trends and the optimal selection of engineering materials based on mechanical, physical and operational properties as well as technological, operational and economic criteria	P7U_W	P7S_WG	
KMBM_W06	knows and understands in-depth knowledge of the structure, technical and operational features, instrumentation and technological capabilities of various types of manufacturing machines; has structured knowledge of the elements of the production system and awareness of the importance of using these systems in the production process	P7U_W	P7S_WG	P7S_WG_ inż.
KMBM_W07	has specialized and structured knowledge of the possibilities of shaping, designing materials and describing specific physical features of the material and its surface layer, important due to the operational and functional properties of the product	P7U_W	P7S_WG	P7S_WG_ inż.
KMBM_W08	has the extended knowledge necessary to understand the economic, legal, ethical and other conditions related to professional activity in the field of mechanics and machine construction	P7U_W	P7S_WK	
KMBM_W09	has extended knowledge of technologies and development trends in technology, as well as the necessary knowledge to understand the social and political conditions of engineering activities	P7U_W	P7S_WG	

KMBM_W10	knows the rules of preparing and presenting oral speeches in the field of scientific disciplines relevant to the field studied, using audiovisual tools and taking into account psychological knowledge about communicating with others	P7U_W	P7S_WG	
KMBM_W11	has extensive knowledge of marketing and management, including quality management and running a business	P7U_W	P7S_WK	P7S_WK_ inż.
KMBM_W12	knows the general principles of creating and developing forms of individual entrepreneurship, knows and understands the concepts and principles of protection of intellectual property and copyright in connection with knowledge in the field of mechanics and machine construction	P7U_W	P7S_WK	P7S_WK_ inż.
SKILLS (U)				
KMBM_U01	can obtain, apply and creatively interpret information from literature, databases and other available sources for engineering activities in the field of design, operation of machines and manufacturing techniques	P7U_U	P7S_UW	
KMBM_U02	has the ability to use various sources and critically evaluate them to plan and implement self-education	P7U_U	P7S_UU	
KMBM_U03	can, in Polish and a foreign language, prepare and deliver a presentation as well as conduct a discussion on a selected topic in the field of materials engineering, construction, operation and technology of machines	P7U_U	P7S_UK	
KMBM_U04	can formulate and solve complex problems of analytical mechanics to describe the operation of simple mechanical systems; can use a professional system for simulation and dynamic analysis of multi-body systems	P7U_U	P7S_UW	
KMBM_U05	acquires the skills to plan simulation and experimental research, analyze results and propose new solutions, and formulate and test hypotheses	P7U_U	P7S_UW	P7S_UW_ inż.
KMBM_U06	depending on the selected level of the language studied: has knowledge, skills and competencies consistent with the requirements specified for CEFR level A1; uses basic language skills to an elementary degree; knows basic vocabulary and grammatical structures in the field of everyday life topics and basic intercultural behaviours or has knowledge, skills and competences consistent with the requirements specified for CEFR level A2; uses lexical and grammatical means within the scope of the learned topics and adequately to the sociocultural knowledge; can participate in conversations on familiar topics and express limited opinions about studies and professional work	P7U_U	P7S_UK	
KMBM_U07	can select materials or develop design assumptions based on databases and assumptions regarding operational requirements for non-standard elements or structural assemblies of machines and devices	P7U_U	P7S_UW	
KMBM_U08	can apply modern simulation research methods in solving unusual mechanical engineering tasks	P7U_U	P7S_UW	P7S_UW_ inż.
KMBM_U09	can plan and conduct an experiment using measuring tools and techniques in order to conduct research, monitoring and diagnostics of technical objects	P7U_U	P7S_UW	P7S_UW_ inż.

KMBM_U10	can work in a group, organize the work of others and manage a project group, can communicate using various techniques in a professional environment and outside it	P7U_U	P7S_UO	
KMBM_U11	depending on the selected level of the language studied: has knowledge, skills and competences consistent with the requirements specified for the CEFR additional level B2+ in the field of scientific and technical language related to the studied discipline and related issues or has knowledge, skills and competencies consistent with the requirements specified for the additional level C1+ CEFR; independently uses specialist literature, uses scientific and technical language in speech and writing, analyzes the presented content and presents it in various forms of specialist debates	P7U_U	P7S_UK	
KMBM_U12	can report on the individual phases of completing a diploma thesis, prepare a presentation containing the final results of the work, and justify conclusions. Knows the rules of creative discipline. Can determine directions and ways of further acquiring knowledge	P7U_U	P7S_UW	
KMBM_U13	understands foreign-language texts in the field of mechanics and machine construction, e.g. technical, technological and business documentation. Can obtain necessary information in a foreign language from various sources, interpret and critically evaluate it; has resources appropriate for the specialized language	P7U_U	P7S_UK	
KMBM_U14	can design unusual technical objects using materials, technology, control, modern techniques and tools	P7U_U		
KMBM_U15	understands quite well the content and intentions of an oral statement or written text on a familiar topic from everyday and professional life. Can write a short text on a known topic, including a functional text. Can participate in conversations on familiar topics and express limited opinions on the topic	P7U_U		
KMBM_U16	can independently complete a master's thesis containing research aspects, including obtaining information from literature, databases and other sources, integrating it, interpreting and critically evaluating it, planning and conducting experiments, including measurements and computer simulations, interpreting the obtained results and writing conclusions, can integrate knowledge from various fields and disciplines and apply a systemic approach, taking into account both technical, technological and non-technical aspects, can interpret the obtained research results, draw appropriate conclusions and formulate recommendations, can edit a master's thesis under formal requirements	P7U_U	P7S_UW	P7S_UW_ inż.
SOCIAL COMPETENCES (K)				
KMBM_K01	gains the characteristics of an active and creative person, acting under ethical principles	P7U_K	P7S_KR	
KMBM_K02	acquires attention to the style of languages: native, English and the one chosen during studies	P7U_K	P7S_KR	
KMBM_K03	acquires care for the aesthetics of the work performed, including projects and reports	P7U_K		
KMBM_K04	develops a sense of responsibility for a colleague through teamwork	P7U_K		
KMBM_K05	acquires the ability to take responsibility for the work performed	P7U_K		
KMBM_K06	is aware of the coexistence of interconnected knowledge in the fields of mechanics, chemistry, electronics, computer science and thermodynamics	P7U_K	P7S_KK	

KMBM_K07	is aware of the second-cycle graduate as a future leader	P7U_K	P7S_KR	
KMBM_K08	has ecological awareness	P7U_K	P7S_KO; P7S_KR	
KMBM_K09	can appropriately set priorities for the implementation of tasks specified by himself or others; Can work in a group, taking on various roles. Able to lead a small team and take responsibility for the results of its work.	P7U_K	P7S_KK	
KMBM_K10	can think and act creatively. Can appropriately determine priorities for implementing a specific task.	P7U_K	P7S_KK; P7S_KO	

* delete as applicable

DESCRIPTION OF THE PROGRAM OF STUDIES

Main field of study: Mechanics and Machine Building
Level of studies: second-level studies
Profile: general academic
Form of studies: full-time studies

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
Specialization:	**AEN**						**1.4 Prerequisites (particularly for second-level studies):**
1.3 Total number of hours:	1105						Engineer title, and obtaining the right number of points in the recruitment process
1.5 Upon completion of studies graduate obtains professional degree of: magister inżynier							**1.6 Graduate profile, employability:** The graduate can use advanced knowledge in mechanics, design, production and operation of machinery and manufacturing systems. He acquires knowledge in the technology of manufacturing machines and products, IT methods supporting engineering works: design, production, operation of machines and selection of engineering materials. Knowledge of pro-ecological technologies and integrated environmental management, security and quality in manufacturing processes. The graduate is prepared for: - creative activities in the field of design, production and operation of manufacturing machines and systems; - management and development of production in industrial enterprises and technological process management; - independent research at scientific and research institutes; - management of project laboratory studies in technological machinery and processes; - making creative initiatives and decisions; - self-conducting and undertaking third-cycle (doctoral) studies. The graduate should master the ability to cooperate with people, manage teams and manage industrial and scientific units. The graduate is prepared to work in: - design and construction and technological units; - machine industry and related industries; - scientific and research institutes and research and development centres; - units dealing with consulting and dissemination of knowledge in the field of mechanics and machine construction and production engineering.
1.7 Possibility of continuing studies: Studies at a doctoral school, postgraduate studies							**1.8 Indicate connection with University's mission and its development strategy:** The University's mission is: "By studying, teaching and cooperating, we inspire and support the development of personality, which based on knowledge and ethical standards, showing sensitivity to social needs and global challenges, with courage and responsibility shape the future", and the mission of the Mechanical Faculty is consistent with the mission and strategy of the Wrocław University of Technology. The mission of the Faculty refers to the didactics offered at the Faculty: "Conducting in the development of technical civilisation, discovering and transferring knowledge in the area of mechanical engineering, through university education based on advanced scientific research, knowledge development and transfer of new technologies and industrial implementations." Plans and programs are discussed with the Social Council of the Faculty of Mechanical Engineering (https://wm.pwr.edu.pl/o-wydziele/wladze/rada-spoleczna) as a voice of the socio-economic environment. This discussion aims to link the mission and strategy of the University and the Faculty with the needs of the socio-economic environment to meet the requirements of specialists in the field of mechanics and machine construction. A clear message under the University's mission and strategy is that our students will gain knowledge that will result in success in their future professional lives and aim to shape a man with the sense of the entrepreneur, creative and open to new challenges.

2. Detailed description

2.1 Total number of learning outcomes in the program of study:

W (knowledge) = 12, U (skills) = 16, K (competences) = 10, W + U + K = 38

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) = 38 (this number must be greater than half the total number of learning outcomes), D2 = 0, D3 = 0, D4 = 0

2.3 For the main field of study assigned to more than one discipline - percentage share of the number of ECTS points for each discipline:

D1 (major) = 100% ECTS points, D2 = 0% ECTS points, D3 = 0% ECTS points, D4 = 0% ECTS points

2.4a For the general academic profile of the main 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 main field of study is assigned – DN (must be greater than 50% of the total number of ECTS points from 1.2)

72 ECTS - Specialization: (AEN) Automotive Engineering

2.4b For the practical profile of the main 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 1.2)

ECTS

2.5 Concise analysis of compliance of the assumed learning outcomes with the needs of the labor market

Learning effects relate not only to mechanics and machine construction, but also because of the requirements of modern management, automation and robotics, mechatronics as well as computer science and IT technologies. Obtaining the assumed learning outcomes will allow the graduate to find an attractive and interesting job in all industries, as well as to start their own business. Work on learning outcomes was reported and discussed at the meetings of the Convention of the Faculty of Mechanical Engineering, which includes, among others, representatives of enterprises

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 subjects / groups of classes marked with the BU1 code)

47,5	ECTS - Specialization: (AEN) Automotive Engineering

2.7 Total number of ECTS points, which student has to obtain from basic sciences classes

	Specialization: AEN				
Number of ECTS points for obligatory subjects	**6**				
Number of ECTS points for optional subjects	**0**				
Total number of ECTS points	**6**				

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 subjects/group of classes denoted with code P)

	Specialization: AEN				
Number of ECTS points for obligatory subjects	**18**				
Number of ECTS points for optional subjects	**40**				
Total number of ECTS points	**58**				

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 subjects/group of classes denoted with code O)

4	ECTS - Specialization: (AEN) Automotive Engineering

2.10 Total number of ECTS points, which student may obtain doing optional blocks (min. 30% of total number of ECTS points)

52	ECTS - Specialization: (AEN) Automotive Engineering

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

- A student starting classes has an appropriate level of knowledge and skills that are preliminary requirements.
- The student participates in classes organized at the university
- The student carries out design, laboratory, computing, analysis, presentations, studies, literature and recommended materials.
- The student participates in the tests of knowledge and skills and gets acquainted with the correct answers, assessments and comments of the lecturer.
- A student learns group work as part of the listed subjects.
- The student is encouraged to engage in the work of scientific clubs.
- The student participates in meetings with entrepreneurs, technical trips, and work fairs.

4. List of education blocks:

4.1 List of obligatory blocks

4.1.1 List of general education blocks

4.1.1.1 Liberal-managerial subjects block (min. 5 ECTS points)

No.	Subject / group of classes code	Name of Subject / group of classes (denote group of classes with symbol "GK")	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form (2) of Subject / group of classes	Way (3) of crediting	Subject / group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN classes (5)	BU classes (1)			University -wide (4)	Concerning sci. activ. (5)	Practical (6)	Type (7)
1	W10MBM-SM4025S	Communication for Engineers					2	KMBM_U02, KMBM_U03, KMBM_U13, KMBM_K01, KMBM_K07, KMBM_K08, KMBM_K09, KMBM_K10	30	50	2		1,4	T	Z			P	KO
2	W10MBM-SM4037W	Management for Engineers	2					KMBM_W06, KMBM_W08, KMBM_W11, KMBM_K01, KMBM_K05, KMBM_K07, KMBM_K08	30	50	2		1,2	T	Z				KO
		Total	**2**	**0**	**0**	**0**	**2**		**60**	**100**	**4**	**0**	**2,6**						

4.1.1.2 Foreign languages block (min. 5 ECTS points)

No.	Subject / group of classes code	Name of Subject / group of classes (denote group of classes with symbol "GK")	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form (2) of Subject / group of classes	Way (3) of crediting	Subject / group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN classes (5)	BU classes (1)			University -wide (4)	Concerning sci. activ. (5)	Practical (6)	Type (7)
1																			
		Total	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0,0**						

4.1.1.3 Sporting classes block (min. 0 ECTS points)

No.	Subject / group of classes code	Name of Subject / group of classes (denote group of classes with symbol "GK")	Weekly number of hours	Learning effect symbol	Number of hours	Number of ECTS points	Form (2) of Subject / group of classes	Way (3) of crediting	Subject / group of classes

			Weekly number of hours						Number of hours	Number of ECTS points						Subject / group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN classes (5)	BU classes (1)			University -wide (4)	Concerning sci. activ. (5)	Practical (6)	Type (7)
1																			
		Total	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0,0**						

4.1.1.4 Information technologies block **(min. 2 ECTS points)**

No.	Subject / group of classes code	Name of Subject / group of classes (denote group of classes with symbol "GK")	Weekly number of hours					Learning effect symbol	Number of hours	Number of ECTS points				Form (2) of Subject / group of classes	Way (3) of crediting	Subject / group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN classes (5)	BU classes (1)			University -wide (4)	Concerning sci. activ. (5)	Practical (6)	Type (7)
1																			
		Total	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0,0**						

Altogether for general education blocks

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes (5)	Number of ECTS points for BU classes (1)
lec	cl	lab	pr	sem					
2	0	0	0	2	60	100	4	0	2,6

4.1.2 List of basic sciences blocks

4.1.2.1 Mathematics block **(min. 7 ECTS points)**

No.	Subject / group of classes code	Name of Subject / group of classes (denote group of classes with symbol "GK")	Weekly number of hours					Learning effect symbol	Number of hours	Number of ECTS points				Form (2) of Subject / group of classes	Way (3) of crediting	Subject / group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN classes (5)	BU classes (1)			University -wide (4)	Concerning sci. activ. (5)	Practical (6)	Type (7)
1	W10MBM-SM4026W	Applied Mathematics - Operational Methods in Automotive Engineering	2					KMBM_W01	30	50	2		1,2	T	Z				PD
		Total	**2**	**0**	**0**	**0**	**0**		**30**	**50**	**2**	**0**	**1,2**						

4.1.2.2 Physics block **(min. 4 ECTS points)**

No.	Subject / group of classes code	Name of Subject / group of classes (denote group of classes with symbol "GK")	Weekly number of hours					Learning effect symbol	Number of hours	Number of ECTS points				Form (2) of Subject / group of classes	Way (3) of crediting	Subject / group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN classes (5)	BU classes (1)			University -wide (4)	Concerning sci. activ. (5)	Practical (6)	Type (7)
1	W10MBM-SM4032W	Analytical Mechanics	2					KMBM_W01, KMBM_W02	30	50	2	2	1,2	T	E		DN		PD
2	W10MBM-SM4032C	Analytical Mechanics		1				KMBM_U04, KMBM_K03	15	50	2	2	0,7	T	Z		DN	P	PD
		Total	**2**	**1**	**0**	**0**	**0**		**45**	**100**	**4**	**4**	**1,9**						

4.1.2.3 Chemistry block **(min. 0 ECTS points)**

No.	Subject / group of classes code	Name of Subject / group of classes (denote group of classes with symbol "GK")	Weekly number of hours					Learning effect symbol	Number of hours	Number of ECTS points				Form (2) of Subject / group of classes	Way (3) of crediting	Subject / group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN classes (5)	BU classes (1)			University -wide (4)	Concerning sci. activ. (5)	Practical (6)	Type (7)
1																			
		Total	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0,0**						

4.1.2.4 Basic subjects block **(min. 0 ECTS points)**

No.	Subject / group of classes code	Name of Subject / group of classes (denote group of classes with symbol "GK")	Weekly number of hours					Learning effect symbol	Number of hours	Number of ECTS points				Form (2) of Subject / group of classes	Way (3) of crediting	Subject / group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN classes (5)	BU classes (1)			University -wide (4)	Concerning sci. activ. (5)	Practical (6)	Type (7)
1																			
		Total	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0,0**						

Altogether for basic sciences blocks

Total number of hours				
lec	cl	lab	pr	sem
4	1	0	0	0

Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes (5)	Number of ECTS points for BU classes (1)
75	150	6	4	3,1

4.1.3 List of the main field of study blocks

4.1.3.1 Obligatory main field of study block (min. 0 ECTS points)

No.	Subject / group of classes code	Name of Subject / group of classes (denote group of classes with symbol "GK")	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form (2) of Subject / group of classes	Way (3) of crediting	Subject / group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN classes (5)	BU classes (1)			University -wide (4)	Concerning sci. activ. (5)	Practical (6)	Type (7)
1	W10MBM-SM4033W	Design of Engineering Materials	1					KMBM_W05, KMBM_W07	15	25	1	1	0,6	T	Z		DN		K
2	W10MBM-SM4033P	Design of Engineering Materials				1		KMBM_U01, KMBM_K04, KMBM_K05, KMBM_K06	15	25	1	1	0,7	T	Z		DN	P	K
3	W10MBM-SM4036W	Developing Engine Technology	2					KMBM_W03, KMBM_W04, KMBM_W05, KMBM_W09	30	50	2	2	1,2	T	E		DN		K
4	W10MBM-SM4036L	Developing Engine Technology			2			KMBM_U03, KMBM_U09, KMBM_U10, KMBM_K01, KMBM_K06, KMBM_K08	30	50	2	2	1,4	T	Z		DN	P	K
5	W10MBM-SM4027W	Energy Efficiency Design of Powertrain and Body	2					KMBM_W04, KMBM_W05, KMBM_W09	30	50	2	2	1,2	T	E		DN		K
6	W10MBM-SM4027L	Energy Efficiency Design of Powertrain and Body			2			KMBM_U01, KMBM_U05, KMBM_U09, KMBM_K03, KMBM_K06, KMBM_K08	30	50	2	2	1,4	T	Z		DN	P	K
7	W10MBM-SM4034W	Fatigue of Materials and Fracture Mechanics	2					KMBM_W03, KMBM_K05	30	50	2	2	1,2	T	Z		DN		K
8	W10MBM-SM4042W	Fluids Mechanics in Automotive Design	1					KMBM_W08, KMBM_W09	15	25	1	1	0,6	T	Z		DN		K
9	W10MBM-SM4042L	Fluids Mechanics in Automotive Design			1			KMBM_U04, KMBM_U05, KMBM_U08, KMBM_K06	15	25	1	1	0,7	T	Z		DN	P	K
10	W10MBM-SM4028W	Machine and Device Control Systems	2					KMBM_W04	30	50	2		1,2	T	Z				K
11	W10MBM-SM4028L	Machine and Device Control Systems			2			KMBM_U01, KMBM_U14, KMBM_K03,KMBM_K05	30	50	2		1,4	T	Z			P	K
12	W10MBM-SM4029W	Machinery Design Process	2					KMBM_W03, KMBM_W12	30	50	2	2	1,2	T	Z		DN		K
13	W10MBM-SM4029P	Machinery Design Process				1		KMBM_U01, KMBM_U07, KMBM_K03, KMBM_K05, KMBM_K09	15	25	1	1	0,7	T	Z		DN	P	K
14	W10MBM-SM4030P	Modelling of Multi-Body Systems				2		KMBM_U01, KMBM_U02, KMBM_U05	30	50	2	2	1,4	T	Z		DN	P	K
15	W10MBM-SM4039W	Non Destructive Evaluation in Contemporary Manufacturing Systems	1					KMBM_W03, KMBM_W07	15	25	1	1	0,6	T	Z		DN		K
16	W10MBM-SM4039L	Non Destructive Evaluation in Contemporary Manufacturing Systems			1			KMBM_U09, U13, KMBM_K03, KMBM_K06, KMBM_K09	15	25	1	1	0,7	T	Z		DN	P	K
17	W10MBM-SM4035W	Surface Engineering	1					KMBM_W05, KMBM_W07	15	25	1	1	0,6	T	Z		DN		K
18	W10MBM-SM4035L	Surface Engineering			1			KMBM_U01	15	25	1	1	0,7	T	Z		DN	P	K
19	W10MBM-SM4031L	Testing of Vehicle Elements and Assemblies			1			KMBM_U01, KMBM_U05, KMBM_U09, KMBM_K04, KMBM_K05	15	25	1	1	0,7	T	Z		DN	P	K
		Total	**14**	**0**	**10**	**4**	**0**		**420**	**700**	**28**	**24**	**17,9**						

Altogether for main field of study blocks

Total number of hours				
lec	cl	lab	pr	sem
14	0	10	4	0

Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes (5)	Number of ECTS points for BU classes (1)
420	700	28	24	17,9

4.2 List of optional blocks

4.2.1 List of general education blocks

4.2.1.1 Liberal-managerial subjects block (min. 5 ECTS points)

No.	Subject / group of classes code	Name of Subject / group of classes (denote group of classes with symbol "GK")	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form (2) of Subject / group of classes	Way (3) of crediting	Subject / group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN classes (5)	BU classes (1)			University -wide (4)	Concerning sci. activ. (5)	Practical (6)	Type (7)
1	W08MBM-SM4002W	The basis of negotiations	1					KMBM_W08, KMBM_W10, KMBM_K01, KMBM_K02, KMBM_K07	15	25	1		0,6	T	Z	O			KO

		Total	**1**	**0**	**0**	**0**	**0**		**15**	**25**	**1**	**0**	**0,6**								

4.2.1.2 Foreign languages block **(min. 5 ECTS points)**

No.	Subject / group of classes code	Name of Subject / group of classes (denote group of classes with symbol "GK")	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form (2) of Subject / group of classes	Way (3) of crediting	Subject / group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN classes (5)	BU classes (1)			University -wide (4)	Concerning sci. activ. (5)	Practical (6)	Type (7)
1	SJO-SM0001C	Foreign language I		1				KMBM_U11, KMBM_K02	15	30	1		0,5	T	Z	O		P	KO
2	SJO-SM0002C	Foreign Language II		3				KMBM_U06, KMBM_K02	45	60	2		1,5	T	Z	O		P	KO
		Total	**0**	**4**	**0**	**0**	**0**		**60**	**90**	**3**	**0**	**2,0**						

4.2.1.3 Sporting classes block **(min. 0 ECTS points)**

No.	Subject / group of classes code	Name of Subject / group of classes (denote group of classes with symbol "GK")	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form (2) of Subject / group of classes	Way (3) of crediting	Subject / group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN classes (5)	BU classes (1)			University -wide (4)	Concerning sci. activ. (5)	Practical (6)	Type (7)
1																			
		Total	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0,0**						

4.2.1.4 Information technologies block **(min. 2 ECTS points)**

No.	Subject / group of classes code	Name of Subject / group of classes (denote group of classes with symbol "GK")	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form (2) of Subject / group of classes	Way (3) of crediting	Subject / group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN classes (5)	BU classes (1)			University -wide (4)	Concerning sci. activ. (5)	Practical (6)	Type (7)
1																			
		Total	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0,0**						

Altogether for general education blocks

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes (5)	Number of ECTS points for BU classes (1)
lec	cl	lab	pr	sem					
1	4	0	0	0	75	115	4	0	2,6

4.2.2 List of basic sciences blocks

4.2.2.1 Mathematics block **(min. 7 ECTS points)**

No.	Subject / group of classes code	Name of Subject / group of classes (denote group of classes with symbol "GK")	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form (2) of Subject / group of classes	Way (3) of crediting	Subject / group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN classes (5)	BU classes (1)			University -wide (4)	Concerning sci. activ. (5)	Practical (6)	Type (7)
1																			
		Total	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0,0**						

4.2.2.2 Physics block **(min. 4 ECTS points)**

No.	Subject / group of classes code	Name of Subject / group of classes (denote group of classes with symbol "GK")	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form (2) of Subject / group of classes	Way (3) of crediting	Subject / group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN classes (5)	BU classes (1)			University -wide (4)	Concerning sci. activ. (5)	Practical (6)	Type (7)
1																			
		Total	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0,0**						

4.2.2.3 Chemistry block **(min. 0 ECTS points)**

No.	Subject / group of classes code	Name of Subject / group of classes (denote group of classes with symbol "GK")	Weekly number of hours	Learning effect symbol	Number of hours	Number of ECTS points	Form (2) of Subject / group of classes	Way (3) of crediting	Subject / group of classes

			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN classes (5)	BU classes (1)			University -wide (4)	Concerning sci. activ. (5)	Practical (6)	Type (7)
1																			
		Total	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0,0**						

Altogether for basic sciences blocks

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes (5)	Number of ECTS points for BU classes (1)
lec	cl	lab	pr	sem					
0	0	0	0	0	0	0	0	0	0,0

4.2.3 List of the main field of study blocks

4.2.3.1 Optional main field of study block (min. 0 ECTS points)

No.	Subject / group of classes code	Name of Subject / group of classes (denote group of classes with symbol "GK")	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form (2) of Subject / group of classes	Way (3) of crediting	Subject / group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN classes (5)	BU classes (1)			University -wide (4)	Concerning sci. activ. (5)	Practical (6)	Type (7)
1	W10MBM-SM4044S	Diploma Seminar					2	KMBM_U01, KMBM_U02, KMBM_U03, KMBM_U12, KMBM_U13, KMBM_U15, KMBM_U16, KMBM_K01, KMBM_K02, KMBM_K04, KMBM_K07,K MBM_K09	30	50	2	2	1,4	T	Z		DN	P	K
2	W10MBM-SM4041D	Master Thesis I				0,20		KMBM_U01, KMBM_U02, KMBM_U12, KMBM_U13, KMBM_U15, KMBM_U16, KMBM_K01, KMBM_K02, KMBM_K05, KMBM_K07, KMBM_K10	3	100	4	4	0,4	T	Z		DN	P	K
3	W10MBM-SM4047D	Master Thesis II				0,47		KMBM_U01, KMBM_U02, KMBM_U12, KMBM_U13, KMBM_U15, KMBM_U16, KMBM_K01, KMBM_K02, KMBM_K04, KMBM_K05, KMBM_K06, KMBM_K07, KMBM_K10	7	375	15	15	0,8	T	Z		DN	P	K
		Total	**0**	**0**	**0**	**0,67**	**2**		**40**	**525**	**21**	**21**	**2,6**						

Altogether for main field of study blocks

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes (5)	Number of ECTS points for BU classes (1)
lec	cl	lab	pr	sem					
0	0	0	0,67	2	40	525	21	21	2,6

4.2.4 List of specialization blocks

4.2.4.1 Specialization subjects block (min. 0 ECTS points)

Specialization: Automotive Engineering (AEN)

No.	Subject / group of classes code	Name of Subject / group of classes (denote group of classes with symbol "GK")	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form (2) of Subject / group of classes	Way (3) of crediting	Subject / group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN classes (5)	BU classes (1)			University -wide (4)	Concerning sci. activ. (5)	Practical (6)	Type (7)
1	W10MBM-SM4040L	Alternative Drive Systems			2			KMBM_U05, KMBM_U08, KMBM_U14, KMBM_K01, KMBM_K06, KMBM_K08	30	50	2	2	1,4	T	Z		DN	P	S
2	W05MBM-SM4002W	Alternative Drive Systems	2					KMBM_W04, KMBM_W09,	30	50	2	2	1,2	T	Z		DN		S
3	W10MBM-SM4043W	Automotive Expertises	1					KMBM_W03, KMBM_W05, KMBM_W06	15	25	1	1	0,6	T	Z		DN		S
4	W10MBM-SM4043L	Automotive Expertises			2			KMBM_U02, KMBM_U08, KMBM_U13, KMBM_U15, KMBM_K03, KMBM_K05, KMBM_K10	30	50	2	2	1,4	T	Z		DN	P	S
5	W10MBM-SM4043S	Automotive Expertises					2	KMBM_U02, KMBM_U08, KMBM_U13, KMBM_U15, KMBM_K03, KMBM_K05, KMBM_K10	30	50	2	2	1,4	T	Z		DN	P	S
6	W03MBM-SM4002W	Chemistry and Green Fuels	2					KMBM_W07, KMBM_W09	30	50	2		1,2	T	E				S
7	W03MBM-SM4002L	Chemistry and Green Fuels			2			KMBM_U09, KMBM_K06, KMBM_K08, KMBM_K10	30	50	2		1,4	T	Z			P	S
8	W10MBM-SM4045W	Ecology of Road Transportation	2					KMBM_W05, KMBM_W07	30	50	2	2	1,2	T	Z		DN		S

9	W10MBM-SM4045P	Ecology of Road Transportation				3		KMBM_U01, KMBM_U02, KMBM_U13, KMBM_K03, KMBM_K06	45	50	2	2	2,0	T	Z		DN	P	S
10	W10MBM-SM4038W	Electronics in Car Vehicles	2					KMBM_W06, KMBM_W09, KMBM_W12	30	50	2	2	1,2	T	Z		DN		S
11	W10MBM-SM4038L	Electronics in Car Vehicles			1			KMBM_U05, KMBM_U07, KMBM_U08, KMBM_U09, KMBM_U14, KMBM_K03, KMBM_K06, KMBM_K10,	15	25	1	1	0,7	T	Z		DN	P	S
12	W10MBM-SM4038P	Electronics in Car Vehicles				1		KMBM_U05, KMBM_U07, KMBM_U08, KMBM_U09, KMBM_U14, KMBM_K03, KMBM_K06, KMBM_K10,	15	25	1	1	0,7	T	Z		DN	P	S
13	W10MBM-SM4046W	Safety of Vehicle	2					KMBM_W04, KMBM_K05	30	50	2	2	1,2	T	Z		DN		S
14	W10MBM-SM4046L	Safety of Vehicle			2			KMBM_U05, KMBM_U09, KMBM_U10, KMBM_K03, KMBM_K06	30	50	2	2	1,4	T	Z		DN	P	S
13	P	BLOCK: Project CAD/FEM				3		KMBM_U07, KMBM_U08, KMBM_U10, KMBM_U13, KMBM_U14, KMBM_U15, KMBM_K03, KMBM_K07, KMBM_K09	45	50	2	2	2,0	T	Z		DN	P	S
	W10MBM-SM4048P	Project CAD/FEM - Metals				3													
	W10MBM-SM4049P	Project CAD/FEM - Flows				3													
		Total	**11**	**0**	**9**	**7**	**2**		**435**	**675**	**27**	**23**	**18,8**						

Altogether for specialization blocks

Total number of hours				
lec	cl	lab	pr	sem
11	0	9	7	2

Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes (5)	Number of ECTS points for BU classes (1)
435	675	27	23	18,8

4.3 Training block - concerning principles of training crediting

Name of training				
Number of ECTS points	**Number of ECTS points for DN classes (5)**	**Number of ECTS points for BU classes (1)**	**Training crediting mode**	**Code**
0	0	0		
Training duration	**Training objective**			

4.4 „Diploma dissertation" block (if it is foreseen at first level studies)

Type of diploma dissertation	Master's thesis	
Number of diploma dissertation semesters	**Number of ECTS points**	**Code**
2	19	W10MBM-SM4041D, W10MBM-SM4047D
Character of diploma dissertation	The subject of the master's thesis is a comprehensive solution to the problem in mechanics and machine construction, preceded by literature analysis. The work is not only descriptive, but the student's contribution is also visible.	
Number of ECTS points for BU classes (1)	1,2	
Number of ECTS points for DN classes (5)	19	
Number of hours of organized classes ZZU	10	

5. Ways of verifying assumed learning outcomes

Form of classes	**Ways of verifying assumed learning outcomes**
lecture	exam, colloquium, quiz, oral response, participation in the discussion
class	test, colloquium, project preparation assessment, quiz, oral response, survey
laboratory	quiz, laboratory report, test, oral answer, survey, activity, report, discussion
project	project defence, colloquium, quiz, test, problem discussion, project presentation, report, oral answer
seminar	participation in the discussion, presentation of the topic, activity, report
training	report from training
diploma dissertation	prepared diploma dissertation

6. Range of diploma examination

The diploma exam is an oral exam checking knowledge acquired by a student during his studies in the scope of a given plan and study program, in particular subjects' cards. During the exam, the students were asked three questions: one question from the first group and two from the second group.
- The first group focuses on the thematic area of generally understood mechanical engineering in the field of mechanics and machine construction,
- The second group - the scope covers issues related to specialization in a given thematic area.

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

No.	Subject / group of classes code	Name of Subject / group of classes (denote group of classes with symbol "GK")	Crediting by deadline of... (number of semester)
1			

8. Plan of studies (attachment no. 4)

Approved by faculty student government legislative body:

..... Date

..... Name and surname, signature of student representative

..... Date

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

1 BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
2 Traditional – enter T, remote – enter Z
3 Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
4 University-wide subject /group of classes – enter O
5 DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
6 Practical subject / group of classes – enter P. For the group of classes – in brackets enter the number of ECTS points assigned to practical courses
7 KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

PLAN OF STUDIES

FACULTY:	**Faculty of Mechanical Engineering**
MAIN FIELD OF STUDY:	**Mechanics and Machine Building**
EDUCATION LEVEL:	**second-level studies**
FORM OF STUDIES:	**full-time studies**
PROFILE:	**general academic**
SPECIALIZATION:	**Automotive Engineering**
LANGUAGE OF STUDY:	**english**
IN EFFECT SINCE:	**2023/2024**

*delete as applicable

Plan of studies structure (optionally)
in ECTS point and/or hourly layout

1. Set of obligatory and optional subjects and groups of classes in semestral arrangement

Semester 1

Obligatory subjects / groups of classes **Number of ECTS points 28**

No.	Subject / group of classes code	Name of Subject / group of classes (denote group of classes with symbol "GK")	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form (2) of Subject / group of classes	Way (3) of crediting	Subject / group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN classes (5)	BU classes (1)			University -wide (4)	Concerning sci. activ. (5)	Practical (6)	Type (7)
1	W10MBM-SM4032W	Analytical Mechanics	2,0					KMBM_W01, KMBM_W02	30	50	2	2	1,2	T	E		DN		PD
2	W10MBM-SM4032C	Analytical Mechanics		1,0				KMBM_U04, KMBM_K03	15	50	2	2	0,7	T	Z		DN	P	PD
3	W10MBM-SM4026W	Applied Mathematics - Operational Methods in Automotive Engineering	2,0					KMBM_W01	30	50	2		1,2	T	Z				PD
4	W10MBM-SM4025S	Communication for Engineers					2,0	KMBM_U02, KMBM_U03, KMBM_U13, KMBM_K01, KMBM_K07, KMBM_K08, KMBM_K09, KMBM_K10	30	50	2		1,4	T	Z			P	KO
5	W10MBM-SM4033W	Design of Engineering Materials	1,0					KMBM_W05, KMBM_W07	15	25	1	1	0,6	T	Z		DN		K
6	W10MBM-SM4033P	Design of Engineering Materials				1,0		KMBM_U01, KMBM_K04, KMBM_K05, KMBM_K06	15	25	1	1	0,7	T	Z		DN	P	K
7	W10MBM-SM4027W	Energy Efficiency Design of Powertrain and Body	2,0					KMBM_W04, KMBM_W05, KMBM_W09	30	50	2	2	1,2	T	E		DN		K
8	W10MBM-SM4027L	Energy Efficiency Design of Powertrain and Body			2,0			KMBM_U01, KMBM_U05, KMBM_U09, KMBM_K03, KMBM_K06, KMBM_K08	30	50	2	2	1,4	T	Z		DN	P	K
9	W10MBM-SM4034W	Fatigue of Materials and Fracture Mechanics	2,0					KMBM_W03, KMBM_K05	30	50	2	2	1,2	T	Z		DN		K
10	W10MBM-SM4028W	Machine and Device Control Systems	2,0					KMBM_W04	30	50	2		1,2	T	Z				K
11	W10MBM-SM4028L	Machine and Device Control Systems			2,0			KMBM_U01, KMBM_U14, KMBM_K03,KMBM_K05	30	50	2		1,4	T	Z			P	K
12	W10MBM-SM4029W	Machinery Design Process	2,0					KMBM_W03, KMBM_W12	30	50	2	2	1,2	T	Z		DN		K
13	W10MBM-SM4029P	Machinery Design Process				1,0		KMBM_U01, KMBM_U07, KMBM_K03, KMBM_K05, KMBM_K09	15	25	1	1	0,7	T	Z		DN	P	K
14	W10MBM-SM4030P	Modelling of Multi-Body Systems				2,0		KMBM_U01, KMBM_U02, KMBM_U05	30	50	2	2	1,4	T	Z		DN	P	K
15	W10MBM-SM4035W	Surface Engineering	1,0					KMBM_W05, KMBM_W07	15	25	1	1	0,6	T	Z		DN		K
16	W10MBM-SM4035L	Surface Engineering			1,0			KMBM_U01	15	25	1	1	0,7	T	Z		DN	P	K
17	W10MBM-SM4031L	Testing of Vehicle Elements and Assemblies			1,0			KMBM_U01, KMBM_U05, KMBM_U09, KMBM_K04, KMBM_K05	15	25	1	1	0,7	T	Z		DN	P	K
		Total	**14,0**	**1,0**	**6,0**	**4,0**	**2,0**		**405**	**700**	**28**	**20**	**17,2**						

Optional subjects / groups of classes **Number of ECTS points 2**

No.	Subject / group of classes code	Name of Subject / group of classes (denote group of classes with symbol "GK")	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form (2) of Subject / group of classes	Way (3) of crediting	Subject / group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN classes (5)	BU classes (1)			University -wide (4)	Concerning sci. activ. (5)	Practical (6)	Type (7)
1	SJO-SM0001C	Foreign language I		1,0				KMBM_U11, KMBM_K02	15	30	1		0,5	T	Z	O		P	KO
2	W08MBM-SM4002W	The basis of negotiations	1,0					KMBM_W08, KMBM_W10, KMBM_K01, KMBM_K02, KMBM_K07	15	25	1		0,6	T	Z	O			KO
		Total	**1,0**	**1,0**	**0,0**	**0,0**	**0,0**		**30**	**55**	**2**	**0**	**1,1**						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes (5)	Number of ECTS points for BU classes (1)
lec	cl	lab	pr	sem					
15,0	2,0	6,0	4,0	2,0	435	755	30	20	18,3

Semester 2

Obligatory subjects / groups of classes **Number of ECTS points 10**

No.	Subject / group of classes code	Name of Subject / group of classes (denote group of classes with symbol "GK")	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form (2) of Subject / group of classes	Way (3) of crediting	Subject / group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN classes (5)	BU classes (1)			University -wide (4)	Concerning sci. activ. (5)	Practical (6)	Type (7)
1	W10MBM-SM4036W	Developing Engine Technology	2,0					KMBM_W03, KMBM_W04, KMBM_W05, KMBM_W09	30	50	2	2	1,2	T	E		DN		K
2	W10MBM-SM4036L	Developing Engine Technology			2,0			KMBM_U03, KMBM_U09, KMBM_U10, KMBM_K01, KMBM_K06, KMBM_K08	30	50	2	2	1,4	T	Z		DN	P	K
3	W10MBM-SM4042W	Fluids Mechanics in Automotive Design	1,0					KMBM_W08, KMBM_W09	15	25	1	1	0,6	T	Z		DN		K
4	W10MBM-SM4042L	Fluids Mechanics in Automotive Design			1,0			KMBM_U04, KMBM_U05, KMBM_U08, KMBM_K06	15	25	1	1	0,7	T	Z		DN	P	K
5	W10MBM-SM4037W	Management for Engineers	2,0					KMBM_W06, KMBM_W08, KMBM_W11, KMBM_K01, KMBM_K05, KMBM_K07, KMBM_K08	30	50	2		1,2	T	Z				KO
6	W10MBM-SM4039W	Non Destructive Evaluation in Contemporary Manufacturing Systems	1,0					KMBM_W03, KMBM_W07	15	25	1	1	0,6	T	Z		DN		K
7	W10MBM-SM4039L	Non Destructive Evaluation in Contemporary Manufacturing Systems			1,0			KMBM_U09, U13, KMBM_K03, KMBM_K06, KMBM_K09	15	25	1	1	0,7	T	Z		DN	P	K
		Total	**6,0**	**0,0**	**4,0**	**0,0**	**0,0**		**150**	**250**	**10**	**8**	**6,3**						

Optional subjects / groups of classes **Number of ECTS points** **20**

No.	Subject / group of classes code	Name of Subject / group of classes (denote group of classes with symbol "GK")	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form (2) of Subject / group of classes	Way (3) of crediting	Subject / group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN classes (5)	BU classes (1)			University -wide (4)	Concerning sci. activ. (5)	Practical (6)	Type (7)
1	W10MBM-SM4040L	Alternative Drive Systems			2,0			KMBM_U05, KMBM_U08, KMBM_U14, KMBM_K01, KMBM_K06, KMBM_K08	30	50	2	2	1,4	T	Z		DN	P	S
2	W05MBM-SM4002W	Alternative Drive Systems	2,0					KMBM_W04, KMBM_W09,	30	50	2	2	1,2	T	Z		DN		S
3	W03MBM-SM4002W	Chemistry and Green Fuels	2,0					KMBM_W07, KMBM_W09	30	50	2		1,2	T	E				S
4	W03MBM-SM4002L	Chemistry and Green Fuels			2,0			KMBM_U09, KMBM_K06, KMBM_K08, KMBM_K10	30	50	2		1,4	T	Z			P	S
5	W10MBM-SM4038W	Electronics in Car Vehicles	2,0					KMBM_W06, KMBM_W09, KMBM_W12	30	50	2	2	1,2	T	Z		DN		S
6	W10MBM-SM4038L	Electronics in Car Vehicles			1,0			KMBM_U05, KMBM_U07, KMBM_U08, KMBM_U09, KMBM_U14, KMBM_K03, KMBM_K06, KMBM_K10,	15	25	1	1	0,7	T	Z		DN	P	S
7	W10MBM-SM4038P	Electronics in Car Vehicles				1,0		KMBM_U05, KMBM_U07, KMBM_U08, KMBM_U09, KMBM_U14, KMBM_K03, KMBM_K06, KMBM_K10,	15	25	1	1	0,7	T	Z		DN	P	S
8	SJO-SM0002C	Foreign Language II		3,0				KMBM_U06, KMBM_K02	45	60	2		1,5	T	Z	O		P	KO
9	W10MBM-SM4041D	Master Thesis I				0,2		KMBM_U01, KMBM_U02, KMBM_U12, KMBM_U13, KMBM_U15, KMBM_U16, KMBM_K01, KMBM_K02, KMBM_K05, KMBM_K07, KMBM_K10	3	100	4	4	0,4	T	Z		DN	P	K
10		BLOCK: Project CAD/FEM				3,0		KMBM_U07, KMBM_U08, KMBM_U10, KMBM_U13, KMBM_U14, KMBM_U15, KMBM_K03, KMBM_K07, KMBM_K09	45	50	2	2	2,0	T	Z		DN	P	S
	W10MBM-SM4048P	Project CAD/FEM - Metals				3,0													
	W10MBM-SM4049P	Project CAD/FEM - Flows				3,0													
		Total	**6,0**	**3,0**	**5,0**	**4,2**	**0,0**		**273**	**510**	**20**	**14**	**11,6**						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes (5)	Number of ECTS points for BU classes (1)
lec	cl	lab	pr	sem					
12,0	3,0	9,0	4,2	0,0	423	760	30	22	17,9

Semester 3

Obligatory subjects / groups of classes **Number of ECTS points** **0**

No.	Subject / group of classes code	Name of Subject / group of classes (denote group of classes with symbol "GK")	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form (2) of Subject / group of classes	Way (3) of crediting	Subject / group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN classes (5)	BU classes (1)			University -wide (4)	Concerning sci. activ. (5)	Practical (6)	Type (7)
1																			
		Total	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**		**0**	**0**	**0**	**0**	**0,0**						

Optional subjects / groups of classes **Number of ECTS points** **30**

No.	Subject / group of classes code	Name of Subject / group of classes (denote group of classes with symbol "GK")	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form (2) of Subject / group of classes	Way (3) of crediting	Subject / group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN classes (5)	BU classes (1)			University -wide (4)	Concerning sci. activ. (5)	Practical (6)	Type (7)
1	W10MBM-SM4043W	Automotive Expertises	1,0					KMBM_W03, KMBM_W05, KMBM_W06	15	25	1	1	0,6	T	Z		DN		S
2	W10MBM-SM4043L	Automotive Expertises			2,0			KMBM_U02, KMBM_U08, KMBM_U13, KMBM_U15, KMBM_K03, KMBM_K05, KMBM_K10	30	50	2	2	1,4	T	Z		DN	P	S
3	W10MBM-SM4043S	Automotive Expertises					2,0	KMBM_U02, KMBM_U08, KMBM_U13, KMBM_U15, KMBM_K03, KMBM_K05, KMBM_K10	30	50	2	2	1,4	T	Z		DN	P	S
4	W10MBM-SM4044S	Diploma Seminar					2,0	KMBM_U01, KMBM_U02, KMBM_U03, KMBM_U12, KMBM_U13, KMBM_U15, KMBM_U16, KMBM_K01, KMBM_K02, KMBM_K04, KMBM_K07,K MBM_K09	30	50	2	2	1,4	T	Z		DN	P	K
5	W10MBM-SM4045W	Ecology of Road Transportation	2,0					KMBM_W05, KMBM_W07	30	50	2	2	1,2	T	Z		DN		S
6	W10MBM-SM4045P	Ecology of Road Transportation				3,0		KMBM_U01, KMBM_U02, KMBM_U13, KMBM_K03, KMBM_K06	45	50	2	2	2,0	T	Z		DN	P	S
7	W10MBM-SM4047D	Master Thesis II				0,47		KMBM_U01, KMBM_U02, KMBM_U12, KMBM_U13, KMBM_U15, KMBM_U16, KMBM_K01, KMBM_K02, KMBM_K04, KMBM_K05, KMBM_K06, KMBM_K07, KMBM_K10	7	375	15	15	0,8	T	Z		DN	P	K
8	W10MBM-SM4046W	Safety of Vehicle	2,0					KMBM_W04, KMBM_K05	30	50	2	2	1,2	T	Z		DN		S
9	W10MBM-SM4046L	Safety of Vehicle			2,0			KMBM_U05, KMBM_U09, KMBM_U10, KMBM_K03, KMBM_K06	30	50	2	2	1,4	T	Z		DN	P	S
		Total	**5,0**	**0,0**	**4,0**	**3,47**	**4,0**		**247**	**750**	**30**	**30**	**11,3**						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes (5)	Number of ECTS points for BU classes (1)
lec	cl	lab	pr	sem					
5,0	0,0	4,0	3,47	4,0	247	750	30	30	11,3

2. Set of examinations in semestral arrangement

Subject / group of classes code	Names of subjects / groups of classes ending with examination	Semester
W10MBM-SM4032W	Analytical Mechanics	1
W10MBM-SM4027W	Energy Efficiency Design of Powertrain and Body	1
W03MBM-SM4002W	Chemistry and Green Fuels	2
W10MBM-SM4036W	Developing Engine Technology	2

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

Semester	Allowable deficit of ECTS points after semester

1	7
2	5
3	0

Approved by faculty student government legislative body:

.....	.....
Date	Name and surname, signature of student representative
.....	.....
Date	Signature of the Dean of the Faculty / Director of the Branch

1 BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
2 Traditional – enter T, remote – enter Z
3 Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
4 University-wide subject /group of classes – enter O
5 DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
6 Practical subject / group of classes – enter P. For the group of classes – in brackets enter the number of ECTS points assigned to practical courses
7 KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Faculty of Mechanical Engineering

SUBJECT CARD

Name of subject in Polish: **Chemia i paliwa alternatywne**
Name of subject in English: **Chemistry and Green Fuels**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **W03MBM-SM4002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	50		50		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the basics of motor vehicle construction and operation, and basic chemistry.
2. The ability to perform laboratory exercises independently, supported by elementary manual dexterity.
3. Ability to perform simple calculations and create graphs in a computer program of choice. Ability to create reports in any word processor.

SUBJECT OBJECTIVES

C1. Familiarization with the physical and chemical properties of petroleum and alternative fuels, as well as methods of their analysis, production, storage and distribution, and operating conditions.
C2. Familiarization with global trends in the fuel market including biofuels.
C3. Acquire the ability to analyze the relationship between fuel properties, operating conditions, and environmental impacts.
C4. Acquire the ability to test fuel properties according to standards and analyze the results obtained.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

PEU_W01 - Knows the chemical and technological concept of the processes of production and use of fuels, including biofuels. Knows the sources of information about the properties of raw materials to produce fuels, including biofuels, and the products obtained from them. Can identify, describe, and characterize the basic raw material sources of fuels, including biofuels.

PEU_W02 - Knows the basic properties of biofuels and the principles of selecting fuels for propulsion systems. Knows methods of reducing the impact of motor fuel combustion on the environment. Knows the basic economic trends in alternative fuels.

PEU_W03 - Knows the sources of information on current standards regulating the properties of motor fuels.

II. Relating to skills:

PEU_U01 - Can critically analyze the information contained in literature sources and draw conclusions from them. Deepens in his own knowledge of fuels, including biofuels.

PEU_U02 - Able to provide a critical, factual evaluation of fuel production technologies used in the industry in terms of economic effects, environmental impact, product quality and social factors.

PEU_U03 - Has the ability to conduct experiments in the analysis of physical and chemical properties of fuels. Can determine the quality and utility of the tested fuel based on the results obtained. Knows the principles of safe work in a chemical laboratory.

III. Relating to social competences:

PEU_K01 - Can use in practice the acquired theoretical and practical knowledge and apply the possessed skills.

PEU_K02 - Can predict the effects of fuel operation on vehicles and the environment.

PEU_K03 - Understands the need to formulate and communicate information and opinions to the public regarding the
operation of biofuels in vehicles and for the environment.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction	1
Lec2	Properties, classification, and chemistry of petroleum products	2
Lec3	Methods of testing the properties of petroleum products, and the applicable standards in this area	2
Lec4	Fuel additives, a way to improve the properties of petroleum-based fuels	2
Lec5	LPG - properties and production	3
Lec6	Liquid fuels from coal processing - production and properties	2
Lec7	Natural gas	2
Lec8	Properties, classification and chemistry of biofuels	3
Lec9	Gaseous biofuels (biogas, DME, biohydrogen) - properties and production	3
Lec10	Hydrogen and fuel cells	3
Lec11	Biodiesel - properties and production	3

Lec12	Alcohols as a substitute for gasoline	2
Lec13	Renewable fuels - forecasts and trends	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Introduction and general Occupational Safety and Health rules in chemical laboratory	1
Lab2	Fuel sampling methodology	1
Lab3	Determination of fractional composition of gasoline	2
Lab4	Determination of density and gum content in gasoline	3
Lab5	Determination of vapor pressure of gasoline	2
Lab6	Preparation of rapeseed oil methyl esters (RME)	4
Lab7	Determination of fractional composition of diesel oil	2
Lab8	Determination of density and viscosity of diesel oil and biodiesel	3
Lab9	Calculation of cetane index of diesel oil and biodiesel	2
Lab10	Determination of ester content in diesel	2
Lab11	Determination of flash point of B-10 fuel	3
Lab12	Determination of low-temperature properties of biodiesel	3
Lab13	Determination of heat of combustion of diesel oil and biodiesel	2
		Total hours: 30

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

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_K02, PEU_K03	exam
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01- PEU_U03, PEU_K01	Average of reports
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SECONDARY LITERATURE

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name of subject in Polish: **Alternatywne układy napędowe**
Name of subject in English: **Alternative Drive Systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **W05MBM-SM4002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	50				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The base knowlege about electricity, definition of DC and AC voltage and electrical current, resistancy, reactancy, impedancy, electrical capacity and inductancy, frequency,active,reactive and apperancy elecrtical power, rules of Ohm and Kirchoff, calculation of simply electrical circuits, unstabil status of circuits,, electrical sources, batteries.
2. The base knowlege about electronics, diodes, transistors,amplifiers,integrated circuits,regulators and supplyers. The base knowlege about theory of regulations.
3. The base knowlage about electrical machines and electrical drives DC and AC.

SUBJECT OBJECTIVES

C1. The knowlege of base sources of electrical energy and their power supply in motor vehickles of convetional, electrical and hybrid types.
C2. The knowlege of basic power electronical circuits applied in motor vehickles of electrical and hybrid types.
C3. The knowlege of basic electrical drives with brushless electrical machines as a main drives of hybrid motor vehickles.
C4. The knowlege of hybrid vehickles with series and paralell drives.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - The student is able to define the condition for power supply circuits of electrical and hybrid vehickles and calculate the main parameters of batteries and ultracapacitors.
PEU_W02 - The student is able to apply of power electronics systems of control of drives for electrical and hybrid vehickles, describe the main relations of voltage and current,rotation speed,process of dynamical starts,constans drive and braking ststus.
PEU_W03 - The student is able to describe condition of work status of series and paralell hybrid drives.

II. Relating to skills:

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	The repertory of fundamentals of electritechnics	2
Lec2	The description of basic electrical sources supply of hybrid and electrical drives and present applied solutions of vehickles	2
Lec3	The description of different types of batteries and ultracapacitors	2
Lec4	The description base power electronics elements	2
Lec5	The description and analysis status of one and two puls rectifiers	2
Lec6	The description and analysis status of three and six puls rectifiers	2
Lec7	The analysis of status of DC choppers	4
Lec8	The analysis of status of different type of converters	6
Lec9	The analysis of status of different type of electrical machines DC and AC supply	4
Lec10	The analysis of status of brushless machines type BLDC	2
Lec11	The control systems of converters with brushless machines type BLDC	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. case study

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

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE 1.Maciej Pawłowski:Alternative drive systems, Wydawnictwo Polit.Wrocł.Wrocław 2011 2.Ali Emadi: Handbook of Automotive Power Electronics and Motor Drives.T&F Group, Boca Ratan' Illinois 2005 SECONDARY LITERATURE 1.K.Jankowski.Elektrotechnika samochodowa-Ćwiczenia Laboratoryjne.Wyd.Politechn.Radomskiej 2010 2.Czerwiński A.:Akumulatory-baterie-ogniwa.WKiŁ,Warszawa 2005 3.Herner A.,Riehl H-J.:Elektrotechnika i elektronika w pojazdach Samochodowych.WKiŁ,Warszawa 2010

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name of subject in Polish: **The basis of negotiations (Podstawy negocjacji)**
Name of subject in English: **The basis of negotiations**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **W08MBM-SM4002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	25				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. A lack of prerequisites

SUBJECT OBJECTIVES

C1. Acquiring communication skills and managing the negotiation process in a professional and non-professional environment with the use of various bargaining styles and tactics.
C2. Acquiring the ability to select negotiation techniques adequately to the realization of own goals and interests.
C3. Acquiring communication skills in crisis situations.
C4. Increase the awareness of own influence on the solution - closing of the negotiation process.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - knows and understands the social conditions of undertaking various types of professional activities relating to the awarded qualification, including regulations on industrial property rights and copyrights

II. Relating to skills:

III. Relating to social competences:
PEU_K01 - Is prepared to acquire new competencies and collaborate with professionals from other fields, especially in the area of productivity
PEU_K02 - Understands the role of innovation and creativity in performing tasks.
PEU_K03 - Can perform tasks in a pragmatic and creative manner

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to the classes (presenting the purpose and effects of the course, learning about students' expectations, key competences and negotiations, rules of course work and its completion). Truths and myths about negotiations.	1
Lec2	Attitude and interests as a condition for success (preparation for negotiations - building and using tools to define goals, interests, priorities, assessing one's own position and the partner's position, identifying partners' needs, analyzing problems)	2
Lec3	Conflict as an opportunity to obtain additional profits. Crisis communication (definition of conflicts, conflict management, learning methods and ways of resolving conflicts).	2
Lec4	Ways to build strength in negotiations. Business dialogue. Defending your own opinion (building good contacts, ladder of reasoning - from facts to conclusions, needs analysis - as a tool for building arguments in negotiations, using linguistic techniques to build an advantage).	2
Lec5	Emotions and non-verbal tactics in negotiations (Recognizing your own emotions, dealing with difficult emotions of yourself and your partner, dealing with criticism and objections, body language, how to sit at the table to achieve the intended goals).	2
Lec6	Negotiation tactics (selection of techniques and strategies for the negotiation phase)	4
Lec7	Final presentations.	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. tutorials N3. problem discussion N4. case study

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_K01-PEU_K03	Final presentation
F2	PEU_W01, PEU_K01-PEU_K03	Activity in classes
P = 0.6*F1+0.4*F2		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE [1] Shapiro „Negotiating the nonnegotiable: How to resolve your most emotionally charged conflicts”, 2006, Pengium [2] Dawson R. „Secrets of power negotiating for salespeople”, 2010, Career Press [3] Fisher, Ury „Getting to YES, Negotiating agreement without giving out”, 2011 Penguin Books [4] Camp J. „Start with NO...The Negotiating Tools that the Pros Don't Want You to Know”, 2002, Hardcover SECONDARY LITERATURE

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name of subject in Polish: **Komunikacja dla inżynierów**
Name of subject in English: **Social communication for engineers**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SM4025**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					30
Number of hours of total student workload (CNPS)					50
Form of crediting					Crediting with grade
Group of courses					
Number of ECTS points					2
including number of ECTS points for practical (P) classes					2
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)					1.4

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. None

SUBJECT OBJECTIVES

C1. Getting to know the basic tasks of social communication.
C2. Learning the basic principles of human resources management.
C3. Gaining teamwork skills.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:

PEU_U01 - The ability to properly communicate with the environment, especially in the field of substantive engineering discussions.
PEU_U02 - Gained the skills of building a project team, working within a team and managing it.
PEU_U03 - It has the ability to present information.

III. Relating to social competences:

PEU_K01 - Be able to work independently and in a team and correctly assess the priorities of tasks.
PEU_K02 - Use language skills in interpersonal contacts and communication in an international professional environment.

PROGRAM CONTENT

Form of classes – Seminar		Number of hours
Sem1	The concept of social communication - definition, role, types.	2
Sem2	Recruitment and selection in communication - types, form, documents.	2
Sem3	Introducing team members to the workplace – job and rest.	2
Sem4	Negotiations, mediation, facilitation, arbitration.	2
Sem5	Motivation of a single employee and a group of people.	2
Sem6	Evaluation of work and employee.	2
Sem7	Cooperation with people with disabilities.	2
Sem8	Mobbing, stalking, harassment.	2
Sem9	Addictions at work.	2
Sem10	The importance of meeting spaces.	2
Sem11	The essence of non-verbal behavior - body language.	2
Sem12	International social communication - selected example.	2
Sem13	Elements of individual and group promotion (PR).	2
Sem14	Public appearances - lectures and presentations.	2
Sem15	Human resource management - case study.	2
		Total hours: 30

TEACHING TOOLS USED
N1. multimedia presentation N2. problem discussion N3. case study N4. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01; PEU_U02; PEU_K01	Participation in the problem discussion.
F2	PEU_U03; PEU_K02	Presentation of the topic selected.
P = 0,2F1+0,8F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.Greene J.O., Burleson B.R., Handbook of communication and social interaction skills, Zoya 2022
2.Armstrong M.; Human Resource Management. Strategy and Operation, Kogan Page 1996
3.Barker L.L.; Listening Behavior, New Orleans, SPECTRA 1990
4.Hoskins J., Social Skills & Communication Mastery, 2021

SECONDARY LITERATURE

1.Lewis S., Cooper C.L.; Work-Life Integration, Wiley, Chichester 2005
2.Smith M.J.; When I Say No, I feel Guilty, New York, Bantam 1985
3.Wendler D., Improve Your Social Skills 2014
4.Fast J.; The Body Language, New York 1994

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name of subject in Polish: **Matematyka stosowana- metody badań operacyjnych w inżynierii pojazdów**
Name of subject in English: **Applied Mathematics - Operational Methods in Automotive Engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SM4026**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	50				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Students have the knowledge from the courses: Mathematical Analysis I, Algebra and Analytic Geometry confirmed with positive grades completing the courses

SUBJECT OBJECTIVES

C1. Acquiring the knowledge of analytical and numerical optimization methods
C2. Ability to formulate optimization models and their solving in the decision-making process

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

PEU_W01 - A course participant has the basic knowledge on the supporting methods of taking optimum decisions.
PEU_W02 - She/he knows analytical and numerical algorithms of solution of linear and nonlinear programming. He /she knows optimization IT tools.

II. Relating to skills:

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to Optimization Theory and Operations Research (OR): basic definitions, examples of optimization problems, OR in a decision-making process, OR history, classification of OR methods and algorithms. Linear programming: linear model, feasible and optimum decisions.	2
Lec2	Linear programming – the graphical method. Interpretation of method's results.	2
Lec3	Linear programming – the minimization problem. Sensitivity analysis of the optimum solution.	2
Lec4	The Simplex method – a maximization case, a minimization case (the big M method).	3
Lec5	IT tools for solutions of linear programming problems.	1
Lec6	Linear programming – examples of application: Production processes options / Trim losses (Material losses) minimizing, Diet Problem / Mixture problem, Allocation / Transportation problems, Process Control Problem, Linear-fractional Programming.	8
Lec7	Multi-criteria programming.	2
Lec8	Nonlinear programming: introduction, unconstrained optimization, constrained optimization with equality constraints (the method of Lagrange multipliers), constrained optimization with inequality constraints (Kuhn – Tucker conditions).	2
Lec9	Nonlinear programming: numerical methods of a single-variable and multivariable optimization.	4
Lec10	Network programming: Minimum Spanning Tree, Maximum Flow in a Network.	2
Lec11	Final test.	2
		Total hours: 30

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

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

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SECONDARY LITERATURE

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name of subject in Polish: **Sterowanie maszyn i urządzeń**
Name of subject in English: **Machine and Device Control Systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SM4028**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	50		50		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge about basic hydraulic components.
2. Basic knowledge about fluid power control systems.
3. Basic knowledge regarding pneumatic control systems.

SUBJECT OBJECTIVES

C1. Acquire knowledge about hydraulic and electrohydraulic control systems.
C2. Acquire knowledge about proportional valves and servovalves.
C3. Acquire knowledge about pneumatic control systems
C4. Acquire knowledge about design of control systems.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

PEU_W01 - Know basic hydraulic and electrohydraulic control systems.
PEU_W02 - Know the design principles of proportional valves and servovalves.
PEU_W03 - Know basic kind of pneumatic systems.

II. Relating to skills:

PEU_U01 - Able to solve the problems connecting with hydraulic and electrohydraulic control.
PEU_U02 - Able to solve questions connected with application of proportional valves and servovalves.
PEU_U03 - Able to solve basic questions connected with pneumatic control systems.

III. Relating to social competences:

PEU_K01 - Effective search of informations and it critical evaluation.
PEU_K02 - Capability to work in a team with clear distribution of obligations and effectvie solving of entrusted tasks.
PEU_K03 - Capability of proper argumentation and substantiation of own point of view.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction and definition of machine control system. Open and close loop control systems.	2
Lec2	Hydraulic components - pumps, hydraulic motors, valves, cylinders, filters, accumulators, etc.	2
Lec3	Basic principles in the design of hydraulic control systems.	2
Lec4	Structures of the hydraulic control systems and its design.	2
Lec5	Proportional control valves and servo valves, design principles, examples of application.	2
Lec6	Hydrostatic transmission systems.	2
Lec7	Hydraulic systems with flow rate and pressure regulation. Structure of electrohydraulic control system	2
Lec8	Description of the dynamic behavior of hydraulic control systems. Modeling and simulation methods.	2
Lec9	Transmission of control signals. CAN communication bus.	2
Lec10	Standard electric and electronic signals in electrohydraulic control systems.	2
Lec11	Relay control systems – principle of operation, examples, and typical components.	2
Lec12	Industrial-grade microcontrollers and PLCs – examples and typical operation ratings.	2
Lec13	Industrial-grade microcontrollers and PLCs – applications.	2
Lec14	Sensors in electrohydraulic control systems; sensors, end switches, etc.	2
Lec15	Final test	2

		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Introduction to lab, safety regulations, course passing requirements.	2
Lab2	Direction control in hydraulic systems	2
Lab3	Pressure valves in hydraulic systems.	2
Lab4	Regenerative hydraulic systems.	2
Lab5	Proportional direction control valve.	2
Lab6	Parallel and series connection of hydraulic acting elements.	2
Lab7	Sequence control in hydraulic systems - pressure switch.	2
Lab8	Sequence and time delay control and in hydraulic systems - proximity switch.	2
Lab9	Hydraulic steering systems	2
Lab10	In series throttle control - Meter-in and Meter-Out control.	2
Lab11	Parallel - open and closed loop throttle control.	2
Lab12	Three way flow regulator.	2
Lab13	Introduction to pneumatic systems.	2
Lab14	Sequence control in pneumatic systems.	2
Lab15	Final test	2
		Total hours: 30

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

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

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01 - PEU_U03	short test at the beginning of the class - quiz
F2	PEU_U01 - PEU_U03 PEU_K01--PEU_K03	oral answers
P = 0,2F1+0,4F2+0,4F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. J. Stecki, A. Garbacik: Design and Steady-state Analysis of Hydraulic Control Systems, Fluid Power Net Publications, Cracow 2002
2. J. Ivantysyn, M. Ivantsynowa: Hydrostatic Pumps and Motors, Tech Books International, 2003 - 512
3. S. Stryczek: Napędy i Sterowania Hydrauliczne, PWN Warszawa
4. W. Kollek: Podstawy projektowania napędów i sterowań hydraulicznych , P. Wr., 2004

SECONDARY LITERATURE

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name of subject in Polish: **Podstawy projektowania maszyn**
Name of subject in English: **Machinery Design Process**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SM4029**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	50			25	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of issues related to manufacturability of a design and manufacturing technologies.
2. Basic knowledge in the field of materials science and strength of materials.

SUBJECT OBJECTIVES

C1. Acquiring knowledge of the heuristic methods of group and individual designing.
C2. Acquiring skills in the field of utilising methodological tools in the initial stage of designing and algorithmic tools in the phase of purpose specifying.
C3. Acquiring ability of practical application of knowledge of designing, technology and organisation.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

PEU_W01 - Student has a detailed knowledge of individual and group design.

PEU_W02 - Student has a detailed knowledge of existing tools used in the initial and final stages of the designing process.

PEU_W03 - Student has a detailed knowledge of the assessment and classifying of developed concepts.

II. Relating to skills:

PEU_U01 - Student can search for information in the available literature on the techniques and methods of searching solutions in the designing process.

PEU_U02 - Student can formulate guidelines for the designing process based on specific requirements and limitations.

III. Relating to social competences:

PEU_K01 - Student can determine the consequences of decisions made in a group where he works.

PEU_K02 - Student can make a report of a carried out engineering work.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Scope of the lecture, credit conditions, literature. Models of technical processes and objects.	2
Lec2	Methods of specifying the purpose of designing extensive technical systems (e. g. braking structures, recovery systems, steering mechanisms).	2
Lec3	Heuristic and algorithmic methods: morphological table, solution tree, brainstorming and reverse brainstorming, synectic methods, algorithmic methods - TRIZ.	10
Lec4	Modeling. Construction of models: functional and computational.	8
Lec5	Synthesis. Example and practice of designing machine elements and systems	4
Lec6	Synthesis and ranking of the importance of own assessment criteria. Evaluation and organizing solutions.	2
Lec7	Summary of lectures and additional explanations.	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Scope of the project, credit conditions, literature. Selection and specification of the design object. Construction of object models (e.g. braking structures, regenerative systems, steering mechanisms, etc.).	4
Proj2	Practical use of heuristic and algorithmic methods (morphological table, solution tree for own project, brainstorming and reverse brainstorming, synectic methods, algorithmic methods - TRIZ).	6
Proj3	Synthesis of own assessment criteria, example and practice. Ranking the importance of assessment criteria.	2

Proj4	Creating and organizing preliminary solutions. Evaluation of initial design solutions.	1
Proj5	Detailing the selected, pre-designed device and project documentation.	2
		Total hours: 15

TEACHING TOOLS USED
N1. informative lecture N2. traditional lecture with the use of transparencies and slides N3. problem discussion N4. self study - preparation for project class N5. project presentation

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

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01 - PEU_U02, PEU_K01, PEU_K02	oral answers, report, project acceptance
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Cross N.: Engineering Design Methods, John Wiley & Sons, 1989.
[2] Norton R. L.: Design of Machinery. Sixth edition, McGraw Hill, 2017.

SECONDARY LITERATURE

[1] Norton R. L.: Machine Design: An Integrated Approach. 3/E. Prentice Hall, 2006.
[2] Pahl G., Beitz W. et al. Engineering Design. A Systematic Approach. Springer, 2007.

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name of subject in Polish: **Modelowanie układów wieloczłonowych**
Name of subject in English: **Modelling of multibody systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SM4030**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				50	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of mathematical analysis, matrix algebra
2. Knowledge of the theory of machines and mechanisms
3. Ability to analyze the kinematics and kinetostatics of mechanisms

SUBJECT OBJECTIVES

C1. Understanding of building of discrete computational multibody models
C2. Understanding the principles of planning research, taking into account the working conditions (kinematic excitations, dynamic excitations, forces, torques, masses in multibody dynamic analysis of computer systems
C3. Ability to critically assess the results of simulations of machinery in computer systems for dynamic analysis

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:

PEU_U01 - Ability to apply professional computer system for simulating and analyzing dynamic multibody
PEU_U02 - The ability to model the loads and the nature of work and the ability to analyze the mechanism of the results of the simulation of the multi-segment
PEU_U03 - The ability to compute the kinematics and dynamics of selected groups of mechanisms

III. Relating to social competences:

PEU_K01 - Acquires care about the aesthetics of the work, including projects and reports
PEU_K02 - Knowledge of how to take responsibility for own work

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	An introduction to the principles of building a model of multibody systems	2
Proj2	Basics of modeling planar mechanisms in the multibody dynamics simulation software system- modeling of links, joints, kinematic excitations	2
Proj3	Basics of modeling spatial mechanisms - modeling of loads, perform calculations and rules for analyzing the results of simulation tests	2
Proj4	A multibody system modeling test	2
Proj5	Simulation researches of gears (normal, planetary and differential) - principles of construction of virtual model (project 1)	2
Proj6	Research of kinematic properties of gears (project 1)	2
Proj7	Simulation research of spatial manipulators – direct and inverse transformation – model building (project 2)	2
Proj8	Basics of modeling control systems – building a regulator model (project 2)	2
Proj9	Research on the kinematics and dynamics of manipulator movement along a given trajectory taking into account regulators (project 2)	2
Proj10	Basics of modeling advanced mechanical systems – selected issues (modeling of contact, friction, elasticity)	2
Proj11	Simulation research of selected spatial kinematic systems (e.g. working machines, mechanisms of machines, vehicles) – model building (project 3)	2
Proj12	Research on the kinematics and dynamics – analysis of calculation results (project 3)	2
Proj13	Simulation of advanced mechanical systems (e.g. mobile systems, connections taking into account friction, elasticity) - model construction (project 4)	2
Proj14	Simulation research of the dynamics of movement – analysis of the calculation results (project 4)	2
Proj15	Pass and supplement	2

	Total hours: 30

TEACHING TOOLS USED
N1. problem discussion N2. project presentation N3. self study - preparation for project class N4. report preparation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_K02	building the virtual model - test
F2	PEU_U02,PEU_U03, PEU_K01, PEU_K02	report, defence of the report
P = (1/5)F1+(4/5)F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Gronowicz A.: Podstawy analizy układów kinematycznych. Oficyna Wydawnicza PWr., Wrocław 2003. 2. Frączek J., Wojtyra M.: Metoda układów wieloczłonowych w dynamice mechanizmów. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2007 3. MD. Adams – Reference Manual, 2008 4. Haug E.J.: Computer Aided Kinematics and Dynamics of Mechanical Systems. Allyn and Bacon, Boston 1989 5. Norton R., L.: Design of Machinery, An introduction to the synthesis and analysis of mechanisms of machines. WCB, McGraw-Hill, Boston, 1999. 6. Shabana A. Ahmed: Computational Dynamics, . A
Wiley-Interscience Publications, NewYork, 1994.

SECONDARY LITERATURE

[1] Miller S.: Teoria maszyn i mechanizmów. Analiza układów mechanicznych. Oficyna wydawnicza PWr. Wrocław 1996.
[2] Waldron J., Kinzel G.; Kinematics, dynamics and design of machinery, John Wiley & Sons, Inc. New York, 1999
[3] Miller S.: Układy kinematyczne. Podstawy projektowania. WNT 1988.
[4] MD. Adams – Reference Manual, 2008

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Faculty of Mechanical Engineering

SUBJECT CARD

Name of subject in Polish: **Badania elementów i zespołów maszyn**
Name of subject in English: **Testing of Vehicle Elements and Assemblies**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SM4031**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			15		
Number of hours of total student workload (CNPS)			25		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)			0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of the construction and principles of operation of assemblies and systems of motor vehicles, as well as specialized terminology (in English).
2. Ability to interpret the observed physical phenomena.
3. Knowledge of the techniques of development and presenting the experiment measurements results.

SUBJECT OBJECTIVES

C1. Understanding of the fundamental theories, equipment and methods of analysis of the results of measurements of selected parameters characterizing the properties and/or the performance of elements and assemblies of motor vehicles using modern experimental methods.
C2. Mastering of the practical application of the selected measurement method (selection of the measuring system scheme, the identification of the factors influencing the accuracy of the measurement, interpretation of the data).
C3. Improving the ability to team work.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:

PEU_U01 - Ability to practical application of the representative (for selected methods of measuring mechanical quatities) measurement techniques in the area: construction of the measuring system and data acquisition.
PEU_U02 - Performing a quantitative analysis based on measurements recorded data, including those obtained by optical methods.
PEU_U03 - Formulation of conclusions based on relationships between measured parameters and functioning of the elements and assemblies of the motor vehicles.

III. Relating to social competences:

PEU_K01 - Recognizes the importance of the experimental methods application in the design and operation of vehicles.
PEU_K02 - Demonstrates the ability of self-education (preparation for laboratory classes) and presentation of their work in a foreign language.

PROGRAM CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Application of the acoustic holography in vehicle assembly testing.	2
Lab2	Determination of the temperature field parameters using thermovision.	2
Lab3	Application of the holographic interferometryfor pneumatic valve cover displacement determination or for detection of the vehicle tire defects.	2
Lab4	The sandwich construction displacement measurement using the speckle photography method.	2
Lab5	Application of the ESPI method for chassis frame's element displacement determination.	2
Lab6	Photoelastic investigation of the towing hitch model.	2
Lab7	Application of the photoelastic coating technique for suspension element testing.	2
Lab8	Application of the videoextensometer for large strains determination in rubber or rubber-metal elements of motor vehicles	1
		Total hours: 15

TEACHING TOOLS USED

N1. case study
N2. self study - preparation for laboratory class
N3. laboratory experiment
N4. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U02, PEU_K01-PEU_K03	Lab exercise reports, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Orłoś Z., Doświadczalna analiza odkształceń i naprężeń, PWN, Warszawa 1977.
Szczepiński W., Metody doświadczalne mechaniki ciała stałego, PWN, Warszawa1984.
Będziński R., Biomechanika inżynierska. Zagadnienia wybrane, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 1997.

SECONDARY LITERATURE

Roliński Z., Tensometria oporowa: podstawy teoretyczne i przykłady zastosowań, WNT, Warszawa 1981.
J.W. Dally, Experimental Stress Analysis, College House Enterprises Llc, 2005.
Beckwith T.G., Mechanical Measurements, Prentice Hall, 1995.
Rastogi K., Optical Measurement Techniques and Applications., Artech House, 1997.

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name of subject in Polish: **Mechanika analityczna**
Name of subject in English: **Analytical Mechanics**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SM4032**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	50	50			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	2	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematical analysis (differential and integral calculus)
2. Linear algebra (matrices, determinants), geometry, trigonometry
3. Mechanics I and mechanics II in range of study stage I

SUBJECT OBJECTIVES

C1. Knowledge of analytical methods for the application of Lagrangian mechanics in the dynamics of mechanical holonomic systems (for systems with constrains depending and not depending from time). Knowledge of vibration analysis of linear holonomic conservative systems with many degrees of freedom.
C2. Knowledge of the dynamics of a rigid body in case of the spherical rotation about a fixed point. The using in to the gyroscope (in approximate theory range). Elementary knowledge of the theory of mass collisions (elastic and inelastic collision)
C3. Ability to independently analyze complex mechanical systems with a holonomic constrains which are not depend on time to determine : differential equations of movement, natural vibration frequency spectrum, the modal matrix. The ability of dynamic analysis of rigid bodies in case of the spherical rotation about a fixed point and gyroscope.
C4. The acquisition and consolidation of social skills including emotional intelligence relying
ability to work in a group of students with a view to effective problem solving.
Responsibility, honesty and fairness in conduct; observance of manners in
the academic community and socjety

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - He can define a discrete mechanical holonomic system and its possible and virtual displacements. He knows the fundamental problem of dynamics. He knows the classification of dynamical systems in respect of the constrain types. He knows the general equation of dynamics and the principle of virtual work.
PEU_W02 - He knows the notion of generalized coordinates and configuration space of a dynamical system. He knows the concept of generalized forces (active and inertia). He knows the Lagrange's equations of the first and second kind.
PEU_W03 - He knows the variational interpretation of virtual displacements, the central equation of the dynamics and the Hamilton's principle. He has an elementary knowledge of gyroscopic systems.

II. Relating to skills:
PEU_U01 - He is able to apply the virtual work principle and d'Alembert's principle for holonomic systems
PEU_U02 - He can derive the differential equations of motion of discrete dynamical systems by using Lagrange's equations and by using the energy conservation law for conservative holonomic systems.
PEU_U03 - He can calculate the spectrum of natural frequencies and can determine the modal matrix for discrete conservative linear systems. He is able to analyze the dynamics of the gyro using the approximate theory (gyroscopic moment and reaction forces in the supports).

III. Relating to social competences:
PEU_K01 - He can search information and is able to critical review
PEU_K02 - He can objectively evaluate the arguments and rationally explain and justify
own point of view.
PEU_K03 - He can observe the customs and rules of the academic community.

PROGRAM CONTENT

Form of classes – Lecture	Number of hours

Lec1	Curriculum. Requirements. Examples of dynamic systems. Constrains and their types, classification systems for the sake of the constrain types (holonomic systems), possible velocities and possible displacements.	2
Lec2	The fundamental problem of dynamics, virtual displacement, the notion of ideal constraints, the general equation of dynamics, the virtual work principle.	2
Lec3	The dynamic general equation for the rotational and planar motion of rigid body (examples)	2
Lec4	Generalized coordinates. Derivation of differential equations of motion by using the energy conservation law expressed in generalized coordinates (examples).	2
Lec5	Generalized forces. Configuration space. Lagrange's equations (of II type).	2
Lec6	Lagrange's equations (cont. examples, applications). Lagrangian.	2
Lec7	Linear systems with a finite number of degrees of freedom, matrix notation, conservative systems.	2
Lec8	Free vibrations of conservative systems: natural frequencies, modal matrices, mode shapes.	2
Lec9	Harmonically forced vibration, frequency characteristics, an example of oscillation analysis of two- degree- of- freedom system.	2
Lec10	The dynamics of a rigid body in general motion: the orientation, the recognition issue. Kinematics and dynamics of rigid body in case the spherical rotation about a fixed point (reminder of the course Mechanics II), the angular momentum in the general movement.	2
Lec11	The dynamic equations for general motion of rigid body (Euler's equation).	2
Lec12	Gyroscope (approximate theory).	2
Lec13	An outline of modal analysis.	2
Lec14	Variational approach of Lagrangian mechanics.	2
Lec15	The central Lagrange's equation. Fundamental integral mechanical principle (Hamilton's principle)	2
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Introduction. Derivation of equations for possible velocities and virtual displacements.	2
Cl2	Solving of static problems by using a principle of virtual work	2
Cl3	Solving of dynamic problems by using a dynamic general equation (d'Alembert's principle).	2
Cl4	Derivation of motion differential equations based on the energy conservation law and Lagrange's equations (comparison of methods and results) for systems with one and two degrees of freedom	2
Cl5	Determination of the natural frequencies and modal parameters for conservative systems with two degrees of freedom	2
Cl6	Solving some kinematic and dynamic problems in case of the spherical rotation about a fixed point of a rigid body.	2
Cl7	Final test	2

Cl8	Credits. Improvement of marks	2
		Total hours: 16

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

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03, PEU_K01-PEU_K03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

M. Lunn, A First Course in Mechanics, Oxford Science Publications, 1991

SECONDARY LITERATURE

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name of subject in Polish: **Projektowanie materiałów inżynierskich**
Name of subject in English: **Design of Engineering Materials**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SM4033**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	25			25	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge in such disciplines as: Materials science, Strength of materials, Manufacturing technology, processing and recycling of materials, design and examination methods of structure and properties of materials.
2. Skills in usage of technical data and specialized computer software.
3. Skills in collaboration with other users of engineering materials and specialists in the fields of design, manufacturing, processing, and application of materials.

SUBJECT OBJECTIVES

C1. Obtaining the skills in design of chemical composition and structure of engineering materials to produce products with desired mechanical and operational properties.
C2. Obtaining the skills in materials selection for technical applications.
C3. Obtaining the skills in failure analysis of materials and design of repair processes for improvement of products durability.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Possessing advanced knowledge on structure- properties relationship as well as on strengthening mechanisms in materials and their practical usage for material design of products.
PEU_W02 - Knowing the fundamentals and design philosophy of modern engineering materials.
PEU_W03 - Knowing the criteria and methodology of materials selection and can participate in engineering design of products.

II. Relating to skills:
PEU_U01 - Able to design the materials structure in order to obtain the desired operational properties of product.
PEU_U02 - Able to select a material for a specific product with consideration of economical and ecological aspects.
PEU_U03 - Able to conduct the failure analysis of material and design the repair process for improvement of product durability.

III. Relating to social competences:
PEU_K01 - Possessing the collaboration skills and able to lead the research teams in engineering design process.
PEU_K02 - Conducting the research activity on materials design of products.
PEU_K03 - Possessing the skills of objective evaluation of arguments and formulation of rational conclusions concerning the use of engineering materials for different products and operational conditions.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to design of engineering materials. Effect of chemical composition, processing and microstructure on properties of materials	2
Lec2	The role and signifcance of alloy phase diagrams in design of materials.	2
Lec3	The design philosophy of modern steels for automotive industry.	3
Lec4	Theory of strengthening of metals and alloys.	2
Lec5	Methods of strengthening metals and alloys.	2
Lec6	Structural composites- fundamentals of design.	2
Lec7	Criteria and quantitative methods of materials selection in engineering design.	2
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Selection of material for chosen machine part - introduction.	2
Proj2	Design of chemical composition of steel with desired hardenability.	2
Proj3	Design of microstructure of steel in the process of heat treatment - process parameters selection and experiment.	2
Proj4	Design of microstructure of steel in the process of heat treatment - analysis of results.	2
Proj5	Individual materials expertise combined with selection of material.	3
Proj6	Structural composites - design problems.	2
Proj7	Selection of material for chosen machine part - presentation.	2
		Total hours: 15

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

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

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01÷PEU_U03	short quiz, oral answers, report, discussions
F2	PEU_U01÷PEU_U03;PEU_K01-PEU_K03	defence of the project

P = 0,3F1+0,7F2

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.J.P. Schaffer, A. Saxena, S.D. Antolovich, T.H. Sanders, S.B. Warner: The science and design of engineering materials, WCB/McGraw-Hill, 1999;
2.M.F. Ashby: Materials Selection in Engineering Design, Pergamon Press, Oxford 1998;
3.Thomas H. Courtney: Mechanical Behaviour of Materials, 2th ed., McGraw-Hill, 2000;
4.Ch. R. Brooks, A. Choudhury: Failure Analysis of Engineering Materials, McGraw-Hill, 2002.

SECONDARY LITERATURE

1.D. Henkel, A. W. Pense: Structure and properties of engineering materials, McGraw-Hill, 2002.

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name of subject in Polish: **Budowa pojazdów i układów napędowych**
Name of subject in English: **Energy Efficiency Design of Powertrain and Body**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SM4033**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	50		50		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of fundamentals of machine design, mechanics, mathematics and physics on the level adequate for first years of studies at Mechanical Department.
2. Competence in joining phenomenon with mathematical description.

SUBJECT OBJECTIVES

C1. Study of fundamental systems, assemblies and sub-assemblies of automotive vehicles.
C2. Understanding of relationshps between phenomenon connected with vehicle movement and respective vehicle assemblies.
C3. Understanding of development tendencies relating to particular vehicle systems, assemblies and subassemblies
C4. Effort to forecast of vehicle choosen assemblies development.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Have fundamental knowledge related to building means of transport particulary cars, trucs, busses and one-track vehicles
PEU_W02 - Have knowledge about phenomenon existing in main automotive vehicle systems

II. Relating to skills:
PEU_U01 - Capable of analyzing relationships between requirements for means of transport and their structure

III. Relating to social competences:
PEU_K01 - Have consciousness of practical application of knowledge achieved during studies for designing and exploatation means of road transport.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	history of automotive development	2
Lec2	Transportation systems	2
Lec3	Systems in passenger cars, commercial vehicles and motorcycles.	2
Lec4	Vehicle centre of gravity. Forces acting on vehicle during parking and movement.	2
Lec5	Collaboration between wheel and foundation. Rolling resistance.	2
Lec6	Aerodynamic resistance	2
Lec7	The power of movement resistance	2
Lec8	Engine map and required power	2
Lec9	Drive transmission system.	2
Lec10	Construction and functioninig of seering system	2
Lec11	Construction and functioning of break system.	2
Lec12	Tendencies in application of new materials in automotive vehicles	2
Lec13	Comunicational systems used in vehicles and by vehicles.	2
Lec14	Vehicle as a robot.	2
Lec15	Examination	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Safety rules	2
Lab2	Motion resistances.	2
Lab3	Investigation of steering system.	2

Lab4	Investigation of suspension system	2
Lab5	Investigation of break system.	2
Lab6	Static and dynamic wheels balancing	2
Lab7	Investigation of body geometry.	2
Lab8	Vehicle noise tests	2
Lab9	Investigation of comfort and visibility.	2
Lab10	Investigation of aerodynamic	2
Lab11	Simultational investigation of automotive vehicles systems.	2
Lab12	Vehicle dynamics research - acceleration and braking	2
Lab13	FEM strength analysis of automotive vehicles.	2
Lab14	Identification of security systems	2
Lab15	Credit for laboratory.	2
		Total hours: 30

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

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

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

F1	PEU_U01, PEU_K01	Short written examination
F2	PEU_U01, PEU_K01	Reports
F3	PEU_U01, PEU_K01	Activity during lessons.
P = P = 0,7F1 + 0,15F2 + 0,15F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.Mitschke Manfred: Dynamika Samochodu, WKŁ9 (in polish), also available in german Dynamik der Kraftferzeuge, Springer Verlag.
2.Kazimierz Studziński: Budowa Samochodu, WKŁ (in polish)
3. Victor Albert Walter Hillier.: Fundamentals of Motor Vehicle Technology. Nelson Thornes, 2001
4.R.K.Rajput, Text Book of Automobile Engineering, Laxmi Publications Ltd, 2007
5.Richard Stone, Jeffrey K. Ball, Automotive Engineering Fundamentals, SAE international, 2004

SECONDARY LITERATURE

1. William H. Crouse, Automotive Machanics, McGraw-Hill
2. Malcolm James Nunney.: Light and Heavy Vehicle Technology. Butterworth-Heinemann, 2007
3. Allan Bonnick.: Automotive Science and Mathematics. Elsevier, 2008
4. George Appel, International Correspondence Schools.: Automobile Manual Transmission Systems. International Correspondence Schools, 1970
5. Lambert M. Surhone,Miriam T. Timpledon,Susan F. Marseken.: Transmission: Transmission Mechanics, Speed, Torque, Gear Ratio, Fuel. Betascript Publishers, 2009
6.Ulrich W. Seffert, Hans Hermann Braess,Handbook of Automotive Engineering.
7. Teacher's materials.

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name of subject in Polish: **Zmęczenie materiałów i mechanika pękania**
Name of subject in English: **Fatigue of materials and fracture mechanics**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SM4034**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	50				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mechanics (statics, kinematics, dynamics)
2. Strength of Materials
3. Knowledge of differential and integral calculus

SUBJECT OBJECTIVES

C1. Learning about linear models of fracture mechanics
C2. Stress intensity factor K and integral J as basic parameters of fracture mechanics
C3. Description of the fatigue process and fatigue life prediction of structural components
C4. Learning about models and phenomena related to fatigue crack propagation

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

PEU_W01 - To learn about linear models of fracture mechanics

PEU_W02 - To learn how to use the stress intensity factors K and the integral J as basic parameters of fracture mechanics

PEU_W03 - To learn about the mechanisms of fatigue fracture

II. Relating to skills:

III. Relating to social competences:

PEU_K01 - Be able to search for information and be able to analyze it critically

PEU_K02 - Be able to objectively evaluate arguments and rationally explain and justify own point of view.

PEU_K03 - Be able to respect the customs and rules of the academic environment

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Theoretical strength of materials and the Griffith's fracture model	2
Lec2	Description of the stress field ahead of the crack tip - linear-elastic fracture mechanics	2
Lec3	Crack tip plasticity - Irwin and Dugdale models	2
Lec4	Nonlinear fracture mechanics - CTOD and J (definition)	2
Lec5	Experimental methods in fracture mechanics and evaluation of fracture mechanisms of constructional materials	2
Lec6	Fatigue phenomenon of materials and fatigue fracture micromechanisms - fatigue fracture nucleation	2
Lec7	Methods for describing S-N curves and predicting the fatigue lifetime	2
Lec8	Probabilistic description of fatigue characteristics P-S-N	2
Lec9	Fatigue fracture mechanics, kinetic fracture diagrams and crack growth prediction	4
Lec10	Multiaxial material stress-state - fracture criteria under complex stress conditions	2
Lec11	Fatigue under multiaxial loading - proportional and non-proportional. SWT parameter.	2
Lec12	Fatigue of materials in the gigacycle range	2
Lec13	Mixed mode (I+II, I+III) fatigue crack growth - description and analysis of fracture mechanisms	2
Lec14	Written test	2
		Total hours: 30

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

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03, PEU_K01, PEU_K02, PEU_K03	written test
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE 1. Neimitz A., Mechanika pękania, PWN Warszawa 1998, 2. Kocańda St., Zmęczeniowe pękanie metali, WNT Warszawa, wyd. 3, 1985, 3. Boroński D., Metody badań odkształceń i naprężeń w zmęczeniu materiałów i konstrukcji, Wyd. Inst. Tech. Ekspl. - PIB , Radom 2007, 4. Szata M., Opis rozwoju zmęczeniowego pękania w ujęciu energetycznym, OW PWr, Wrocław 2002 SECONDARY LITERATURE 1. Bochenek A., Elementy mechaniki pękania, Wyd. Politechniki Częstochowskiej, Częstochowa 1998, 2. Gasiak G., Trwałość materiałów konstrukcyjnych przy obciążeniach cyklicznych z udziałem wartości średniej obciążenia, OW PO Opole 2002.

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name of subject in Polish: **Inżynieria powierzchni**
Name of subject in English: **Surface Engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SM4035**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	25		25		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of physico-chemical and mechanical properties of materials engineering; basic understanding of heat and thermo-chemical treatment, able to analyze images of macro and microstructure of engineering materials.
2. Knowledge about the types of engineering materials - their structure, properties, applications and selection.
3. Structured knowledge about manufacturing techniques.

SUBJECT OBJECTIVES

C1. Understanding the possibilities of shaping and charaterize certain physical features of the surface layer, which are important for its future exploitational characteristics.
C2. Understanding the basic techniques of: analysis of the surface layer, profilographometry and locate and analyze of surface defects.
C3. Gaining knowledge on techniques to modify the properties of the surface layer of engineering materials. In this surface machining and coating.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Able to explain, including the physico-chemical properties of metallic materials, composites and plastics, rules of the selection of materials for the operating conditions.
PEU_W02 - Definition and formulation of the surface properties of components used in automotive engineering.
PEU_W03 - Appropriate linguistic resources for specialist meaning in the field of surface engineering to communicate effectively in a professional environment.

II. Relating to skills:
PEU_U01 - Gaining the skills to conduct research in industrial practice using profilographometry and microscopic techniques.
PEU_U02 - Able to measure and analyze the reasons for cutting tool wear.
PEU_U03 - Able to select engineering materials to the operating conditions.

III. Relating to social competences:
PEU_K01 - Objective evaluation of arguments to justify and the rational explanation his own point of view, using knowledge of surface engineering.
PEU_K02 - Awarness of professional conduct on the test stand and know the main principles of safe operation of measuring devices.
PEU_K03 - Understanding the need of life long learning by knowledge updating, training and enhance skills in the field of surface engineering.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Characteristic properties of the surface layer (SL) of an object.	2
Lec2	The methods and measurement for 2D and 3D roughness testing.	2
Lec3	Functional features of machine and devices, technological and exploitational, surface layers.	2
Lec4	Physico-chemical properties of the surface layer of engineering materials.	2
Lec5	Methods for modifying the physical and geometrical characteristics of surface layer.	2
Lec6	Possibilities of creating surfaces with specific properties applying different methods of shaping and forming.	2

Lec7	Surface coating methods.	3
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Flat (2D) and spatial (3D) measurements and analysis of surface micro-geometry.	2
Lab2	Measurement of the mechanical and physico-chemical properties of the selected materials.	2
Lab3	Surface measuremnt using a computerized video analysis.	2
Lab4	Superfinish surface machining.	2
Lab5	Modifying of surface layer by roller burnishing.	2
Lab6	Measurement of shape and position deviations of machine components.	2
Lab7	Surface layer analysis after WEDM.	3
		Total hours: 15

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

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

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

F1	PEU_U01; PEU_UO2; PEU_U03;PEU_K01; PEU_K02; PEU_K03	quiz
F2	PEU_U01; PEU_U02; PEU_U03;PEU_K01; PEU_K02; PEU_K03	participate in discussions problem
F3	PEU_U01; PEU_UO2; PEU_U03;PEU_K01; PEU_K02; PEU_K03	laboratory report
P = 0,3F1 + 0,3F2 +O,4F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. R.Chattopadhyay, 'Advanced Thermally Assisted Surface Engineering Processes' Kluwer Academic Publishers, MA, USA (now Springer, NY), 2004, ISBN 1-4020-7696-7, E-ISBN 1-4020-7764-5.
2. Sanjay Kumar Thakur and R. Gopal Krishnan, 'Advances in Applied Surface Engineering', Research Publishing Services, Singapore, 2011, ISBN 978-981-08-7922-8.

SECONDARY LITERATURE

1. Walia, R.S., Murtaza, Q., Pandey, S.M., & Tyagi, A. (Eds.). (2022). Surface Engineering: Methods and Applications (1st ed.). CRC Press. https://doi.org/10.1201/9781003319375

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name of subject in Polish: **Silniki spalinowe**
Name of subject in English: **Developing Engine Technology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SM4036**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	50		50		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of the theory and design of internal combustion engines.
2. Ability to conduct measurements of mechanical and electrical engineering.
3. Knowledge of technical English vocabulary associated with internal combustion engines.

SUBJECT OBJECTIVES

C1. Arrangement engineering knowledge about the design and classification of internal combustion engines.
C2. Discussion of opportunities and identify development trends of internal combustion engines, coupled with the transfer of knowledge on the combustion process and engine characteristics.
C3. Familiar with laboratory measurement techniques needed in research and development of internal combustion engines.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Depth knowledge of the design and development trends of internal combustion engines.
PEU_W02 - A knowledge of the calculation and analysis of the combustion process in internal combustion engines
PEU_W03 - knowledge of the characteristics of the internal combustion engine and method of their use for the development of engine design with special consideration of environmental requirements and sports.

II. Relating to skills:
PEU_U01 - Getting eco-skills and sports operation of internal combustion engines.
PEU_U02 - Able to independently organize and carry out measurements of selected engine systems and engine bench testing of the complete motor and able to correctly interpret the results of theoretical analysis and laboratory testing of internal combustion engines.
PEU_U03 - Understand the need for lifelong learning including language skills to the free discussion of matters of research and development of internal combustion engines in English.

III. Relating to social competences:
PEU_K01 - Gaining characteristics of a person operating in accordance with the principles of ethics.
PEU_K02 - Meets the rules and customs, and different methods of training by the association in an international team.
PEU_K03 - The strengthened responsibility for the work carried out and get respect for the work of another man.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Overview engineering knowledge of internal combustion engines - history and classification.	2
Lec2	Overview engineering knowledge of internal combustion engines – design and technology (Part One).	2
Lec3	Overview engineering knowledge of internal combustion engines - design and technology (Part Two).	2
Lec4	The laws of thermodynamics in combustion engines.	2
Lec5	The operating factors of the internal combustion engine.	2
Lec6	The characteristics of internal combustion engines.	2
Lec7	The study of internal combustion engines according to current regulations.	2
Lec8	The development of internal combustion engines - construction and technological activities.	2
Lec9	The development of internal combustion engines in terms of the use of alternative fuels.	2
Lec10	The development of internal combustion engines by downsizing - the global ecological effect.	2
Lec11	The development of internal combustion engines for the sport.	2
Lec12	Durability of engines.	2

Lec13	Hybridization of combustion drive systems.	2
Lec14	Development trends of internal combustion engines for example engines as "Engines of the Years". Engine news in improving the overall efficiency.	2
Lec15	Exam.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	The organization of research in laboratory studies of internal combustion engines with a discussion of the safety and health at work.	2
Lab2	Methodology of engine research - selection and calibration of the brake, connections, sensors, data sheets, etc.	2
Lab3	Dimensional measurements of selected elements of the piston-crank set and assessment of the degree of wear.	2
Lab4	Design of various fuel supply systems for spark ignition engines with the determination of the characteristics of fuel injection	2
Lab5	Design of various fuel supply systems of diesel engines with the determination of the characteristics of fuel injection.	2
Lab6	Identification of the filling ratio for combustion engine and improvement of the overall efficiency.	2
Lab7	Determination of the performance map of the internal combustion engine – tests for different load and revolution - Part One.	2
Lab8	Determination of the performance map of the internal combustion engine – tests for different load and revolution - Part Two.	2
Lab9	The performance map of the internal combustion engine - interpretation of results.	2
Lab10	The pressure measurement in the combustion chamber of the engine for different settings.	2
Lab11	Determination of the heat balance of the internal combustion engine along with the measurement of temperature fields of outside walls by thermovision technology.	2
Lab12	Tests of the efficiency of the catalyst in the exhaust system and gas chemical analysis.	2
Lab13	Research engines fitted to vehicles on a chassis dynamometer.	2
Lab14	Rating combustion engine based on data from the OBD system under natural operating conditions.	2
Lab15	Visit in garage - engine diagnostics.	2
		Total hours: 30

TEACHING TOOLS USED
N1. multimedia presentation N2. self study - self studies and preparation for examination N3. laboratory experiment N4. self study - preparation for laboratory class N5. report preparation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01	Involvement in the class (class activity)
F2	PEU_W01; PEU_W02; PEU_W03	Oral/Written exam
P = 0,2F1+0,8F2		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U02; PEU_U03; PEU_K01	Entry quiz F1=(W1+…W14)/14
F2	PEU_U01; PEU_U02; PEU_U03; PEU_K01; PEU_K02; PEU_K03	Activity in the classroom F2=(A1+…+A15)/15
F3	PEU_U01; PEU_U02; PEU_U03; PEU_K01; PEU_K02; PEU_K03	Laboratory report (at least a satisfactory rating of each laboratory) F3=(S1+…+S15)/15
P = 0,2F1+0,2F2+0,6F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Heywood J.B., Internal Combustion Engine Fundamentals 2E, McGraw-Hill Education, 2018
Sroka Z.J., Kułażyński M. Developing Engine Technology, Printpap Łódź 2011
Kirkpatrick A.T., Internal Combustion Engines - Applied Thermosciences, Wiley, 2020
Advanced Hybrid and Electric Vehicles, Springer Int. Publishing, 2018

SECONDARY LITERATURE

Janicka A., Kolanek Cz., Walkowiak W. Applied Thermodynamics – internal combustion engine Laboratory, Printpap Łódź 2011
Kułazyński M. Green Fuels, Printpap Łódź 2011

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name of subject in Polish: **Zarządzanie dla inżynierów**
Name of subject in English: **Management for Engineers**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SM4037**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	50				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. None

SUBJECT OBJECTIVES

C1. Understanding fundamentals of project management.
C2. Learning basic principles of being a leader.
C3. Gaining skills to raise funds for projects.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Fundamental knowledge of project management.
PEU_W02 - Knowledge of how to create and manage a project team.
PEU_W03 - Knowledge in raising funds for projects.

II. Relating to skills:

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	The project and its phases.	2
Lec2	The importance of leadership - the leader or manager?	2
Lec3	Team building - human resources in the project.	2
Lec4	Description of the problem, the concept and clarifications.	2
Lec5	Planning - Structure Plan.	2
Lec6	The schedule of the project.	2
Lec7	The project realization.	2
Lec8	Monitoring and control?	2
Lec9	Time Management.	2
Lec10	Project Quality Management.	2
Lec11	Risk analysis of the project.	2
Lec12	Budgeting Project - estimating the cost.	2
Lec13	Fundraising mechanisms of the European Union.	2
Lec14	Computer-aided project management.	2
Lec15	Test - a case study.	2
		Total hours: 30

TEACHING TOOLS USED

N1. multimedia presentation
N2. problem lecture
N3. problem discussion
N4. case study

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W02	Involvement in class (class activity)
F2	PEU_W01; PEU_W02; PEU_W03	Test - a case study
P = 0,2F1+0,8F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Lewis J.P.; Fundamentals of Project Management, AMACOM, New York 2002

Lewis J.P.; The Project Planning, Scheduling and Control, McGraw-Hill, New York 2001

Kerzner H., Project Management: A Systems Approach to Planning , Scheduling, and Controlling, 13th Edition, Jhon Wiley&Sons Inc, 2022

SECONDARY LITERATURE

Kerzner H., Project Management Case Studies, Jhon Wiley&Sons Inc, 2022

Skyttermoen T., Vaagaasar A., Project Management, A Value Creation Approach, SAGE Publication Ltd, 2020

Wysocki R.K., Efektywne zarządzanie projektami, Onepress, 2018

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name of subject in Polish: **Elektronika pojazdowa**
Name of subject in English: **Electronics in car vehicles**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SM4038**
Group of courses: **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)	50		25	25	
Form of crediting	Crediting with grade		Crediting with grade	Crediting with grade	
Group of courses					
Number of ECTS points	2		1	1	
including number of ECTS points for practical (P) classes			1	1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		0.7	0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of electronics and electrical engineering
2. Ability to independently perform laboratory exercises and projects supported by elementary manual skills
3. Ability to work in a group

SUBJECT OBJECTIVES

C1. Learning about electronic systems in vehicles
C2. Understanding the principles of operation of systems controlling vehicle supply systems
C3. Acquiring skills in designing simple electronic circuits
C4. Ability to characterize the bus in vehicles

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Explains the principle of operation of communication protocols in vehicles
PEU_W02 - Characterizes control systems for combustion engine power systems
PEU_W03 - Selects the appropriate sensors for individual vehicle systems

II. Relating to skills:
PEU_U01 - Verifies the correct operation of control systems in vehicles
PEU_U02 - Interprets data and addressing modes in vehicle buses
PEU_U03 - Uses catalog notes to select the best electronic actuating systems in the vehicle

III. Relating to social competences:
PEU_K01 - He understands the need and knows the possibilities of continuous education, especially increasing knowledge of trends in vehicle electronics
PEU_K02 - Is aware of the importance, responsibility and effects of the activities of an engineer in mechanics and machine construction in terms of responsibility for the state of the natural environment resulting from the proper operation of systems controlling the power supply systems of combustion engines, which constitute a significant threat to the natural environment
PEU_K03 - Appreciates the need to improve professional, personal and social competences

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	The architecture of electronic systems in motor vehicles	4
Lec2	Microprocessor control systems for combustion engine power systems	2
Lec3	Basics of microprocessor technology in the automotive field	2
Lec4	LIN and CAN networks	4
Lec5	FlexRay and MOST network	4
Lec6	Internet and Ethernet	8
Lec7	Introduction to sensors in vehicles	4
Lec8	E-E systems in vehicles	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Construction of a single-element electronic system	1
Lab2	Construction of a multi-element electronic system	4
Lab3	Construction of the conditioning system	4
Lab4	Dynamic load measurements using OBD	2
Lab5	Vehicle power measurements using OBD	2
Lab6	Build the diagnostic system	2

		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Sensor network topology design for a vehicle	8
Proj2	Design of a data acquisition system from vehicle sensors	7
		Total hours: 15

TEACHING TOOLS USED
N1. case study N2. laboratory experiment N3. multimedia presentation N4. report preparation N5. project presentation

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

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03, PEU_K01-PEU_K03	Report of laboratory exercises
P = F1		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03, PEU_K01-PEU_K03	Defense of the project
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SECONDARY LITERATURE

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name of subject in Polish: **Metody badań nieniszczących**
Name of subject in English: **Non Destructive Evaluation in Contemporary Manufacturing Systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SM4039**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	25		25		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the basic mechanical properties of engineering materials, about the types of metallic materials engineering - their construction, properties, applications and selection rules.
2. Abilities of reading and interpretation of drawings and diagrams used in the technical documentation, abilities to perform the technical documentation.

SUBJECT OBJECTIVES

C1. Getting knowledge of non-destructive testing methods used in modern technology.
C2. Getting knowledge about the various methods of NDT: visual, liquid penetrant, magnetic-particle, ultrasonic eddy current and radiographic examinations.
C3. Learning about the possibilities of using non-destructive testing in terms of materials, construction and use.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Explanation the advantages and limitations of selected methods of non-destructive testing.
PEU_W02 - Proposals of method of non-destructive testing for a structural component or in-use means of transport (eg. vehicles, cranes, container extraction, welded pressure vessels, etc.).
PEU_W03 - Abilities to identify and assess risks of detected discontinuities.

II. Relating to skills:
PEU_U01 - Abilities of applying non-destructive testing methods for welds, castings and products in service.
PEU_U02 - Abilities to develop a protocol of non-destructive examinations.
PEU_U03 - Abilities to do selected methods of NTD and assess its results.

III. Relating to social competences:
PEU_K01 - Explanation in a clearly way the results of research and assess them critically.
PEU_K02 - Objectively evaluation of arguments, rationally explaination and justify their own point of view using the knowledge of non-destructive testing.
PEU_K03 - Knowing the rules of team cooperation on improving methods for the selection of a strategy to optimally solve problems assigned to the group.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Rules of assessment. Visual examination.	2
Lec2	Liquid penetrant testing.	2
Lec3	Magnetic particle testing	2
Lec4	X-ray , γ-ray testing	2
Lec5	Ultrasonic testing of welding joints	4
Lec6	Eddy current testing	2
Lec7	Assessment - final test.	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction to the labs. Assessment rules.	1
Lab2	Visual testing	2
Lab3	Liquid penetrant testing.	2
Lab4	Magnetic particle testing.	2
Lab5	X-ray , γ-ray testing	2
Lab6	Ultrasonic testing of welding joints. Evaluation the size of flaws by ultrasound.	2
Lab7	Ultrasonic testing of spot welds by matrix array transducer.	2

Lab8	Non-destructive testing using eddy currents.	2
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03, PEU_K01-PEU_K03	Average grade from reports
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE 1.NDT Handbook - The American Society for Nondestructive Testing, 2nd and 3rd Edition 2.Chuck H. - Handbook of Nondestructive Evaluation, 2003 by The McGraw-Hill Companies SECONDARY LITERATURE 1. Peter J. Shull - Nondestructive Evaluation: Theory, Techniques, and Applications, Marcel Dekker, Inc.,New York 2002

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name of subject in Polish: **Alternatywne układy napędowe**
Name of subject in English: **Alternative Drive Systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SM4040**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			50		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)			1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of informatics and solving differential equations.
2. Having a knowledge of mechanics.
3. Ability to analyze and design systems in particular hydraulic drive systems.

SUBJECT OBJECTIVES

C1. Gaining skills in modeling and simulation of the systems.
C2. Knowledge of design methodology using a computer simulation system.
C3. Performance analysis of the results of computer simulation in the form of a report and / or a multimedia presentation

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:

PEU_U01 - Is able to build a simulation model of a selected real object.
PEU_U02 - Understand the purpose and can simplify the actual model and describe it in the form of mathematical equations.
PEU_U03 - Is Able to plan a program of simulation, analyze the results, draw conclusions and present them in an appropriate form.

III. Relating to social competences:

PROGRAM CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Introduction to Simulink	2
Lab2	Creation of a model and simulation of a harmonic oscillator.	2
Lab3	Creation of a model and simulation of hydraulic bumper.	2
Lab4	Creation of a model and simulation of vehicle entry to the curb (car suspension).	2
Lab5	Creation of a model and simulation of vehicle entry to the curb (car suspension)-contuation.	2
Lab6	Creation of a model and simulation of start up of hydrostatic transmission.	2
Lab7	Creation of a model and simulation of start up of hydrostatic transmission (continuation).	2
Lab8	The choice of project for realizing in the second half of the semester. Subject should be related to modeling and simulation of the alternative drive system used in motor vehicles.	2
Lab9	The operation analysis of the structure or process. Real model.	2
Lab10	Simplifying assumptions- physical model.	2
Lab11	Creation of a mathematical model of the object. Implementation of the simulation model.	2
Lab12	Running the simulation model. The simulation research.	2
Lab13	Analysis and study results.	2
Lab14	Presentation and discussion of the results	2
Lab15	Presentation and discussion of the results (continuation). Final ratings.	2
		Total hours: 30

TEACHING TOOLS USED

N1. problem discussion
N2. self study - preparation for laboratory class
N3. multimedia presentation
N4. project presentation
N5. report preparation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01	Laboratory report
F2	PEU_U02	Reporty, student work
F3	PEU_U03	Participation in problem discussions, multimedia presentation, project presentation
P = 0,4F1+0,4F2+0,2 F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.Matlab Simulink - Handbook, 2020.
2.Cannon R.H. jr: Dynamic of physical systems. WNT. 1973.
3. BP Zeigler, H Praehofer, TG Kim: Theory of modeling and simulation: Integrating discrete event and continuous complex dynamic systems. 2000.
4. Lennart Ljung: System Identification. 1999.
5. Raymond J. Madachy: The Modeling Process with System Dynamics, 2007.
6. Kulisiewicz M., Piesiak S.: Methodology of modeling and identification of mechanical dynamic systems. Publishing House of the Wrocław University of Technology, 1995.
6.Nizioł J.: Fundamentals of vibrations in machines. Script of the Cracow University of Technology, Cracow 1996.
7. Szczepaniak C.: Basics of system modelling: man - vehicle - environment. ed. Science. PWN 1999.

SECONDARY LITERATURE

1.Bekey G.A., Karplus W.I.: Hybrid computing. WNT 1976.
2. Kącki E.: Partial differential equations in physics and technology. PWN 1992.
3.Osiński Z.: A collection of problems in the theory of vibrations. PWN. 1988.
4. Budak M., Samerski A., Tichonov V.: Research and problems of mathematical physics. PWN 1965.
5. Arczyński S.: Mechanics of car motion. WNT, Warsaw 1997.
6. Mitschke M.: Car dynamics. Volume 1. Propulsion and braking. WKiŁ 1987. Volume 2. Vibrations. WKiŁ 1988.

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name of subject in Polish: **Mechanika płynów w projektowaniu pojazdów**
Name of subject in English: **Fluids Mechanics in Automotive Design**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SM4042**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	25		25		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of fluid mechanics
2. Knowledge of the basics of vehicle construction
3. Knowledge of the basics of machine design (including vehicles)

SUBJECT OBJECTIVES

C1. Knowledge about the flow phenomena occurring in the systems and systems of vehicles of various types
C2. Knowledge about the influence of flow phenomena on the forces acting on the vehicle in static conditions and in motion (aerodynamics)
C3. Expand knowledge of fluid mechanics and phenomena occurring in systems and flow systems of machine

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - The student has knowledge of flow phenomena occurring in systems and systems of vehicles of various types
PEU_W02 - The student has knowledge of the effects of flow phenomena on forces acting on a vehicle in static conditions and in motion (aerodynamics)
PEU_W03 - The student has advanced knowledge of fluid mechanics and the phenomena occurring in systems and flow systems of machine

II. Relating to skills:
PEU_U01 - The student is able to conduct an experiment in the field of fluid mechanics and explain the observed flow phenomena
PEU_U02 - The student is able to operate the measuring apparatus in the field of flow devices
PEU_U03 - The student is able to critically discuss the obtained results of the realized experiment

III. Relating to social competences:
PEU_K01 - Student is able to solve an experimental task in a group
PEU_K02 - Student potrafi wyciągać logiczne wnioski i w sposób uporządkowany rozwiązywać postawiony problem

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, properties of liquids and gases, forces and stresses in fluids, Newtonian and non-Newtonian fluids, types of pressures.	2
Lec2	Basic equations of fluid mechanics, continuity equation, equation of conservation of momentum for perfect and real fluids (Euler and Navier-Stokes equation)	2
Lec3	Equations of hydrostatics, connected vessels, fluid pressure on walls, buoyancy and stability of floating bodies. Integrals of Euler's equation - Bernoulli's equation, examples of applications: velocity measurements, fluid outflow through holes, suction action of a jet	2
Lec4	Principle of momentum and angular momentum, hydrodynamic reaction, fundamentals of flow machine theory. Classification of flows, laminar and turbulent flow, Bernoulli's equation for real liquids.	2
Lec5	Theory of the boundary layer, laminar and turbulent layer, flow detachment phenomenon. Flow of bodies, resistance to flow, hydrodynamic buoyancy, carrier lobe, hydrodynamic characteristics of profiles.	2
Lec6	Examples of solutions of the N-S equations, flows in axisymmetric pipes, linear losses, principles of their calculation, effect of roughness, characteristics of the pipeline. Numerical methods in fluid mechanics.	2
Lec7	Pumps, fans, compressors	2
Lec8	Test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introduction to the class, health and safety training	2
Lab2	Basic properties of fluids	2
Lab3	Fluid pressure on vessel walls	2
Lab4	Hydrostatic displacement	2
Lab5	Bernoulli equation without losses	2
Lab6	Hydrodynamic reaction	2
Lab7	Bernoulli equation with losses	2
Lab8	Final evaluation	1
		Total hours: 15

TEACHING TOOLS USED
N1. multimedia presentation N2. laboratory experiment

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Maciej Zawiślak, Metoda projektowania i modernizacji maszyn oraz układów przepływowych z zastosowaniem numerycznej mechaniki płynów, Wydawnictwo Politechniki Poznańskiej, 2017

Janusz Walczak; Inżynieryjna Mechanika Płynów, Wydawnictwo Politechniki Poznańskiej, 2012
Inne podręczniki do mechaniki płynów

SECONDARY LITERATURE

Other fluid mechanics books

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name of subject in Polish: **Elementy rzeczoznawstwa samochodowego**
Name of subject in English: **Automotive expertises**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SM4043**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30		30
Number of hours of total student workload (CNPS)	25		50		50
Form of crediting	Crediting with grade		Crediting with grade		Crediting with grade
Group of courses					
Number of ECTS points	1		2		2
including number of ECTS points for practical (P) classes			2		2
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.6		1.4		1.4

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed subjects in Automotive Engineering: Energy Efficiency Design of Powertrain and Body, Developing Engine Technology, Trends in Electronics Vehicles, Alternative Drive Systems, Chemistry and Green Fuels.

SUBJECT OBJECTIVES

C1. Understanding the basic elements of automotive expert opinions.
C2. Awareness of need for lifelong learning due to the rapid development of automotive technology.
C3. Skills of English language in specialist vocabulary from the automotive expert opinions.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

PEU_W01 - An extended knowledge in automotive engineering with particular focus on methods and measurement techniques aimed to determine the technical condition of vehicles and engines, and the cost calculation of repair of the vehicle.

PEU_W02 - A knowledge in mathematics and physics required to describe and interpret the results of studies related to the processes that happen in each vehicle and engine systems and the unusual situations as failures and road collisions.

PEU_W03 - A knowledge in project management, in particular the automotive expert projects, in-depth the legal aspects and presentation of investigation results.

II. Relating to skills:

PEU_U01 - Know how to diagnose the vehicles' systems and internal combustion engine.

PEU_U02 - Skills to use measuring instruments and specialized software applied in the automotive expert opinions.

PEU_U03 - Acquisition of the ability to collect data on the means of transport and skills of interpretation of those data as well as self-expression in native language and English.

III. Relating to social competences:

PEU_K01 - Gaining characteristics of a person working in accordance with the principles of ethics.

PEU_K02 - Awareness of the knowledge relationships from different fields.

PEU_K03 - Acquisition of the ability to properly write technical reports while maintaining the aesthetics and the current form and style.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Automotive expertises in Polish and international law and the role of the appraiser	1
Lec2	Methodology for preparing opinions in the field of automotive technique.	1
Lec3	Automotive technique – identification and assessment of the technical condition of the vehicle	4
Lec4	Determination of the market value of the vehicle.	2
Lec5	Traffic- mechanics of collision, deformation and energy consumption of car chassis, time-spatial analysis.	2
Lec6	Traffic - systems supporting the reconstruction of road incidents - photogrammetry.	2
Lec7	Medical aspect of automotive expertise.	2
Lec8	Test	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Vehicle identification - identification of vehicle make, model, type, VIN-number identification, registration expiration, definition of equipment, etc.	2

Lab2	Technical scrutiny for pre-registration and vehicle approval - setting requirements, equipment, vehicle inspection stations, power of scrutinizers, etc.	2
Lab3	Test of fuel consumption in the natural operating conditions and on a chassis dynamometr.	2
Lab4	Test of fuel systems for combustion engines including LPG and CNG due to compliance with the approval and technical conditions.	2
Lab5	Technical scrutiny of combustion engine due to environmental protection.	2
Lab6	Analysis of the causes of damage to the components of the crank-piston set.	2
Lab7	Tests of valve timing system.	2
Lab8	Technical scrutiny of the vehicle, together with the assessment of the quality of the paint.	2
Lab9	Finding the causes and assessment of damage to the vehicle chassis.	2
Lab10	Identification of damage to some parts of the drive system.	2
Lab11	Technical scrutiny of tires of a motor vehicle and analysis of tires damages.	2
Lab12	Rating road accident based on the provision of material related to a traffic accident (identification of incident space, setting marks on the road and vehicles, technical scrutiny of vehicles - participants of the accident, the reconstruction of the incident, offering technology repair and vehicle repairs valuation).	8
		Total hours: 30
Form of classes – Seminar		Number of hours
Sem1	Repertory of traffic theory.	2
Sem2	Traffic and safety of the participants in Poland and in the world.	2
Sem3	Today's traffic monitoring systems.	2
Sem4	Approval and evaluation of technical condition of special vehicles.	2
Sem5	Approval and evaluation of the technical condition of sports cars.	2
Sem6	Technical studies of hybrid vehicle and electric cars.	2
Sem7	Technical studies of two-wheelers.	2
Sem8	Giving opinions antique and collector vehicles.	2
Sem9	Giving opinions vehicle SAM type (made by owner).	2
Sem10	The importance of the OBD system in automotive expertise.	2
Sem11	Modern techniques and technologies for vehicle body repairs.	2
Sem12	Modern technology and repair techniques for combustion engines.	2
Sem13	Vehicle repairs valuing systems in the world.	2
Sem14	Construction and operation of roads.	2
Sem15	Driver’s psychology and physiology.	2
		Total hours: 30

TEACHING TOOLS USED
N1. multimedia presentation N2. self study - self studies and preparation for examination N3. laboratory experiment N4. self study - preparation for laboratory class N5. report preparation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01; PEU_W02	Involvement in the class (class activity)
F2	PEU_W01; PEU_W02; PEU_W03	Written/Oral test
P = 0,2F1+0,8F8		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U03	entry quiz F1=(W1+…W12)/12
F2	PEU_U01; PEU_U02	activity in the classroom F2=(A1+…+A12)/12
F3	PEU_U01; PEU_U03	Laboratory report (at least a satisfactory rating of each laboratory) F3=(S1+…+S12)/12
P = 0,2F1+0,2F2+0,6F3		

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Seminar)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U03; PEU_K01	Activity in the classroom F1=(A1+…+A15)/15

F2	PEU_K02; PEU_K03	Presentation (P) plus report (R) F2=(P+R)/2
P = 0,2F1+0,8F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Borg K.L. Auto Mechanics: Technology and Expertise in Twentieth-Century America, JHU Press 2007
Eubanks Pedestrian Accident Reconstruction, Tucson 1994
Automotive Handbook, 11th Edition, John Wiley and Sons Ltd, 2022

SECONDARY LITERATURE

Diehlmann J., Häcker J., Automotive Management, De Gruyter, 2013
Autor książki: praca zbiorowa, Opiniowanie wypadków drogowych. Niektóre zagadnienia, Image Grupa, 2006
Kodeks Drogowy -Prawo o ruchu drogowym, 2022 ze zmianami

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name of subject in Polish: **Seminarium dyplomowe**
Name of subject in English: **Diploma seminar**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SM4044**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					30
Number of hours of total student workload (CNPS)					50
Form of crediting					Crediting with grade
Group of courses					
Number of ECTS points					2
including number of ECTS points for practical (P) classes					2
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)					1.4

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the issues covered by the study program.
2. Deficit of ECTS points not greater than that resulting from the resolution of the Council of Faculty of Mechanical Engineering.

SUBJECT OBJECTIVES

C1. Transfer of knowledge about the requirements for writing an engineering diploma thesis.
C2. Acquiring the ability to present one's own work and defend the theses included.
C3. Acquisition of the ability to conduct discussions on engineering topics and formulate one's own point of view.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:

PEU_U01 - Is able to prepare a speech and multimedia presentation, discuss the purpose and scope of the thesis and its progress.

PEU_U02 - Is able to conduct discussions on engineering and scientific topics, including presentation of own point of view

PEU_U03 - Is able to formulate the purpose of master thesis and select methods to achieve it.

III. Relating to social competences:

PEU_K01 - Understands the need for continuous acquisition of knowledge and professional competence.

PEU_K02 - Understands the need for discussions on how to solve engineering and scientific problems.

PROGRAM CONTENT

Form of classes – Seminar		Number of hours
Sem1	Discussion of the plan and method of conducting classes and setting the schedule of student presentations.	1
Sem2	Transfer of knowledge on the principles of preparing a speech, multimedia presentation and how to conduct their.	1
Sem3	Providing knowledge about the details of writing a master thesis, anti-plagiarism activities and how the diploma exam is organized.	4
Sem4	Students' own presentations on the topics of their diploma theses (substantive discussions).	22
Sem5	Course summary and grading.	2
		Total hours: 30

TEACHING TOOLS USED

N1. multimedia presentation
N2. problem discussion
N3. tutorials

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Seminar)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01; PEU_U03; PEU_K01	The way of preparing and conducting the presentation.
F2	PEU_U02; PEU_K02	Participation in discussions.
P = 0,8F1+0,2F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Gruba P., Zobel J., How To Write Your First Thesis, Springer, 2017
Murray R. How to Write a Thesis, Open University Press, 2017
Kowalkowska, A. Esej naukowy jako trening przed pisaniem pracy dyplomowej. Tutoring Gedanensis, 7(3) 2022
Majchrzak J.: Metodyka pisania prac magisterskich i dyplomowych, Wydawnictwo Uniwersytetu Ekonomicznego, Poznań 2009

SECONDARY LITERATURE

Wiszniewski A.: Sztuka pisania. Videograf II, Katowice 2003
Wiszniewski A.: Sztuka mówienia. Videograf II, Katowice 2003

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name of subject in Polish: **Ekologia transportu drogowego**
Name of subject in English: **Ecology of road transportation**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SM4045**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			45	
Number of hours of total student workload (CNPS)	50			50	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge on field of transportation means design and operation
2. Awareness of necessity of team work and ability of technical problem solving in group

SUBJECT OBJECTIVES

C1. Understanding problems on field of ecology of road transportation
C2. Understanding vehicles production and operation via environment cause (including vehicle life-cycle)
C3. Understanding essence and principals of effective team work with engineering knowledge using material science, vehicle design and operation, ecology, recycling, legislation and logistics

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - Student has a knowledge on field of egological operation of car systems
PEU_W02 - Studen has detailed knowledge on field of vehicle life-cycle as well as EU end-of-life vehicles systems and legislations

II. Relating to skills:
PEU_U01 - Student is able to describe cause and effect relationship between vehicles production, operation, specific materials application or road infrastructure and environment
PEU_U02 - Student is able to diagnose and design complex logistic system of ELVs management
PEU_U03 - Student is able to find information, data bases and other sources and apply them in solving technical problems dealing with vehicles recycling

III. Relating to social competences:
PEU_K01 - Studen has local and global ecological awarness
PEU_K02 - Student takes care about written works aesthetics
PEU_K03 - Student develops sense of responsibility for other by team-working

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Ecology of road transportation: introduction and basic definition	2
Lec2	Automotive industry environmental impacts (direct and indirect)	2
Lec3	Engine combustion process and toxic exhausts emission. Methods of pollution reduction	2
Lec4	Car vehicle as a source of thermal and electromagnetic radiation	2
Lec5	Noise and vibrations emission caused by transportation sector	2
Lec6	Vehicle as a wastes source	2
Lec7	End-of-life vehicle recycling	2
Lec8	Vehicle as a source of hazardous wastes	2
Lec9	Road infrastructure and environmental problems	2
Lec10	Ecodriving	2
Lec11	Mobile emission sources and the Greenhouse Effect	4
Lec12	Alternative fuels and drive systems	4
Lec13	Test	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Intoduction	2

Proj2	ELVs problem in EU choosen region	4
Proj3	Vehicle material composition	4
Proj4	Identification of ELVs management according to EU and local legislation	3
Proj5	ELVs statistic data gaining for choosen region	3
Proj6	Identification of matter, information and finance flow on field of ELVs in choosen region	3
Proj7	Number of ELVs prognosis defining for choosen region	3
Proj8	Identification of ELVs collecting and dissasembly stations for choosen region	3
Proj9	Estimation of load of collecting and dissasembly stations	3
Proj10	Recyclers pointing for choosen region	3
Proj11	ARS management problem	3
Proj12	Design of model ELVs system concept for choosen EU region	5
Proj13	Project presentation and defence	3
Proj14	Project submission	3
		Total hours: 45

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

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

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03	Grading written report
F2	PEU_U01, PEU_U02, PEU_U03	Oral defence of the project
F3	PEU_U01, PEU_U02, PEU_U03 PEU_K01-PEU_K03	Activity during class and rating team working
P = P = F1 x 0,6 + F2 x 0,2 + F3 x 0,2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Janicka, Kolanek, Walkowiak: "Ecology of Road Transportation", PRINTPAP Łódz, 2011

SECONDARY LITERATURE

DAVENPORT J: The Ecology of Transportation: Managing Mobility for the Environment (Environmental Pollution), Springer, 2006
Society of Automotive Engineers, Vehicle Recycling, Regulatory, Policy, and Labeling Issues (Special Publications

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name of subject in Polish: **Bezpieczeństwo pojazdów**
Name of subject in English: **Safety of vehicle**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **W10MBM-SM4046**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	50		50		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of vehicle body design.
2. Knowledge of designing and manufacturing of the car components.
3. The fundamentals of physics.

SUBJECT OBJECTIVES

C1. Active and passive safety.
C2. Issues of driver regarding to psychology and physiology.
C3. New solutions enable improve safety of traffic system.

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:
PEU_W01 - To define active and passive safety.
PEU_W02 - To describe active safety system - ABS, ASR, BAS.
PEU_W03 - To explain new solutions enable improve safety of traffic system.

II. Relating to skills:
PEU_U01 - To analyze vehicle design regarding safety aspects.
PEU_U02 - To calculate absorption of energy for crash zone
PEU_U03 - Ability to show the improvement methods of active and passive safety.

III. Relating to social competences:
PEU_K01 - Being responsible for own and team work.
PEU_K02 - To obey principles and customs valid in university.

PROGRAM CONTENT

Form of classes – Lecture		Number of hours
Lec1	Safety of traffic: historical view.	1
Lec2	Triangle of safety: driver - physiological factors.	2
Lec3	Triangle of safety: driver - psychological factors.	2
Lec4	Trójkąt bezpieczeństwa: traffic surroundings.	2
Lec5	Trójkąt bezpieczeństwa: vehicle	2
Lec6	Definitions and examples of passive safety.	2
Lec7	Passive safety systems: headrest, seat-belts.	2
Lec8	Definitions and examples of active safety.	2
Lec9	Active safety systems: ABS, ESP, ASR	2
Lec10	Construction of energy absorption elements: theoretical background.	2
Lec11	Construction of energy absorption elements: energy-absorbing materials.	2
Lec12	Construction of energy absorption elements: crash-worthiness calculation.	2
Lec13	Biomechanics of injury.	2
Lec14	Campatibility of vehicles.	2
Lec15	Stability of vehicle.	2
Lec16	Knowledge test	1
		Total hours: 30
Form of classes – Laboratory		Number of hours

Lab1	Discussion of: the syllabus, safety rules in the laboratory and conditions for passing the classes.	2
Lab2	Dynamic deformation of thin-wall profile: gravity drop-hammer.	2
Lab3	Dynamic deformation of a thin-walled profile at high speeds: spring hammer.	2
Lab4	Dynamic deformation of large-scale objects: a universal collision simulator.	2
Lab5	Determination of overloads occurring during a collision on a sleigh stand - structure testing.	2
Lab6	Determination of the collision energy absorbed by the deformed element.	2
Lab7	Construction of dummies: neck injury studies.	2
Lab8	Head injury tests according to EN960 standard.	2
Lab9	Construction of material models taking into account strain-rate hardening.	2
Lab10	Vehicle body and floor plate geometry measurements.	2
Lab11	Determination of the characteristics of the suspension system of a motor vehicle.	2
Lab12	Determination of the characteristics of the steering system.	2
Lab13	Tests of road wheels.	2
Lab14	Tests of braking systems.	2
Lab15	Testing the EBS brake assist system.	2
		Total hours: 30

TEACHING TOOLS USED
N1. informative lecture N2. laboratory experiment N3. calculation exercises

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

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_U02, PEU_U03 PEU_K01, PEU_K02	F1=(report1+…+report14)/14 + all positive ratings
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Seiffert U., Wech L., Automotive Safety Handbook, 2003

SECONDARY LITERATURE

Szczuraszek T., Bezpieczeństwo ruchu miejskiego, WKŁ, rok: 2008
Rokosch U., Poduszki gazowe i napinacze pasów, WKŁ, 2003
Wicher J., Bezpieczeństwo samochodów i ruchu drogowego. Pojazdy samochodowe, WKŁ,
Tiwari G., Mohan D., Transport and Safety - Systems, Approaches, and Implementation, Springer, 2021
2004ADVANCED HIGH STRENGTH STEEL (AHSS) APPLICATION GUIDELINES
http://www.ivss.se

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name of subject in Polish: **Project CAD/FEM Metals**
Name of subject in English: **CAD/FEM Project (Metals)**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **W10MBM-SM4048**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				45	
Number of hours of total student workload (CNPS)				50	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge in field of designing with use of CAD and strength of materials
2. Ability to work independently with a computer
3. Knowledge of technical drawing

SUBJECT OBJECTIVES

C1. Knowledge ordering concerning the engineering and design of machines and strength calculations
C2. Application of Finite Element Analysis for the construction and operation of design of vehicles
C3. Proper definition of the boundary conditions coming from the operation of the design or tested object

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

II. Relating to skills:

PEU_U01 - Be able to design a selected part of the vehicle structure using CAD
PEU_U02 - Be able to conduct simulation of the selected element of vehicle with use of FEM
PEU_U03 - Be able to analyze the results of the simulation and to optimize the part of the vehicle in accordance to the requirements

III. Relating to social competences:

PEU_K01 - Understands the need and has an ability of lifelong learning especially in the field of engineering computer tools
PEU_K02 - Recognizes the need to improve professional, personal and social skills
PEU_K03 - Has a sense of responsibility for the work performed by your own and acquire respect for work of another and for the team work

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Basic definitions and Introduction into computer aided engineering CAE	3
Proj2	Principles of constructing the physical model, system idealization, simplification use in physical models	3
Proj3	The presentation of the calculating systems - selection of the element of vehicle for the project	6
Proj4	Principles and ways of designing in innovative designing – creative designing, spatial designing and assembly design	6
Proj5	Design of the selected element	6
Proj6	The building and creating the discrete models: - shell and beam models - spatial-volume models	6
Proj7	Defining the external loads and material review and its properties necessary for FEM simulations used in automotive industry	3
Proj8	Conduction of the calculations	3
Proj9	Modernization of the model according to the guidelines (in accordance with the analysis of the results)	6
Proj10	Final editing and analysis of results, preparation of the report	3
		Total hours: 45

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

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U03, PEU_K01-PEU_K03	project
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Rusiński E.: Principles of supporting structures designing of automotive vehicle. Wroclaw University of Technology publishing house 2002.

SECONDARY LITERATURE

Zienkiewicz O.C.: Finite Element Method. ARKADY, Warszawa 1972.

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name of subject in Polish: **Project CAD/FEM Flows**
Name of subject in English: **Projekt CAD/FEM Przepływy**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **W10MBM-SM4049**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				45	
Number of hours of total student workload (CNPS)				50	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of fluid mechanics
2. Knowledge of the basics of machine and system design including machines and flow systems

SUBJECT OBJECTIVES

C1. Learn methods for solving flow problems of machinery and equipment
C2. Learning about the finite volume method in flow modeling
C3. Getting familiar with methods of solving the Navier-Stokes equation

SUBJECT LEARNING OUTCOMES

I. Relating to knowledge:

PEU_W01 - Student has a basic knowledge of flow modeling in flow systems

PEU_W02 - Student has knowledge in the design of flow systems using numerical fluid mechanics

II. Relating to skills:

PEU_U01 - student is able to simply make a model of the flow system taking into account the phenomena occurring during the flow

PEU_U02 - Student can define boundary conditions for flow mod

PEU_U03 - Student is able to explain the basic phenomena occurring in the flow of a working medium on the basis of flow visualization

III. Relating to social competences:

PEU_K01 - Student is able to think and act creatively.

PEU_K02 - Student is able to draw logical conclusions and solve the posed problem.

PROGRAM CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction, health and safety training, discussion of the scope of the class, how it will be conducted. Discussion of the AnsysFluent environment	3
Proj2	Liquid flow through a pipe: ideal liquid, real liquid: laminar and turbulent	4
Proj3	Change of flow direction and analysis of the phenomena taking place (detachment of the bedding layer)	4
Proj4	Unconfined flow using sphere flow as an example. Laminar flow without wall layer detachment, laminar flow with wall layer detachment, von Karman path, turbulent flow	4
Proj5	Multiphase flow using Volume Of Fluid model, overflow of liquid from tank, falling droplet	4
Proj6	Flow with rotating element using pump flow as an example	4
Proj7	Own work on a given flow issue 1	5
Proj8	Own work on a given flow issue 2	5
Proj9	Own work on a given flow issue 3	5
Proj10	Own work on a given flow issue 4	5
Proj11	Project evaluation	2
		Total hours: 45

TEACHING TOOLS USED
N1. case study N2. self study - preparation for project class N3. project presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02 PEU_U01, PEU_U02, PEU_U03 PEU_K01, PEU_K02	project
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SECONDARY LITERATURE

SUBJECT SUPERVISOR
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