PROGRAMME OF EDUCATION

FACULTIES: *Electrical Engineering, Mechanical Engineering, Microsystem Electronics and Photonics*

MAIN FIELD OF STUDY: *Mechatronics*

in area of technical science

EDUCATION LEVEL: *1-st level engineering study*

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

PROFILE: *general academic*

SPECIALIZATION:

LANGUAGE OF STUDY: *Polish*

Content:
1. Assumed educational effects – attachment no. 1
2. Programme of studies – attachment no. 2
3. Syllabus – attachment no. 3 (additional tome)

Microsystem Electronics and Photonics Faculty Council resolution of **29.09.2015**

In effect since *01.10.2015*

Educational effects
in the field of study: *Mechatronics*
at the first level – general academic profile

<u>Location of the field of study in the area (areas) of education</u>

Mechatronics, belongs to the range of studies in technology and it is connected with such fields of studies as *Mechanics* and *Machine Building, Electrical Power Engineering and Electronics, Informatics and Automatics and Robotics.* At Wrocław University of Technology, the interdisciplinary field of study – *Mechatronics* is provided by three Faculties:
1. Faculty of Mechanical Engineering (W10),
2. Faculty of Electrical Engineering (W5) and
3. Faculty of Microsystem Electronics and Photonics (W12).

Within the first educational level, three areas of graduation have been proposed:
- Mechatronics in Machine Building and Automotive Engineering
- Mechatronics in Automatics and Measurements
- Mechatronic Microsystems

<u>Explanation of symbols:</u>
K – field-of-study educational effects
W – category of knowledge
U – category of skills
K (after line/dash) – category of social competences

Educational effects at the first level study in MTR	DESCRIPTION OF EDUCATIONAL EFFECTS after completion of the first level study in MTR field of study	Correlation with educational effects in the area of technical sciences(T)
KNOWLEDGE		
K1MTR_W01	Has knowledge in the field of mathematics including algebra, analysis, statistics as well as mathematical and numerical methods necessary to describe mechanical and electrical problems.	T1A_W01
K1MTR_W02	has knowledge in the field of physics, including mechanics, thermodynamics, optics, electricity and magnetism, nuclear physics and solid state physics as well as the knowledge necessary to understand the basic physical phenomena occurring in electronic elements and circuits and their surroundings.	T1A_W01
K1MTR_W03	Has basic knowledge in the area of metrology and measurement systems, measurement uncertainty and data handling, knows and understands the methods of measurement of basic electrical and mechanical properties, including the geometrical ones, knows the principles of operation of measurement systems and instruments for measurements of electrical and mechanical properties.	T1A_W03
K1MTR_W04	Has basic knowledge in the area of manufacturing engineering, with a special emphasis on the principles of quality management and ways of running business.	T1A_W08 InzA_W03 T1A_W09 InzA_W04
K1MTR_W05	Has basic knowledge on intellectual property protection, especially industrial property and copyright law; is able to use the resources of patent information.	T1A_W08 InzA_W03 T1A_W10 T1A_W11
K1MTR_W06	Has knowledge concerning principles of construction description (projections, views, cross-sections, systems), dimensioning and standardization issues in construction description, methods of graphical representation of geometric figures and description of electronic circuits.	T1A_W03 T1A_W04
K1MTR_W07	Has knowledge on the basic chemistry, especially about crystallography and physico-chemical properties of inorganic and organic materials, including the relations between the properties and structure, in terms of widely understood materials engineering. has a well-ordered knowledge about technical materials applied in mechatronics (mechanics, electrical power engineering and electronics), their structure, properties and applications. has knowledge on the strength of materials, necessary for strength dimensioning in simple and complex states of stress in materials and systems.	T1A_W01 T1A_W04

K1MTR_W08	Has ordered and theoretically grounded knowledge in the field of mechanics, especially: statics and mass geometry, kinematics of a material point, reactions in statically determinate systems, centers of gravity and moments of inertia.	T1A_W03
K1MTR_W09	Has knowledge concerning the structure, kinematic and dynamic analyses and designing of kinematic machine systems, devices and robots; is familiar with the process of structural design. Has ordered knowledge on the structure and operating principles of the components and units of mechanical systems used in mechatronic systems as well as the methods of developing models and computational methods applicable to these systems.	T1A_W03 T1A_W04
K1MTR_W10	Has ordered and theoretically grounded knowledge concerning principles of operation of electric driving systems and control systems for machines and mechatronic devices. Has basic knowledge about the elements of hydraulic and pneumatic driving units and systems.	T1A_W03 T1A_W04
K1MTR_W11	Has knowledge about the structure and operation of machine tools, shaping of objects and surfaces as well as basic parameters of technological processes, methods of bonding (welding, soldering, friction welding), plastic working and casting.	T1A_W04 T1A_W07 InzA_W02 InzA_W05
K1MTR_W12	Is familiar with the first and the second principle of thermodynamics for the analysis of thermal and mechanical processes; has basic knowledge on the process of heat transmission and cycles of engines and compressors. Has basic knowledge on the mechanics of gas and liquid flow.	T1A_W03
K1MTR_W13	Has basic knowledge on electromagnetic field, single-phase and three-phase electronic circuits, generation and transformation of electric energy.	T1A_W02 T1A_W03
K1MTR_W14	Has ordered and theoretically grounded knowledge concerning principles of operation of electronic semiconductor devices.	T1A_W03 T1A_W04
K1MTR_W15	Has ordered basic knowledge on the operation, structure, properties and parameters of sensors and sensor systems (including the intelligent ones and microsensors) for various applications, for example: automotive industry, medicine, household goods, entertainment, etc. Has ordered and theoretically grounded knowledge concerning operation, structure and basic micromechanical parameters of actuators and specific mechano-electric microsystems.	T1A_W03 T1A_W04 T1A_W05
K1MTR_W16	Has ordered and fundamental knowledge concerning the structure of microprocessor systems, I/O system control, control algorithms, A/D and D/A conversion and microprocessor programming techniques in machine- and C-language.	T1A_W02 T1A_W07 InzA_W02 InzA_W05
K1MTR_W17	Has knowledge on industrial automatics, especially in the analysis of systems in time and frequency domain, description of continuous and discrete systems, operator transmittance, system stability, control and adjustment. Has basic practical and ordered knowledge concerning the applied control algorithms, including the fuzzy and neural ones, in typical engineering tasks with a special emphasis on the parametric and non-parametric methods of data processing. Has basic knowledge concerning the structure and operation of industrial robots.	T1A_W02 T1A_W04 T1A_W07 InzA_W02

K1MTR_W18	Has basic knowledge on the techniques and materials employed in electronic packaging.	T1A_W03 T1A_W06 InzA_W01
K1MTR_W19	Has basic, ordered and theoretically grounded knowledge in the field of informatics, software engineering and computer architecture especially in hardware domain. Furthermore, has knowledge on implementing and testing computer programs as well as developing and saving documentation of computer software.	T1A_W02 T1A_W07 InzA_W02 InzA_W05
K1MTR_W20	Has basic, ordered and theoretically grounded knowledge concerning networks as well as computer and industrial buses.	T1A_W02 T1A_W04 T1A_W07 InzA_W02
K1MTR_W21	Has basic, ordered and theoretically grounded knowledge about the methods of digital processing of signals and images; is able to characterize basic mathematical tools, necessary to design the systems for digital signal processing, and present algorithms in the form enabling their effective implementation.	T1A_W02 T1A_W04 T1A_W07 InzA_W02
K1MTR_W22	Has basic, ordered and theoretically grounded knowledge in the field of techniques, methods and numerical tools for adding engineering work at the stage of design. Especially, has the knowledge concerning planning and analyzing experimental results as well as numerical modeling and simulation in an interdisciplinary range.	T1A_W03 T1A_W07 InzA_W02
K1MTR_W23	Has knowledge concerning a functional description of mechatronic systems and methods of integration of mechanic, hydraulic, electric and informatic sub-systems into complex mechatronic systems. Is familiar with the current state and the newest trends in the development of mechatronics.	T1A_W05 T1A_W06 InzA_W01
K1MTR_W24	Has detailed knowledge concerning specific issues in modeling and design of mechatronic systems.	T1A_W04
K1MTR_W25	Is familiar with methods of drawing conclusions (induction, deduction, abduction); has basic knowledge necessary for understanding social and philosophical aspects of engineering activities.	T1A_W02 T1A_W08 InzA_W03
K1MTR_W26	Has basic knowledge necessary to understand the ethical and social aspects of engineering activities.	T1A_W01

K1MTR_W27	Knows and understands the basic principles of industrial property protection and copyright law; is able to use the resources of patent information.	T1A_W04 T1A_W07 InzA_W02 T1A_W08 InzA_W03
K1MTR_W28	Has basic theoretical knowledge on management; has elementary knowledge about enterprise management and organization and basic methods, models and functions of management. Is also familiar with management functions, organization strategies and levels of planning in an organization. Understands the development trends in management in terms of economic development.	T1A_W03 T1A_W04 T1A_W09 InzA_W04 T1A_W11
K1MTR_W29	Has ordered knowledge on the operation principle of passive and active electronic devices. Knows their parameters and characteristics. Knows how to use the devices properly.	T1A_W04
K1MTR_W30	Has ordered theoretical knowledge in the field of photonics, including the knowledge necessary to understand physical basis of the operation of the elements of an optical transmission path and knows the areas of application of photonic systems, especially in automotive industry, electric power engineering and microsystems.	T1A_W04
K1MTR_W31	Has ordered theoretical knowledge on the structure and operation of basic analog and digital electronic circuits.	T1A_W04
K1MTR_W32	Has knowledge concerning paradigm of object oriented programming and UML language notation.	T1A_W04
K1MTR_W33	Has basic knowledge on the operation and programming of PLC control systems.	T1A_W04
	Achieves results in the category of KNOWLEDGE in one of the following graduation areas: ▪ Mechatronics in Machine Building and Automotive Engineering (Attachment 1) ▪ Mechatronics in Automatics and Measurements (Attachment 2) ▪ Mechatronic Microsystems (Attachment 3)	
SKILLS		
K1MTR_U01	Is able to use mathematical apparatus to describe the mechanical and electronic phenomena, and for signal controlling and processing. Is able to use numerical methods to solve the basic engineering problems.	T1A_U09 InzA_U02

K1MTR_U02	Is able to identify and describe physical phenomena associated with mechanical, electrical and electronic issues.	T1A_U08 InzA_U01 T1A_U09 InzA_U02
K1MTR_U03	Is able to design a measurement experiment, choose suitable instruments and measurement systems which would enable the measurement of basic electric and mechanical properties, including the geometrical ones and characterizing mechatronic elements; is able to assess a measurement uncertainty and handle measurement results.	T1A_U08 InzA_U01 T1A_U09 InzA_U02
K1MTR_U04	Is able to use appropriate methods and tools for quality improvement. Is able to assess different forms of economic activities to meet current market needs and demands. Is conscious of the responsibility for his/her own work and is prepared to obey the rules of team-work; steadily improves his/her professional qualifications, applies industrial safety rules and is familiar with the principles of work in laboratory and industrial environment.	T1A_U12 InzA_U04
K1MTR_U05	Is able to draw spatial geometric shapes using traditional drawing techniques (technical draft) and computer aided drawing (2D and 3D); is able to make and read a technical documentation in form of a drawing. Can read and interpret the drawings and schemes used in technical documentation (machine and electrical engineering).	T1A_U02 T1A_U03
K1MTR_U06	Depending on the level of the studied language: has the knowledge, skills and competence in accordance with the requirements set for the level B2 ESKOJ; acquires, understands and interprets specialized texts; uses in spoken and written linguistic tools in typical academic language and the working environment of the engineer or Has the knowledge, skills and competencies in line with the requirements specified for the C1 level ESOKJ; follows with understanding and formulate statements on topics related to the discipline of study and professional work, using measures appropriate to the situation; reads, interprets, evaluates and creates texts concerning specialist topics; uses the language skills in interpersonal relations and communication in international academic and professional environment.	T1A_U01 T1A_U03 T1A_U04 T1A_U06
K1MTR_U07	Is able to choose materials suitable for specific applications, carry out basic studies of materials, assess basic properties of materials (at micro and macro-level). Is able to conduct the basic strength tests and measure displacement and distortion.	T1A_U15 InzA_U07
K1MTR_U08	Is able to perform reduction of a force system, assess reaction in statically determinate systems, determine characteristics of bending moments, shearing forces normal to beams and frames and centers of inertia. Is able to determine velocity and acceleration in the kinematics of particle.	T1A_U09 InzA_U02
K1MTR_U09	Is able to analyze the operation of basic mechanisms by analytical methods and using software. Is able to use computational models to choose construction properties of elements and mechanical units and make a graphical representation of the designed system.	T1A_U08 InzA_U01 T1A_U09 InzA_U02

K1MTR_U10	Is able to determine and measure electrical and electro-mechanical parameters of driving systems and define the method of controlling the parameters of the systems. Is able to analyze and choose the components of hydraulic and pneumatic systems	T1A_U08 InzA_U01 T1A_U14 InzA_U06 T1A_U16 InzA_U08
K1MTR_U11	Is able to choose proper technology for accomplishing a task taking into account material parameters and methods of measurement of obtained results. Is able to assess the effect of basic parameters on the results of casting, subtractive and additive machining, bonding and identify the disturbing factors (e.g. distortion).	T1A_U11 T1A_U16 InzA_U08
K1MTR_U12	Is able to determine specific heat of gas, volumetric efficiency of compressors and carry out an investigation of heat transfer. Is able to make a computation of flows (conducts, pipelines and slits) and assess the characteristics of pipelines.	T1A_U08 InzA_U01 T1A_U09 InzA_U02
K1MTR_U13	Is able to solve static and dynamic problems concerning electric field and circuits, can specify and use the principles of selecting components for the circuits supplying electric receivers.	T1A_U09 InzA_U02
K1MTR_U14	Is able to use the recognized methods, mathematical models and computer simulations to analyze and assess the operation of electronic devices and simple analog electronic circuits.	T1A_U08 InzA_U01 T1A_U09 InzA_U02
K1MTR_U15	Is able to choose and apply appropriate sensors to measure various physical quantities and use them later in the measuring, monitoring and controlling systems; is able to test basic characteristics of sensors. Is able to explain the principle of operation of specific microsystems, can use chosen microsystems and assess correctness of their operation by performing suitable tests.	T1A_U01 T1A_U08 InzA_U01 T1A_U09 InzA_U02 T1A_U10 InzA_U03
K1MTR_U16	Is able to define general requirements for microprocessor system for a particular application, is able to design the structure of the system, choose the software, write a computer program in a low-level language, according to the control algorithm.	T1A_U07

K1MTR_U17	Is able to develop dynamic models of objects, formulate the conditions and goals of control, define a control system, perform an analysis and synthesis of the automation systems and tuning of PID controllers. Has an ability to use correctly basic control algorithms and techniques, apply proper modeling, approximation and classification techniques with the use of neural and fuzzy algorithms. Uses in practice suitable methods of network learning and interprets the connections between an object inputs and outputs. Is able to program industrial robots.	T1A_U09 InzA_U02 T1A_U10 InzA_U03 T1A_U14 InzA_U06
K1MTR_U18	Is able to design a technological process for the fabrication of an electronic device, taking into account assumed application and economic criteria, with the use of proper methods, techniques, tools and materials.	T1A_U12 InzA_U04 T1A_U16 InzA_U08
K1MTR_U19	Is able to choose appropriate informatics tools and hardware to realize an assumed task from the field of informatics, develop algorithm documentation, use a proper programming language, tools and equipment for the development, implementation and testing of computer programs and prepare documentation of computer software.	T1A_U13 InzA_U05 T1A_U15 InzA_U07
K1MTR_U20	Has an ability to analyze the principles of functioning of network protocols and interfaces and design simple communication networks. Is able to apply in practice the used solutions and network configurations, depending on the chosen problem specification.	T1A_U01 T1A_U10 InzA_U03 T1A_U16 InzA_U08
K1MTR_U21	Chooses appropriate methods, algorithms and tools necessary for digital processing of signals and images, is able to design and implement algorithms and correctly interpret the results of performed analyses.	T1A_U15 InzA_U07 T1A_U16 InzA_U08
K1MTR_U22	Is able to choose proper tools to add engineering jobs and use them in practice in software engineering (Matlab/Simulink, LabView, 3D modeling, MES). Analyzes and interprets the obtained results using experiment design methods, optimization, numerical modeling, simulation, analysis and verification of results.	T1A_U07

K1MTR_U23	Is able to design, integrate and model a simple mechatronic system and subsequently verify the correctness of operation of such system.	T1A_U09 InzA_U02 T1A_U16 InzA_U08
K1MTR_U24	Is able to explain and justify the undertaken engineering task, identify partial tasks, make a work plan on the project and present the work flow and results in form of oral presentation and records. Analyzes complexity of a task, establishes priorities for accomplishment the undertaken task with the use of selected methods and tools.	T1A_U01 T1A_U03 T1A_U04 T1A_U05 T1A_U14 InzA_U06
K1MTR_U25	Is able to acquire information from literature, integrate and interpret liberal texts.	T1A_U02
K1MTR_U26	Is able to acquire information from literature, integrate and interpret scientific texts from the area of engineering ethics.	T1A_U01
K1MTR_U27	Is able to use law codes and apply legal regulations in situations typical of professional practice.	T1A_U01
K1MTR_U28	Is able to apply specialized vocabulary from the field of quality management, read basic ISO standards of 9000 series, with understanding and give examples of management solutions which fulfill the requirements and guidelines of these standards.	T1A_U01 T1A_U03 T1A_U04
K1MTR_U29	Is prepared to business activity in industrial environment, is familiar with industrial safety rules associated with workplace.	T1A_U11
K1MTR_U30	Is able to use statistical methods in topics related to mechanics and electrical engineering.	T1A_U01
K1MTR_U31	Can perform basic acceptance and operating tests for low-voltage electrical installations. Can act properly in the case of failure of electrical equipment resulting in threat to life, health and the environment.	T1A_U09 InzA_U02 T1A_U11
K1MTR_U32	Is able to use catalogues of elements; is able to apply recognized elements for designing simple electronic circuits.	T1A_U16 InzA_U08
K1MTR_U33	Is able to apply the known optoelectronic components and simple optical fiber systems in engineering practice.	T1A_U15 InzA_U07
K1MTR_U34	Is able to design electronic circuits responsible for measurement and processing of sensor signals, and depending on complexity level, run and measure the functional properties of designed analog or digital systems intended for control and measuring (detection).	T1A_U16 InzA_U08

K1MTR_U35	Is able to apply an object oriented approach for designing and programming. Is familiar with the languages of object programming at high level.	T1A_U07 T1A_U16 InzA_U08
K1MTR_U36	Is able to select correctly the configuration of PLC controller systems for the accomplishment of particular control and management tasks and perform their programming.	T1A_U14 InzA_U06
	Achieves the results in the category of SKILLS in one of the following graduation areas: ▪ Mechatronics in Machine Building and Automotive Engineering (Attachment 1) ▪ Mechatronics in Automatics and Measurements (Attachment 2) ▪ Mechatronic Microsystems (Attachment 3)	
COMPETENCES		
K1MTR_K01	Understands the need and knows the possibilities of lifetime learning process (2-nd and 3-rd level studies, post-graduate studies, courses) in raising the professional, personal and social competences.	T1A_K01
K1MTR_K02	Is conscious of the importance and understands beyond technical aspects and consequences of the mechatronic engineer activity, including the environmental aspects and responsibility for undertaken decisions.	T1A_K02 InzA_K01
K1MTR_K03	Is able to co-operate and work in a team, taking up different roles.	T1A_K03
K1MTR_K04	Is able to define priorities in realization of a task established by self or someone else.	T1A_K04
K1MTR_K05	Correctly recognizes and settles dilemmas associated with professional activity.	T1A_K05
K1MTR_K06	Is able to think and act in an entrepreneurial way.	T1A_K06 InzA_K02
K1MTR_K07	Is conscious of the importance and understands humanistic aspects and consequences of engineering activities. Recognizes the impact of technical activities on environment and connected with it social responsibility of science and technology.	T1A_K01
K1MTR_K08	Correctly recognizes and settles dilemmas associated with performing professional activities; is conscious of the social role of technical university graduates. Understands the need to formulate and share in society the information concerning technical achievements and other aspects of engineering activity; is able to share such information and opinion in a clear way, justifying various points of view.	T1A_K05 T1A_K07
K1MTR_K09	Understands legal aspects and consequences of engineering activities.	T1A_K05 T1A_K06 InzA_K02

K1MTR_K10	Understands the ideas of standardization, certification and integration of the management systems including quality, environmental protection, industrial safety and information security. Understands the concept of management through quality. Recognizes the basic problems of quality management, including the cost of quality and the methods of solving this problem. Knows the general rules of establishing and developing the forms of individual entrepreneurship.	T1A_K01 T1A_K06 InzA_K02 T1A_K07
K1MTR_K11	Is conscious of necessity of individual and group activities extending beyond engineering activities.	T1A_K01 T1A_K04
K1MTR_K12	Is conscious of the social role of technical university graduates, especially understands the need to formulate and share in society – among the others by mass-media – the information and opinions concerning the achievements of mechatronics and other aspects of mechatronic engineer activity; takes efforts to share such information and opinions in a clear way.	T1A_K07
K1MTR_K13	Has a sense of responsibility for own work and willingness to comply with the principles of teamwork and improve accountability for jointly implemented activities.	T1A_K03
K1MTR_K14	Thinks that the conscious and systematic physical activity during studies and after graduation, helps in improvement of life quality	T1A_K01 T1A_K03
K1MTR_K15	Is able to interact and work in a group, assuming different roles in it and can think critically and argue his position, so that he can appropriately select priorities and the means to implement stated tasks stated by him or others.	T1A_K04

Attachment no. 1 AREA OF GRAUDATION Mechatronics in Machine Building and Automotive Engineering

	KNOWLEDGE	
K1MTR_M_W01	Mastered the principles of efficiency assessment and applying flexible automation production.	T1A_W06 InzA_W01
K1MTR_M_W02	Knows the structures of production process and its elements, the characteristics of production techniques, principles of material selection and the form of semi-finished goods. Knows technical documentation and technological processes of different class objects.	T1A_W04 T1A_W06 InzA_W01 T1A_W07 InzA_W02
K1MTR_M_W03	Has knowledge concerning the survey and classification of driving systems, including the hybrid ones, energy sources, principles of controlling, energy receivers.	T1A_W04
K1MTR_M_W06	Has basic knowledge concerning operation and programming of the systems controlling the motion of CNC machine tools.	T1A_W04
K1MTR_M_W07	Has knowledge concerning the hazards resulting from industrial activity and machine using, knows international conventions and Polish regulation about environmental protection and ecological aspects of machine designing, using and modernizing.	T1A_W08 InzA_W03
	SKILLS	
K1MTR_M_U01	Is able to design simple machine units using synthesis methods. Is able to identify experimentally basic characteristics of mechanical systems.	T1A_U08 InzA_U01 T1A_U09 InzA_U02 T1A_U16 InzA_U08
K1MTR_M_U02	Is able to design, assess and choose a structure of flexible production system on the basis of technological data including the family of workpieces.	T1A_U16 InzA_U08
K1MTR_M_U03	Is able to design a technological process of specific machine parts.	T1A_U14 InzA_U06 T1A_U16 InzA_U08

K1MTR_M_U04	Is able to identify experimentally the parameters of different drives and their loads.	T1A_U08
		InzA_U01
		T1A_U09
		InzA_U02
K1MTR_M_U07	Is able to develop an algorithm for motion control and its implementation for CNC controllers for machine tools.	T1A_U16
		InzA_U08
K1MTR_M_U09	Is able to design a technological process of specific machine parts.	T1A_U14
		InzA_U06
		T1A_U16
		InzA_U08

Attachment no. 2 AREA OF GRAUDATION Mechatronics in Automatics and Measurements

	KNOWLEDGE	
K1MTR_MAP_W01	Has ordered knowledge concerning the principles of operation and control of power engineering electronic systems.	T1A_W03 T1A_W04
K1MTR_MAP_W02	Has ordered knowledge concerning active and intelligent materials applied in the transducers of mechatronic systems.	T1A_W04 T1A_W05
K1MTR_MAP_W03	Has ordered knowledge concerning model application for designing and testing of control systems in mechatronics.	T1A_W03 T1A_W04
K1MTR_MAP_W04	Has ordered knowledge concerning developing of mathematical models of the systems and processes initiated by time sequence of events.	T1A_W01 T1A_W03
K1MTR_MAP_W05	Has basic knowledge concerning algorithms for numerical solution of linear and nonlinear dynamic problems.	T1A_W03
K1MTR_MAP_W06	Has ordered knowledge on the design and using the systems in intelligent buildings.	T1A_W04
K1MTR_MAP_W07	Has knowledge concerning the methods of fabrication of thin-film materials (vacuum evaporation, magnetron sputtering, plasma polymerization) applied in mechatronic systems.	T1A_W04 T1A_W06 InzA_W01 T1A_W07 InzA_W02 InzA_W05
	SKILLS	
K1MTR_MAP_U01	Is able to design and carry out the measurements of electrical characteristics as well as extract the basic parameters characterizing power electronic converters.	T1A_U08 InzA_U01 T1A_U09 InzA_U02
K1MTR_MAP_U02	I able to choose an active material or a converter using the material, suitable for the requirements of a particular mechatronic system.	T1A_U13 InzA_U05
K1MTR_MAP_U03	Is able to use basic computer modeling tools to develop a prototype of an integrated driving system with a control algorithm.	T1A_U09 InzA_U02 T1A_U16 InzA_U08

K1MTR_MAP_U04	Is able to develop and verify mathematical models of the systems and processes connected with mechatronics.	T1A_U09 InzA_U02 T1A_U13 InzA_U05
K1MTR_MAP_U05	Is able to choose appropriate algorithm for solving mathematical models of linear and nonlinear dynamic states.	T1A_U14 InzA_U06 T1A_U16 InzA_U08
K1MTR_MAP_U06	Is able to use modern computer tools for design of supplying and control systems in a building.	T1A_U15 InzA_U07 T1A_U16 InzA_U08
K1MTR_MAP_U07	Is able to obtain thin-films with desired electrical properties and assess the influence of technological parameters on the values of these properties.	T1A_U15 InzA_U07 T1A_U16 InzA_U08
K1MTR_MAP_U08	Is able to define a configuration of a microprocessor system for realization of engineering tasks concerning measurements and control and choose proper tools for the system programming.	T1A_U14 InzA_U06

Attachment no. 3 AREA OF GRAUDATION Mechatronic Microsystems

	KNOWLEDGE	
K1MTR_MM_W01	Has ordered and theoretically grounded knowledge concerning materials, technology, structure as well as specific electrical properties and stability of classical and modern components and passive elements of electronic circuits in mechatronic systems.	T1A_W01 T1A_W03
K1MTR_MM_W02	Has ordered and theoretically grounded knowledge in the field of photonics, including the knowledge necessary to understand the physical basis of the operation of the components of an optical transmission path and knows the areas of application of photonic systems, especially in automotive industry, electric power engineering and microsystems.	T1A_W01 T1A_W03 T1A_W04
K1MTR_MM_W03	Knows and understands technological processes associated with the fabrication of micro- and nano- devices used in mechatronics. Is familiar with the current state and developing trends in micro- and nano electronic technologies.	T1A_W03 T1A_W04
K1MTR_MM_W04	Has basic, ordered and theoretically grounded knowledge concerning numerical methods applied in engineering. The range of the knowledge comprises error analysis, methods of numerical differentiation and integration, solving of linear and nonlinear systems of equations, approximation and interpolation methods, algorithms for single- and multiple criteria optimization and the methods of experiment design. Has also basic knowledge in the field of modeling and simulation of continuous and discrete phenomena related to macro, micro and mesa scale.	T1A_W02 T1A_W07 InzA_W02
K1MTR_MM_W05	Has basic, ordered and theoretically grounded knowledge concerning the methods and materials used in modern electronics bonding, microsystems and photonics. The range of the knowledge comprises, among the others, basic bonding methods (i.e. wire bonding, surface bonding and flip-chip bonding), substrates intended for bonding with different scale of integration, applied solders (lead and leadless) electrically and thermally conductive resins. Has knowledge about typical failures and bonds reliability.	T1A_W03 T1A_W06 InzA_W01
K1MTR_MM_W06	Has basic knowledge about principles of operation and handling external devices used in computer systems.	T1A_W03 T1A_W07 InzA_W02
	SKILLS	
K1MTR_MM_U01	Is able to perform an analysis of the properties of components and passive elements, analysis of electrical circuits built of passive elements (DC, AC and transient analysis), is able to use proper methods and devices for measurement of basic quantities characterizing electronic components and systems.	T1A_U07 T1A_U08 InzA_U01
K1MTR_MM_U02	Can use the recognized methods, mathematical models and computer simulations for analysis and evaluation of the operation of optoelectronic components and simple optical fiber systems; can use proper methods and instruments to measure the basic quantities characteristic of these elements and optoelectronic systems. Is able to prepare technical documentation on realization of an engineering task and arrange a report containing results of the task.	T1A_U03 T1A_U08 InzA_U01 T1A_U09 InzA_U02

K1MTR_MM_U03	Is able to design a technological process of fabrication of an electronic device, taking into account desired functional and economic criteria, using proper methods, techniques , tools and materials. Applies industrial safety rules and is familiar with the principles of working in laboratory and industrial environment.	T1A_U11 T1A_U12 InzA_U04 T1A_U16 InzA_U08
K1MTR_MM_U04	Is able to choose and apply in practice proper tools, programs, numerical methods and algorithms to solve typical problems from the field of computer aided design in engineering. Furthermore, is able to interpret the obtained results and use appropriate methods of their verification. Correctly identifies and defines priorities for accomplishment the undertaken engineering task from the field of computer aided design.	T1A_U08 InzA_U01 T1A_U09 InzA_U02 T1A_U15 InzA_U07
K1MTR_MM_U05	Correctly analyzes, chooses and applies proper materials used for bonding in contemporary electronics. Is able, by himself/herself to perform simple activities connected with realization of simple electrical connections and bonding or debonding of elements on printed boards. Is prepared to use the knowledge both in electronic industry and small professional service firms.	T1A_U12 InzA_U04 T1A_U16 InzA_U08
K1MTR_MM_U06	Is able design and develop software for computer measurement systems with different communication interfaces. Is able to use catalogue cards and application notes to select appropriate components of designed circuit or electronic system; is able to prepare documentation on realization of an engineering task and arrange a report containing an analysis of results of the task.	T1A_U01 T1A_U03 T1A_U07 T1A_U10 InzA_U03 T1A_U16 InzA_U08

PROGRAMME OF STUDIES

1. Description

Number of semesters: **7**	*Number ECTS points necessary to obtain qualifications:* **210**
Prerequisites (particularly for second-level studies): *The basis for admission to study is the ENROLMENT INDEX. Its value is determined by selected results of the secondary school-leaving examination. The ENROLMENT INDEX is the sum of the points scored in the qualifying subjects (mathematics, physics, the Polish language, a modern foreign language), calculated in accordance with the applicant admission rules passed by the Senate. The enrolment index threshold value is set depending on the number of applicants.*	*Upon completion of studies graduate obtains professional degree of: inżynier* *1st/ 2nd * level qualifications*
Possibility of continuing studies: **2nd level**	*Graduate profile, employability:* *The 1st-level-studies main-field-of-study MTR graduate has skills in: using the acquired knowledge in her/his professional life, communicating with the workplace milieu, actively participating in team work, managing her/his subordinates, undertaking independent business activity and dealing with legal and economic problems. The Mechatronics graduate has knowledge of mechanics, electrotechnics and electronics, information science, metrology, automation and robotics, and control theory and engineering. This wide, specific to main field of study Mechatronics, education area, forms a nationally unique profile of the graduate as a comprehensively educated engineer prepared to take up challenges in practically any field of present-day science and technology. The graduate has the skill to exploit the acquired knowledge in the design, manufacture, implementation and operation of mechatronic devices. The graduate is prepared to work in:* *the electrical machinery industry, the automotive industry, the aircraft industry, the machine tool industry, the domestic appliances industry, the medical equipment industry, scientific-research institutions, R&D centres, design-construction centres, health-care institutions (medical and diagnostic equipment operation) and service and testing stations.* *The graduate is prepared to undertake 2nd level studies.*
Indicate connection with University's mission and its development strategy: the knowledge acquired in the course of the studies is not only to bear fruit in the graduate's future professional career, but also to shape an enterprising and creative person ready to face new challenges.	

2. Fields of science and scientific disciplines to which educational effects apply:

Technological sciences /
electronics, automatic control and robotics, information science

3. Concise analysis of consistency between assumed educational effects and labour market needs

The education effects apply to not only the broadly understood mechanics, electrotechnics and electronics, automation and robotics, but also, because of the demands of the modern engineering and technology used in industry today, to microprocessor engineering, control theory and engineering, information science and management and marketing techniques. Having achieved the assumed educational effects, the graduate will be able to find an attractive and interesting job in all the branches of industry and to set up her/his own business. The educational effects were reported and discussed at meetings of the Electrical Engineering Faculty Council whose members include representatives of industrial plants from Poland, especially from Lower Silesia and the neighbouring provinces.

4. List of education modules:

4.1. List of obligatory modules:

4.1.1 List of general education modules

4.1.1.1 *Liberal-managerial subjects* module *(min. ..2.... ECTS points):*

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	Weekly number of hours					Field-of-study educational effect symbol	Number of hours		Number of ECTS points		Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes[1]			university-wide[4]	practical[5]	kind[6]	type[7]
1.	MCM031006W	Management Essentials	1					K1MTR_W04, K1MTR_W28	15	30	1	0,6	T	Z			KO	Ob.
2.	MCM036006W	Project Management	1					K1MTR_W28	15	30	1	0,6	T	Z			KO	Ob.
		Total	**2**	**0**	**0**	**0**	**0**		**30**	**60**	**2**	**1,2**						

4.1.1.2 *Foreign languages* module *(min. .... ECTS points):*

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

4.1.1.3 *Sporting classes* module *(min. .... ECTS points):*

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

4.1.1.4 *Information technologies* module *(min. 2 ECTS points):*

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	Weekly number of hours					Field-of-study educational effect symbol	Number of hours		Number of ECTS points		Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes[1]			university-wide[4]	practical[5]	kind[6]	type[7]
1.	MCM031007W	Information Technology	1					K1MTR_W01, K1MTR_W02	15	30	1	0,6	T	Z			KO	Ob.
2.	MCM031007L	Information Technology			1			K1MTR_U19	15	30	1	0,7	T	Z		P	KO	Ob.
		Total	**1**	**0**	**1**	**0**	**0**		**30**	**60**	**2**	**1,3**						

Altogether for general education modules

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK classes1
lec	cl	lab	pr	sem				
3	**0**	**1**	**0**	**0**	**60**	**120**	**4**	**2,5**

4.1.2 List of basic sciences modules

4.1.2.1 *Mathematics* module

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	Weekly number of hours					Field-of-study educational effect symbol	Number of hours		Number of ECTS points		Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes[1]			university-wide[4]	practical[5]	kind[6]	type[7]
1.	MAP001140W	Algebra and Analytic Geometry	2					K1MTR_W01	30	60	2	1,5	T	E	O		PD	Ob.
2.	MAP001140C	Algebra and Analytic Geometry		1				K1MTR_U01, K1MTR_K01	15	60	2	1,0	T	Z	O	P	PD	Ob.
3.	MAP001142W	Mathematical Analysis 1.1 A	2					K1MTR_W01	30	150	5	3,0	T	E	O		PD	Ob.
4.	MAP001142C	Mathematical Analysis 1.1 A		2				K1MTR_U01	30	90	3	2,0	T	Z	O	P	PD	Ob.
5.	MAP001156W	Mathematical Analysis 2.1 A	2					K1MTR_W01	30	120	4	3	T	E	O		PD	Ob.
6.	MAP001156C	Mathematical Analysis 2.1 A		2				K1MTR_U01	30	90	3	2	T	Z	O	P	PD	Ob.
7.	MAP003062W	Ordinary Differential Equations	1					K1MTR_W01	15	60	2	1,2	T	Z			PD	Ob.
8.	MAP003062C	Ordinary Differential Equations		1				K1MTR_U01, K1MTR_K01	15	60	2	1,4	T	Z		P	PD	Ob.
9.	MCD033002W	Statistics for Engineers	1					K1MTR_W26	15	60	2	1,2	T	Z			PD	Ob.
10.	MCD033002C	Statistics for Engineers		1				K1MTR_U30	15	60	2	1,4	T	Z		P	PD	Ob.
		Total	**8**	**7**	**0**	**0**	**0**		**225**	**810**	**27**	**17,7**						

4.1.2.2 *Physics* module

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	Weekly number of hours					Field-of-study educational effect symbol	Number of hours		Number of ECTS points		Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes[1]			university-wide[4]	practical[5]	kind[6]	type[7]
1.	FZP001058W	Physics 1.2	2					K1MTR_W01, K1MTR_W02, K1MTR_W12, K1MTR_K01, K1MTR_K02, K1MTR_K07, K1MTR_K12	30	120	4	4	T	E	O		PD	Ob.
2.	FZP001058C	Physics 1.2		2				K1MTR_U01, K1MTR_U02, K1MTR_U12, K1MTR_U24, K1MTR_K01, K1MTR_K02, K1MTR_K07, K1MTR_K12	30	60	2	2	T	Z	O	P	PD	Ob.
3.	FZP003002W	Physics 2.8	1					K1MTR_W01, K1MTR_W02, K1MTR_W07, K1MTR_W13, K1MTR_W14, K1MTR_W25	15	60	2	2	T	E	O		PD	Ob.
4.	FZP003002L	Physics 2.8			1			K1MTR_U01, K1MTR_U24, K1MTR_U25, K1MTR_K02, K1MTR_K11	15	60	2	2	T	Z	O	P	PD	Ob.
		Total	**3**	**2**	**1**	**0**	**0**		**90**	**300**	**10**	**10**						

4.1.2.3 *Chemistry* module

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	Weekly number of hours					Field-of-study educational effect symbol	Number of hours		Number of ECTS points		Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes[1]			university-wide[4]	practical[5]	kind[6]	type[7]
1.	MCD031001W	Chemisty	2					K1MTR_W07	30	60	2	1,2	T	Z			PD	Ob.
		Total	**2**	**0**	**0**	**0**	**0**		**30**	**60**	**2**	**1,2**						

4.1.2.4 *Informatics* module

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	Weekly number of hours					Field-of-study educational effect symbol	Number of hours		Number of ECTS points		Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes[1]			university-wide[4]	practical[5]	kind[6]	type[7]
1.	MCM033005W	Software Engineering and UML	1					K1MTR_W19, K1MTR_W32	15	30	1	0,6	T	Z			PD	Ob.
		Total	**1**	**0**	**0**	**0**	**0**		**15**	**30**	**1**	**0,6**						

4.1.2.5 *Basic Courses* Module

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	Weekly number of hours					Field-of-study educational effect symbol	Number of hours		Number of ECTS points		Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes[1]			university-wide[4]	practical[5]	kind[6]	type[7]
1.	MCM032004W	Material Science I	2					K1MTR_W02, K1MTR_W07	30	60	2	1,2	T	Z			PD	Ob.
2.	MCM032004L	Material Science I			1			K1MTR_U07	15	30	1	0,7	T	Z		P	PD	Ob.
3.	MCR033102W	Material Science II	1					K1MTR_W07	15	60	2	1,2	T	E			PD	Ob.
4.	MCR033102L	Material Science II			1			K1MTR_U03	15	30	1	0,7	T	Z		P	PD	Ob.
		Total	**3**	**0**	**2**	**0**	**0**		**75**	**180**	**6**	**3,8**						

Altogether for basic sciences modules:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK classes1
lec	cl	lab	pr	sem				
17	**9**	**3**	**0**	**0**	**435**	**1380**	**46**	**33,3**

4.1.3 List of main-field-of-study modules

4.1.3.1 *Obligatory main-field-of-study* **modules**

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	Weekly number of hours					Field-of-study educational effect symbol	Number of hours		Number of ECTS points		Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes[1]			university-wide[4]	practical[5]	kind[6]	type[7]
1.	MCR031101W	Metrology principles	1					K1MTR_W03	15	30	1	0,6	T	Z			K	Ob.
2.	MCM031005W	Engineering Graphics	1					K1MTR_W06	15	30	1	0,6	T	Z			K	Ob.
3.	MCM031005L	Engineering Graphics			2			K1MTR_U05, K1MTR_U09, K1MTR_U29	30	60	2	1,4	T	Z		P	K	Ob.
4.	MCM031008W	Introduction to Mechatronics	2					K1MTR_W10, K1MTR_W15, K1MTR_W16, K1MTR_W19, K1MTR_W22, K1MTR_W23, K1MTR_W26	30	60	2	1,2	T	Z			K	Ob.
5.	MCR032102W	Fundamentals of Electrotechnics	2					K1MTR_W13	30	90	3	1,8	T	E			K	Ob.
6.	MCR032102C	Fundamentals of Electrotechnics		1				K1MTR_U13	15	30	1	0,7	T	Z		P	K	Ob.
7.	MCM032005W	Mechanics I (Statics)	2					K1MTR_W01, K1MTR_W02, K1MTR_W08	30	90	3	1,8	T	Z			K	Ob.
8.	MCM032005C	Mechanics I (Statics)		2				K1MTR_U08	30	60	2	1,4	T	Z		P	K	Ob.
9.	MCD032001W	Electronic Components and Circuits	2					K1MTR_W14, K1MTR_W29	30	60	2	1,2	T	Z			K	Ob.
10.	MCR033231W	Electrical installations and supply systems	1					K1MTR_W10	15	30	1	0,6	T	Z			K	Ob.
11.	MCR033231C	Electrical installations and supply systems		1				K1MTR_U01, K1MTR_U02, K1MTR_U03, K1MTR_U04, K1MTR_U05, K1MTR_K01	15	30	1	0,7	T	Z		P	K	Ob.
12.	MCM033006W	Mechanics II (Dynamics)	2					K1MTR_W09	30	60	2	1,2	T	E			K	Ob.
13.	MCM033006C	Mechanics II (Dynamics)		1				K1MTR_U01, K1MTR_U02	15	60	2	1,4	T	Z		P	K	Ob.
14.	MCM033007W	Strength of materials, Mechanics of engineering materials	2					K1MTR_W07	30	60	2	1,2	T	Z			K	Ob.
15.	MCM033007C	Strength of materials, Mechanics of engineering materials		2				K1MTR_U01, K1MTR_U02, K1MTR_U09	30	60	2	1,4	T	Z		P	K	Ob.
16.	MCM033008W	Fundamentals of manufacturing	2					K1MTR_W04	30	30	1	0,6	T	Z			K	Ob.
17.	MCD033001L	Electronic Components and Circuits			2			K1MTR_U32, K1MTR_K03	30	60	2	1,4	T	Z		P	K	Ob.
18.	MCR034103W	Electrical metrology	1					K1MTR_W03	15	30	1	0,6	T	Z			K	Ob.
19.	MCR034103L	Electrical metrology			1			K1MTR_U03	15	60	2	1,4	T	Z		P	K	Ob.
20.	MCR034211W	Fundamentals of control engineering	2					K1MTR_W17	30	90	3	1,8	T	E			K	Ob.
21.	MCM034005W	Analysis and Synthesis of Kinematic Systems	2					K1MTR_W09	30	60	2	1,2	T	E			K	Ob.
22.	MCM034005P	Analysis and Synthesis of Kinematic Systems				2		K1MTR_U09	30	60	2	1,4	T	Z		P	K	Ob.
23.	MCM032006W	Metrology of geometrical quantites	1					K1MTR_W03	15	30	1	0,6	T	Z			K	Ob.
24.	MCM032006L	Metrology of geometrical quantites			1			K1MTR_U29, K1MTR_K03, K1MTR_K04, K1MTR_K09	15	30	1	0,7	T	Z		P	K	Ob.
25.	MCM034006L	Fundamentals of manufacturing			3			K1MTR_U03, K1MTR_U11, K1MTR_U29, K1MTR_K01, K1MTR_K05, K1MTR_K08	45	90	3	2,1	T	Z		P	K	Ob.
26.	MCM034007W	Systems for Manufacturing and Assembly	2					K1MTR_W08, K1MTR_W11, K1MTR_W18	30	60	2	1,2	T	E			K	Ob.
27.	MCM034007L	Systems for Manufacturing and Assembly			1			K1MTR_U11, K1MTR_U18, K1MTR_K03, K1MTR_K04, K1MTR_K06	15	30	1	0,7	T	Z		P	K	Ob.

No.	Code	Course name	lec	cl	lab	pr	sem	Codes										
28.	MCD034002W	Principles of microprocessor technology	1					K1MTR_W16	15	60	2	1,2	T	Z			K	Ob.
29.	MCD034002L	Principles of microprocessor technology			2			K1MTR_U16	30	60	2	1,4	T	Z		P	K	Ob.
30.	MCR035241W	Safety in electrical engineering	1					K1MTR_W27	15	30	1	0,6	T	Z			K	Ob.
31.	MCR035241L	Safety in electrical engineering			1			K1MTR_U31, K1MTR_K13	15	30	1	0,7	T	Z		P	K	Ob.
32.	MCR035301W	Electrical Drives	2					K1MTR_W10	30	90	3	1,8	T	E			K	Ob.
33.	MCR035301L	Electrical Drives			2			K1MTR_U02, K1MTR_U10	30	60	2	1,4	T	Z		P	K	Ob.
34.	MCR035211L	Fundamentals of control engineering			1			K1MTR_U17, K1MTR_K03	15	30	1	0,7	T	Z		P	K	Ob.
35.	MCR035212W	Elements of control engineering	1					K1MTR_W17	15	60	2	1,2	T	Z			K	Ob.
36.	MCR035212L	Elements of control engineering			1			K1MTR_U17, K1MTR_K01	15	30	1	0,7	T	Z		P	K	Ob.
37.	MCM035003W	Fundamentals of machine elements design	2					K1MTR_W07, K1MTR_W09, K1MTR_W10	30	60	2	1,2	T	Z			K	Ob.
38.	MCM035003P	Fundamentals of machine elements design				2		K1MTR_U05, K1MTR_U09, K1MTR_U23, K1MTR_K02, K1MTR_K04	30	90	3	2,1	T	Z		P	K	Ob.
39.	MCM035004W	Drive systems, hydraulic components and pneumatic components	2					K1MTR_W10, K1MTR_W24	30	60	2	1,2	T	E			K	Ob.
40.	MCM035004L	Drive systems, hydraulic components and pneumatic components			1			K1MTR_U10, K1MTR_U23, K1MTR_K04	15	30	1	0,7	T	Z		P	K	Ob.
41.	MCD035001W	Fundamentals of Electronic Design	1					K1MTR_W31	15	30	1	0,6	T	Z			K	Ob.
42.	MCD035002W	Applications of optoelectronics	1					K1MTR_W30	15	30	1	0,6	T	Z			K	Ob.
43.	MCD035002L	Applications of optoelectronics			2			K1MTR_U33	30	30	1	0,7	T	Z		P	K	Ob.
44.	MCM036004W	Basics of mechatronical design of systems	1					K1MTR_W24	15	60	2	1,2	T	Z			K	Ob.
45.	MCM036004P	Basics of mechatronical design of systems				2		K1MTR_U23, K1MTR_K02	30	60	2	1,4	T	Z		P	K	Ob.
46.	MCM036005W	Industrial robots	2					K1MTR_W09, 1MTR_W10, 1MTR_W15, K1MTR_W23	30	30	1	0,6	T	E			K	Ob.
47.	MCM036005L	Industrial robots			1			K1MTR_U09, K1MTR_U24, K1MTR_U29	15	60	2	1,4	T	Z		P	K	Ob.
48.	MCD036001W	Microsystems (MEMS)	2					K1MTR_W15	30	60	2	1,2	T	E			K	Ob.
49.	MCD036001L	Microsystems (MEMS)			1			K1MTR_U15, K1MTR_K03	15	60	2	1,4	T	Z		P	K	Ob.
50.	MCD036002P	Fundamentals of Electronic Design				2		K1MTR_U34, K1MTR_U32, K1MTR_K03, K1MTR_K04	30	30	1	0,7	T	Z		P	K	Ob.
		Total	**41**	**7**	**22**	**8**	**0**		**1170**	**2580**	**86**	**55,6**						

Altogether (for main-field-of-study modules):

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK classes1
lec	cl	lab	pr	sem	**1170**	**2580**	**86**	**55,6**
41	**7**	**22**	**8**	**0**				

4.1.4 List of Speciality Modules

4.1.4.1 *Speciality Courses* modules

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

Altogether (for Speciality Courses modules):

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK classes[1]
lec	cl	lab	pr	sem				
0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

4.2 List of optional modules
4.2.1 List of general education modules

4.2.1.1 Liberal-managerial subjects modules *(min. ...4... ECTS points):*

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	Weekly number of hours					Field-of-study educational effect symbol	Number of hours		Number of ECTS points		Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes[1]			university-wide[4]	practical[5]	kind[6]	type[7]
1.	HMH100035BK	Block of humanistic courses	1					K1MTR_W25, K1MTR_K02, K1MTR_K07	15	30	1	0,6	T	Z	O		KO	W
2.	HMH100035BK	Block of humanistic courses	1					K1MTR_W05, K1MTR_K09	15	30	1	0,6	T	Z	O		KO	W
3.	HMH100035BK	Block of humanistic courses					1	K1MTR_U25, K1MTR_K15	15	60	2	1,4	T	Z	O	P	KO	W
	Total		**2**	**0**	**0**	**0**	**1**		**45**	**120**	**4**	**2,6**						

4.2.1.2 *Foreign languages* module *(min. ....5...... ECTS points):*

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	Weekly number of hours					Field-of-study educational effect symbol	Number of hours		Number of ECTS points		Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes[1]			university-wide[4]	practical[5]	kind[6]	type[7]
1.	JZL100707BK	Foreign Languages B2 or C1		4				K1MTR_U06, K1MTR_K01	60	60	2	1,5	T	Z	O	P	KO	W
2.	JZL100708BK	Foreign Languages B2 or C1		4				K1MTR_U06, K1MTR_K01	60	90	3	2,5	T	Z	O	P	KO	W
	Total		**0**	**8**	**0**	**0**	**0**		**120**	**150**	**5**	**4**						

4.2.1.3 Sporting classes module *(min. ..1.. ECTS points):*

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	Weekly number of hours					Field-of-study educational effect symbol	Number of hours		Number of ECTS points		Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes[1]			university-wide[4]	practical[5]	kind[6]	type[7]
1.	WFW000000BK	Block of Sports Activities		2				K1MTR_K03, K1MTR_K11	30	30	1	1	T	Z	O	P	KO	W
	Total		**0**	**2**	**0**	**0**	**0**		**30**	**30**	**1**	**1**						

4.2.1.4 *Information technologies* module *(min. .... ECTS points):*

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

Altogether for general education modules:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK classes[1]
lec	cl	lab	pr	sem				
2	**10**	**0**	**0**	**1**	**195**	**300**	**10**	**7,6**

4.2.2 List of basic sciences modules

4.2.2.1 *Mathematics* **module** *(min. .... ECTS points):*

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

4.2.2.2 *Physics* **module** *(min. .... ECTS points):*

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

4.2.2.3 *Chemistry* **module** *(min. .... ECTS points):*

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

4.2.2.4 *Informatics* **module** *(min. 13 ECTS points):*

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	lec	cl	lab	pr	sem	Field-of-study educational effect symbol	ZZU	CNPS	total	BK classes[1]	Form[2] of course/group of courses	Way[3] of crediting	university-wide[4]	practical[5]	kind[6]	type[7]
	MCM032101BK	**Optional courses:**	**2**						30	30	1	0,6	T	Z			PD	W
		Informatics			**2**				30	30	1	0,7	T	Z		P	PD	W
1.	MCR032251W	Introduction to programming	2					K1MTR_W19										
2.	MCR032251L	Introduction to programming			2			K1MTR_U19										
3.	MCM032102W	Introduction to programming	2					K1MTR_W19										
4.	MCM032102L	Introduction to programming			2			K1MTR_U19, K1MTR_K03										
5.	MCD032101W	Fundamentals of Computer Science	2					K1MTR_W19										
6.	MCD032101L	Fundamentals of Computer Science			2			K1MTR_U19										
	MCM033101BK	**Optional courses:** **Procedural Programming**			**2**				30	90	3	2,1	T	Z		P	PD	W
7.	MCR033251L	Programming in Matlab			2			K1MTR_U19										
8.	MCM033102L	C Programming			2			K1MTR_U19, K1MTR_K01										
9.	MCD033101L	The Practice of Programming in C			2			K1MTR_U19, K1MTR_K03, K1MTR_K04										
	MCM034101BK	**Optional courses:**	**1**						15	60	2	1,2	T	Z			PD	W
		Network communication			**1**				15	30	1	0,7	T	Z		P	PD	W
10.	MCR034104W	Components of computer networks	1					K1MTR_W19, K1MTR_W20										
11.	MCR034104L	Components of computer networks			1			K1MTR_U19, K1MTR_U20										
12.	MCM034103W	Industrial networks	1					K1MTR_W20										
13.	MCM034103L	Industrial networks			1			K1MTR_U20										
14.	MCD034103W	Introduction to Computer Networks	1					K1MTR_W20										
15.	MCD034103L	Introduction to Computer Networks			1			K1MTR_U20										
	MCM034102BK	**Optional courses:** **Object Oriented Programming**			**2**				30	90	3	2,1	T	Z		P	PD	W
16.	MCR034251L	MATLAB Object Oriented Programming			2			K1MTR_U19, K1MTR_U37, K1MTR_K01										
17.	MCM034104L	C++ Programming			2			K1MTR_U19, K1MTR_U35, K1MTR_K01										
18.	MCD034102L	Object Oriented Programming			2			K1MTR_U19, K1MTR_U35, K1MTR_K01										
	MCM036101BK	**Optional courses:** **CAD 3D-FEM**			**2**			K1MTR_U19, K1MTR_U35, K1MTR_K01	30	60	2	1,4	T	Z		P	PD	W
19.	MCR036303L	FEM modelling in mechatronics			2			K1MTR_U01, K1MTR_U02, K1MTR_U13 , K1MTR_K03										
20.	MCM036106L	CAD/FEM			2			K1MTR_U22										
21.	MCD036101L	Numerical prototyping of microelectronic structures			2			K1MTR_U22, K1MTR_K04, K1MTR_K05										
		Total	**12**	**0**	**36**	**0**	**0**		**180**	**390**	**13**	**8,8**						

Altogether for basic sciences modules:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK classes[1]
lec	cl	lab	pr	sem				
12	**0**	**36**	**0**	**0**	**180**	**390**	**13**	**8,8**

4.2.3 List of main-field-of-study modules

4.2.3.1 *Major Courses* module

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	lec	cl	lab	pr	sem	Field-of-study educational effect symbol	ZZU	CNPS	total	BK classes[1]	Form[2] of course/group of courses	Way[3] of crediting	university-wide[4]	practical[5]	kind[6]	type[7]
	MCR035101BK	**Optional courses:**	**1**						15	30	1	0,6	T	Z			K	W
		Sensing			**2**				30	30	1	0,7	T	Z		P	K	W
1.	MCR035103W	Sensors – properties and applications	1					K1MTR_W15										
2.	MCR035103L	Sensors – properties and applications			2			K1MTR_U15										
3.	MCM035105W	Sensory w systemacha wytwórczych	1					K1MTR_W03, K1MTR_W15, K1MTR_W16										
4.	MCM035105L	Sensory w systemacha wytwórczych			2			K1MTR_U03, K1MTR_U10, K1MTR_U15										
5.	MCM035106W	Sensors in the machine and vehicle construction	1					K1MTR_W03, K1MTR_W15, K1MTR_W16										
6.	MCM035106L	Sensors in the machine and vehicle construction			2			K1MTR_U03, K1MTR_U10, K1MTR_U15										
7.	MCD035101W	Sensors and actuators	1					K1MTR_W15										
8.	MCD035101L	Sensors and actuators			2			K1MTR_U15										
	MCM035102BK	**Optional courses:**	**1**						15	30	1	0,6	T	Z			K	W
		Logical Systems			**1**				15	60	2	1,4	T	Z		P	K	W
9.	MCR035303W	Programming of distributed control systems based on PLC	1					K1MTR_W10, K1MTR_W17, K1MTR_W33										
10.	MCR035303L	Programming of distributed control systems based on PLC			1			K1MTR_W10, K1MTR_W17, K1MTR_W33										
11.	MCM035104W	Programmable Logic Controllers	1					K1MTR_U15, K1MTR_U20, K1MTR_U36										
12.	MCM035104L	Programmable Logic Controllers			1			K1MTR_U16, K1MTR_U38										
13.	MCD035102W	Logic Circuits Modeling	1					K1MTR_U16, K1MTR_U36										
14.	MCD035102L	Logic Circuits Modeling			1			K1MTR_U19, K1MTR_U22										
	MCM036102BK	**Optional courses: Interdisciplinary Team Project**				**2**			30	90	3	2,1	T	Z		P	K	W
15.	MCR036103P, 6231, 6302	Interdisciplinary Team Project				2		K1MTR_U04, K1MTR_U30, K1MTR_K03, K1MTR_K06										
16.	MCM036107P	Interdisciplinary Team Project				2		K1MTR_U04, K1MTR_U30, K1MTR_K03, K1MTR_K06										
17.	MCD036102P	Interdisciplinary Team Project				2		K1MTR_U04, K1MTR_U30, K1MTR_K03, K1MTR_K06										
	MCM036103BK	**Optional courses:**	**1**						15	30	1	0,6	T	Z			K	W
		Signal Processing			**1**				15	60	2	1,4	T	Z		P	K	W
18.	MCR036106W	Digital signal processing	1					K1MTR_W21										
19.	MCR036106L	Digital signal processing			1			K1MTR_U21, K1MTR_U22										
20.	MCM036108W	Signal Processing	1					K1MTR_W16										
21.	MCM036108L	Signal Processing			1			K1MTR_U19, K1MTR_U21										
22.	MCD036103W	Methods of Signal Processing	1					K1MTR_W21										
23.	MCD036103L	Methods of Signal Processing			1			K1MTR_U01, K1MTR_K06										

No.	Course/group of courses code	Name of course/group of courses	lec	cl	lab	pr	sem	Field-of-study educational effect symbol	ZZU	CNPS	total	BK classes	Form of course/group of courses	Way of crediting	university-wide	practical	kind	type
	MCM036104BK	**Optional courses:**	2						30	60	2	1,2	T	Z			K	W
		Applications of Microsystems			2				30	60	2	1,4	T	Z		P	K	W
24.	MCR036304W	Microsystems in measurements	1					K1MTR_W16										
25.	MCR036304L	Microsystems in measurements			1			K1MTR_U15, K1MTR_U16										
26.	MCR036305W	Microsystems in control	1					K1MTR_W21										
27.	MCR036305L	Microsystems in control			1			K1MTR_U15, K1MTR_U16										
28.	MCM036109W	Mechatronics in Medicine	1					K1MTR_M_W03, K1MTR_W08, K1MTR_W23										
29.	MCM036109L	Mechatronics in Medicine			1			K1MTR_M_W03, K1MTR_W08, K1MTR_W23, K1MTR_W09, K1MTR_W26										
30.	MCM036110W	Mechatronic systems in manufacturing technologies	1					K1MTR_U02, K1MTR_U03, K1MTR_U21, K1MTR_K01, K1MTR_K07										
31.	MCM036110L	Mechatronic systems in manufacturing technologies			1			K1MTR_U03, K1MTR_U11, K1MTR_U15										
32.	MCD036104W	Microsystems in medicine	1					K1MTR_W15										
33.	MCD036104L	Microsystems in medicine			1			K1MTR_U15, K1MTR_K03										
34.	MCD036105W	Automotive microsystems	1					K1MTR_W15										
35.	MCD036105L	Automotive microsystems			1			K1MTR_U15, K1MTR_K03										
		Total	21	0	26	8	0		195	450	15	10						

4.2.3.2 *Degree Profile* module

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	lec	cl	lab	pr	sem	Field-of-study educational effect symbol	ZZU	CNPS	total	BK classes[1]	Form[2] of course/group of courses	Way[3] of crediting	university-wide[4]	practical[5]	kind[6]	type[7]
Degree Profile: - Mechatronics in Automation and Measurements																		
1.	MCR035302W	Power Electronics	2					K1MTR_MAP_W01	30	60	2	1,2	T	Z			K	W
2.	MCR035302L	Power Electronics			1			K1MTR_MAP_U01	15	30	1	0,7	T	Z		P	K	W
3.	MCR036102W	Active materials	1					K1MTR_MAP_W02, K1MTR_W02	15	30	1	0,6	T	Z			K	W
4.	MCR036102L	Active materials			1			K1MTR_MAP_U02, K1MTR_U02, K1MTR_U03, K1MTR_U22, K1MTR_U24	15	30	1	0,7	T	Z		P	K	W
5.	MCR036211W	System modelling	1					K1MTR_MAP_W05, K1MTR_MAP_W04	15	30	1	0,6	T	Z			K	W
6.	MCR036211L	System modelling			1			K1MTR_MAP_U04, K1MTR_MAP_U05	15	30	1	0,7	T	Z		P	K	W
7.	MCR036301L	Control Systems Prototyping			1			K1MTR_U19	15	30	1	0,7	T	Z		P	K	W
8.	MCR037231W	Building automation	1					K1MTR_MAP_W03, K1MTR_W19, K1MTR_W20, K1MTR_MAP_W06, K1MTR_W22, K1MTR_W27	15	60	2	1,2	T	Z			K	W
9.	MCR037231P	Building automation				2		K1MTR_MAP_W06	30	60	2	1,4	T	Z		P	K	W
10.	MCR037101P	Numerical methods				1		K1MTR_MAP_U06, K1MTR_K06	15	60	2	1,4	T	Z		P	K	W
11.	MCR037102W	Thin-layer technologies	1					K1MTR_W02, K1MTR_W18, K1MTR_MAP_W07	15	60	2	1,2	T	Z			K	W
12.	MCR037102L	Thin-layer technologies			2			K1MTR_U02, K1MTR_U03	30	60	2	1,4	T	Z		P	K	W
13.	MCR037301S MCR037201S MCR037103S	Diploma seminar					2	K1MTR_MAP_U01, K1MTR_MAP_U02, K1MTR_MAP_U03, K1MTR_MAP_U04, K1MTR_MAP_U05, K1MTR_MAP_U06, K1MTR_MAP_U07, K1MTR_MAP_U08, K1MTR_K04, K1MTR_K06	30	60	2	1,4	T	Z		P	K	W

Degree Profile: - Mechatronics in Machine Building and Vehicles

No.	Code	Course name						Learning outcomes										
14.	MCM035203W	Ecology in industrial manufacturing	1					K1MTR_M_W07	15	30	1	0,6	T	Z			K	W
15.	MCM035204W	Technological designe processes	1					K1MTR_M_W05	15	30	1	0,6	T	Z			K	W
16.	MCM035204P	Technological designe processes			1			K1MTR_W06, K1MTR_W11	15	30	1	0,7	T	Z		P	K	W
17.	MCM036203W	Manufacturing automation	2					K1MTR_M_U03, K1MTR_M_U06	30	60	2	1,2	T	Z			K	W
18.	MCM036203L	Manufacturing automation		1				K1MTR_M_U02	15	30	1	0,7	T	Z		P	K	W
19.	MCM036204W	Design of mechanical assemblies	1					K1MTR_W07, K1MTR_W09, K1MTR_W10	15	30	1	0,6	T	Z			K	W
20.	MCM036204P	Design of mechanical assemblies			1			K1MTR_M_U01, K1MTR_U09, K1MTR_U22, K1MTR_U23, K1MTR_U24, K1MTR_K02, K1MTR_K04	15	30	1	0,7	T	Z		P	K	W
21.	MCM037205W	Monitoring of machines and processes	1					K1MTR_W03, K1MTR_W11, K1MTR_W15, K1MTR_W17, K1MTR_U19, K1MTR_U21, K1MTR_K01, K1MTR_K02, K1MTR_K04, K1MTR_K05, K1MTR_K06, K1MTR_K07, K1MTR_K08, K1MTR_K09	15	60	2	1,2	T	Z			K	W
22.	MCM037205L	Monitoring of machines and processes		1				K1MTR_W03, K1MTR_W11, K1MTR_W15, K1MTR_W17	15	30	1	0,7	T	Z		P	K	W
23.	MCM037206P	Numerical methods			1			K1MTR_U02, K1MTR_U03, K1MTR_U17, K1MTR_U21, K1MTR_U19, K1MTR_K01, K1MTR_K02, K1MTR_K04, K1MTR_K05, K1MTR_K06, K1MTR_K07, K1MTR_K08, K1MTR_K09	15	60	2	1,4	T	Z		P	K	W
24.	MCM037207W	Programing of machine numerical controled	2					K1MTR_M_W06, K1MTR_W11	30	60	2	1,2	T	Z			K	W
25.	MCM037207P	Programing of machine numerical controled			1			K1MTR_M_W04, K1MTR_W11	15	60	2	1,4	T	Z		P	K	W
26.	MCM037208W	SCADA i HMI	1					K1MTR_M_U05, K1MTR_M_U06, K1MTR_U24	15	30	1	0,6	T	Z			K	W
27.	MCM037001S	Diploma seminar					2	K1MTR_U24, K1MTR_K01, K1MTR_K04, K1MTR_K06	30	60	2	1,4	T	Z		P	K	W
Degree Profile: - Mechatronic Systems								K1MTR_U24, K1MTR_K01, K1MTR_K03, K1MTR_K04, K1MTR_K06										
28.	MCD035201W	Electronic Components	2					K1MTR_MM_W01	30	60	2	1,2	T	Z			K	W
29.	MCD035201L	Electronic Components		1				K1MTR_MM_U01	15	30	1	0,7	T	Z		P	K	W
30.	MCD036201W	Photonics	1					K1MTR_MM_W02	15	30	1	0,6	T	Z			K	W
31.	MCD036201L	Photonics		2				K1MTR_MM_U02	30	60	2	1,4	T	Z		P	K	W
32.	MCD036202W	Micro- and Nanoelectronics	2					K1MTR_MM_W01, K1MTR_MM_W03	30	60	2	1,2	T	Z			K	W
33.	MCD037201L	Laboratory on micro- and nanoelectronics		1				K1MTR_MM_U03	15	60	2	1,4	T	Z		P	K	W
34.	MCD037202L	Numerical methods		1				K1MTR_MM_W04, K1MTR_MM_U04	15	60	2	1,4	T	Z		P	K	W
35.	MCD037203W	Packaging of Electronic and Photonics Systems	1					K1MTR_W18	15	60	2	1,2	T	Z			K	W
36.	MCD037203L	Packaging of Electronic and Photonics Systems		1				K1MTR_U18	15	30	1	0,7	T	Z		P	K	W

No.	Course/group of courses code	Name of course/group of courses	lec	cl	lab	pr	sem	Field-of-study educational effect symbol	ZZU	CNPS	total	BK classes[1]	Form[2] of course/group of courses	Way[3] of crediting	university-wide[4]	practical[5]	kind[6]	type[7]
37.	MCD037204W	Peripheral Devices in Computer Systems	2					K1MTR_MM_W02, K1MTR_MM_W06	30	60	2	1,2	T	Z			K	W
38.	MCD037204L	Peripheral Devices in Computer Systems			1			K1MTR_MM_U02, K1MTR_K03	15	30	1	0,7	T	Z		P	K	W
39.	MCD037001S	Diploma seminar					2	K1MTR_MM_W05, K1MTR_MM_U01, K1MTR_MM_U02, K1MTR_MM_U03, K1MTR_MM_U04, K1MTR_MM_U05, K1MTR_MM_U06, K1MTR_U02, K1MTR_U03, K1MTR_U04, K1MTR_U05, K1MTR_U06, K1MTR_U07, K1MTR_U08, K1MTR_U09, K1MTR_U10, K1MTR_U11, K1MTR_U12, K1MTR_U13, K1MTR_U14, K1MTR_U15, K1MTR_U16, K1MTR_U17, K1MTR_U18, K1MTR_U20, K1MTR_U21, K1MTR_U22, K1MTR_U23, K1MTR_U24, K1MTR_U25, K1MTR_U26, K1MTR_U27, K1MTR_U28, K1MTR_U29, K1MTR_U30, K1MTR_U31, K1MTR_U32, K1MTR_U33, K1MTR_K03	30	60	2	1,4	T	Z		P	K	W
		Total	**23**	**0**	**15**	**7**	**6**		**765**	**1800**	**60**	**39,3**						

4.2.3.3 *Training* module

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	lec	cl	lab	pr	sem	Field-of-study educational effect symbol	ZZU	CNPS	total	BK classes[1]	Form[2] of course/group of courses	Way[3] of crediting	university-wide[4]	practical[5]	kind[6]	type[7]
	MCR030001BK	**Training**							0	120	4	4	T	Z		P	K	W
obszar dyplomowania: Mechatronics in Automation and Measurements																		
1.	MCR037001Q	Practice						K1MTR_U29										
obszar dyplomowania: Mechatronics in Machine Building and Vehicles																		
2.	MCM030001Q	Practice						K1MTR_U29										
Degree Profile: Mechatronic Systems																		
3.	MCD030001Q	Practice						K1MTR_U29										
		Total	**0**	**0**	**0**	**0**	**0**		**0**	**120**	**4**	**4**						

4.2.3.4 *Diploma dissertation* **module**

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	Weekly number of hours					Field-of-study educational effect symbol	Number of hours		Number of ECTS points		Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes[1]			university-wide[4]	practical[5]	kind[6]	type[7]
	MCR037002BK	**Diploma thesis**				**2**			30	360	12	12	T	Z		P	K	W
Degree Profile: Mechatronics in Automation and Measurements																		
1.	MCR037100D MCR037200D MCR037300D	Diploma thesis				2		K1MTR_U24, K1MTR_K01, K1MTR_K04, K1MTR_K06										
Degree Profile: Mechatronics in Machine Building and Vehicles																		
2.	MCM037002D	Diploma thesis				2		K1MTR_U24, K1MTR_K01, K1MTR_K04, K1MTR_K06										
Degree Profile: Mechatronic Systems																		
3.	MCD037002D	Diploma thesis				2		K1MTR_MM_U01, K1MTR_MM_U02, K1MTR_MM_U03, K1MTR_MM_U04, K1MTR_MM_U05, K1MTR_MM_U06, K1MTR_U01, K1MTR_U02, K1MTR_U03, K1MTR_U04, K1MTR_U05, K1MTR_U06, K1MTR_U07, K1MTR_U08, K1MTR_U09, K1MTR_U10, K1MTR_U11, K1MTR_U12, K1MTR_U13, K1MTR_U14, K1MTR_U15, K1MTR_U16, K1MTR_U17, K1MTR_U18, K1MTR_U19, K1MTR_U20, K1MTR_U21, K1MTR_U22, K1MTR_U23, K1MTR_U24, K1MTR_U25, K1MTR_U26, K1MTR_U27, K1MTR_U28, K1MTR_U29, K1MTR_U30, K1MTR_U31, K1MTR_U32, K1MTR_U33, K1MTR_K03, K1MTR_K10										
Total			**0**	**0**	**0**	**2**	**0**		**30**	**360**	**12**	**12**						

Altogether for main-field-of-study modules:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK classes[1]
lec	cl	lab	pr	sem				
44	0	41	17	6	990	2730	91	65,3

4.2.4 List of specialization modules

4.2.4.1 *Specialization subjects (e.g. whole specialization)* **modules** *(min. .... ECTS points):*

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

4.2.4.2 *………………(e.g. diploma profile)* **module** *(min. .... ECTS points):*

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

Altogether for specialization modules:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK classes[1]
lec	cl	lab	pr	sem				
0	0	0	0	0	0	0	0	0

4.3 Training module (Faculty Council resolution on principles of crediting training – attachment no. …)

Name of training			
Number of ECTS points	**Number of ECTS points for BK classes[1]**	**Training crediting mode**	**Code**
4	4	report	MCR037001Q (W05) MCM037003Q (W10) MCD030002Q (W12)

Training duration	**Training objective**
4 week	*The aim of the work placement is for the student to gain industrial experience, familiarize herself/himself with the basic technical and technological equipment and with the work of the plant's technical supervisors, and in particular to:* *• broaden the knowledge gained in her/his studies and develop the skills of using it,* *• familiarize herself/himself with the peculiarities of the professional environment,* *• develop specific professional skills directly connected with the work placement venue,* *• hone the skills of effective communication,* *• familiarize herself/himself with the principles of work organization and division of competences, the procedures, the work planning process and the control,* *• improve her/his skills of organizing her/his own work and teamwork and effectively managing time as well as develop conscientiousness and responsibility for the entrusted tasks,* *• hone the skill of using a foreign language in professional situations.* *Through the free choice of the work placement venue, e.g. through her/his choice of the "firm", the student can pursue her/his professional interests. This may help her/him to formulate the topic of her/his engineering diploma work. The student's first professional work often takes place in the work placement venue.*

4.4 Diploma dissertation module

Type of diploma dissertation	~~Licencjat~~ / inżynier / ~~magister~~ / ~~magister inżynier~~	
Number of diploma dissertation semesters	**Number of ECTS points**	**Code**
1	12	**MCR037100, 7200, 7300** **MCM037002, MCD037002**

Character of diploma dissertation	

The engineering diploma dissertation has a character useful for engineering practice. Its subject is, in particular, a solution of a problem relating to: design, a measurement experiment, the development of a computer program and an analysis of a part or the totality of processes having a technical, organizational-technical and economic-technical character. The dissertation has no solely descriptive character, and clearly includes a part being the student's own contribution.

Number of BK[1] ECTS points	**12**

5. Ways of verifying assumed educational effects

Type of classes	Ways of verifying assumed educational effects
lecture	*examination, semi final wrtitten test, short test, oral answer, presence, test, written test*
class	*semi final wrtitten test, short test, oral answer, activity in problem discussions, test, report, activity*
laboratory	*short test, oral answer, activity in problem discussions, pass, activity, average lab. assessment, report, paper presentation,*
project	*semi final wrtitten test, short test, oral answer, activity in problem discussions, pass, activity, project preparation, report, project defense, presence, presentation,*
seminar	*oral answer, activity in problem discussions, activity, presentation, problem work out*
training	*report from training*
diploma dissertation	*prepared diploma dissertation*

6. Total number of ECTS points, which student has to obtain from classes requiring direct academic teacher-student contact (enter total of ECTS points for courses/groups of courses denoted with code BK[1])

| 189,1 | ECTS |

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

Number of ECTS points for obligatory subjects	46
Number of ECTS points for optional subjects	0
Total number of ECTS points	46

8. Total number of ECTS points, which student has to obtain from practical classes, including laboratory classes (enter total number of ECTS points for courses/group of courses denoted with code P)

Number of ECTS points for obligatory subjects	59
Number of ECTS points for optional subjects	MiAaM - 56 MiMBaV - 54 MM - 55
Total number of ECTS points	MiAaM - 115 MiMBaV - 113 MM - 114

9. Minimum number of ECTS points, which student has to obtain doing education modules offered as part of university-wide classes or other main field of study (enter number of ECTS points for courses/groups of courses denoted with code OG)

| 39 | ECTS |

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

| 74 | ECTS |

11. Range of diploma dissertation

The diploma examination problems, divided into thematic blocks, are available on the Faculty website.

12. Requirements concerning deadlines for crediting courses/groups of courses for all courses in particular modules

No.	Course code	Name of course	Crediting by deadline of... (number of semester)

13. Plan of studies (attachment no. ……)

PLAN OF STUDIES

FACULTY: **Electrical Engineering , Mechanical Engineering, Microsystem Electronics and Photonics**

MAIN FIELD OF STUDY: **MECHATRONICS**

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

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

PROFILE: **general academic /~~practical~~ ***

SPECIALIZATION: -------

LANGUAGE OF STUDY: **polish**

………………………….   Faculty Council Resolution of ……………………

In effect since   ……………………..

*delete as applicable

Plan of studies structure (optionally)

1) in point layout and in hourly layout

Education Level: 1st level   full-time   Main Field of Study: **MECHATRONICS**   Degree Profile: **- Mechatronics in Automation and Measurements**

Each course block lists the course title, course code, and hours in the columns: lec | cl | lab | pr | sem.

Semester 1

Course	Code	lec	cl	lab	pr	sem
Metrology principles	MCR031101	1				
Engineering Graphics	MCM031005	1	2			
Management Essentials	MCM031006	1				
Information Technology	MCM031007	1	1			
Introduction to Mechatronics	MCM031008	2				
Chemisty	MCD031001	2				
Algebra and Analytic Geometry E	MAP001140	2	1			
Mathematical Analysis 1.1 A E	MAP001142	2	2			
Physics 1.2 E	FZP001058	2	2			
Block of humanistic courses	HMH100035BK	1				

Semester 2

Course	Code	lec	cl	lab	pr	sem
Optional courses: Informatics	MCM032101BK	2	2			
Fundamentals of Electrotechnics E	MCR032102	2	1			
Metrology of geometrical quantites	MCM032006	1	1			
Material Science I	MCM032004	2	1			
Mechanics I (Statics)	MCM032005	2	2			
Electronic Components and Circuits	MCD032001	2				
Mathematical Analysis 2.1 A E	MAP001156	2	2			
Physics 2.8 E	FZP003002	1	1			
Block of humanistic courses	HMH100035BK	1				

Semester 3

Course	Code	lec	cl	lab	pr	sem
Optional courses: Procedural Programming	MCM033101BK		2			
Electrical installations and supply systems	MCR033231	1	1			
Material Science II E	MCR033102	1	1			
Software Engineering and UML	MCM033005	1				
Mechanics II (Dynamics) E	MCM033006	2	1			
Strength of materials, Mechanics of engineering materials	MCM033007	2	2			
Fundamentals of manufacturing	MCM033008	2				
Electronic Components and Circuits	MCD033001		2			
Ordinary Differential Equations	MAP003062	1	1			
Engineering Statistics	MCD033002	1	1			
Foreign Languages B2 or C1	JZL100707BK		4			

Semester 4

Course	Code	lec	cl	lab	pr	sem
Optional courses: Network communication	MCM034101BK	1	1			
Optional courses: Object Oriented Programming	MCM034102BK		2			
Electrical metrology	MCR034103	1	2			
Fundamentals of control engineering E	MCR034211	2				
Analysis and Synthesis of Kinematic Systems E	MCM034005	2	2			
Fundamentals of manufacturing	MCM034006		3			
Systems for Manufacturing and Assembly	MCM034007	2	1			
Principles of microprocessor technology E	MCD034002	1	2			
Block of Sports Activities	WFW000000BK			2		
Foreign Languages B2	JZL100708BK		3			

Semester 5

Course	Code	lec	cl	lab	pr	sem
Power Electronics	MCR035302	2	1			
Optional courses: Sensing	MCM035101BK	1	2			
Optional courses: Logical Systems	MCM035102BK	1	1			
Safety in electrical engineering	MCR035241	1	1			
Electrical Drives E	MCR035301	2	2			
Fundamentals of control engineering	MCR035211	1				
Elements of control engineering	MCR035212	1	1			
Fundamentals of machine elements design	MCM035003	2	3			
Drive systems, hydraulic components and pneumatic components E	MCM035004	2	1			
Fundamentals of Electronic Design	MCD035001	1				
Applications of optoelectronics	MCD035002	1	2			

Semester 6

Course	Code	lec	cl	lab	pr	sem
Active materials	MCR036102	1	1			
System modelling	MCR036211	1	1			
Control Systems Prototyping	MCR036301	1				
Optional courses: CAD 3D-FEM	MCM036101BK		2			
Optional courses: Interdisciplinary Team Project	MCM036102BK		2			
Optional courses: Signal Processing	MCM036103BK	1	1			
Optional courses: Applications of Microsystems	MCM036104BK	2	2			
Basics of mechatronical design of systems	MCM036004	1	2			
Industrial robots E	MCM036005	2	1			
Project Management	MCM036006	1				
Microsystems (MEMS) E	MCD036001	2	1			
Fundamentals of Electronic Design	MCD036002		2			

Semester 7

Course	Code	lec	cl	lab	pr	sem
Building automation	MCR037231	1	2			
Numerical methods	MCR037101	1				
Thin-layer technologies	MCR037102	1	2			
Block of humanistic courses	HMH100035BK	1				
Diploma seminar	MCR037301, 7201, 7103		2			
Diploma thesis	MCR037100, 7200, 7300					12 / 2
Practice	MCR037001Q				4	

Semester summary

	sem.1	sem.2	sem.3	sem.4	sem.5	sem.6	sem.7
ECTS	30	30	30	30	30	30	30
lec/cl/lab/pr/sem	20 7 3 0 0 0	19 6 5 0 0 0	13 11 6 0 0 0	12 3 12 2 0 1	16 0 11 3 0 0	11 0 13 6 0 0	4 0 2 4 4 16
hours total	23	25	26	27	28	27	12
hours	15 5 3 0 0 0	15 5 5 0 0 0	11 10 5 0 0 0	9 4 10 2 0 2	14 0 12 2 0 0	11 0 10 6 0 0	2 0 2 3 3 2

total	lec	cl	lab	pr	sem	
	77	24	47	13	3	4
			168			

ECTS: 210

Education Level: 1st level   full-time   **Main Field of Study:** MECHATRONICS   **Degree Profile:** - - Mechatronics in Machine Building and Vehicles

Semester 1

Course	Code	lec	cl	lab	pr	sem
Metrology principles	MCR031101	1				
Engineering Graphics	MCM031005	1	2			
Management Essentials	MCM031006	1				
Information Technology	MCM031007	1	1			
Introduction to Mechatronics	MCM031008	2				
Chemisty	MCD031001	2				
Algebra and Analytic Geometry E	MAP001140	2	1			
Mathematical Analysis 1.1 A E	MAP001142	2	2			
Physics 1.2 E	FZP001058	2	2			
Block of humanistic courses	HMH100035BK	1				

Semester 2

Course	Code	lec	cl	lab	pr	sem
Optional courses: Informatics	MCM032101BK	2	2			
Fundamentals of Electrotechnics E	MCR032102	2	1			
Metrology of geometrical quantites	MCM032006	1	1			
Material Science I	MCM032004	2	1			
Mechanics I (Statics)	MCM032005	2	2			
Electronic Components and Circuits	MCD032001	2				
Mathematical Analysis 2.1 A E	MAP001156	2				
Physics 2.8 E	FZP003002	1	1			
Block of humanistic courses	HMH100035BK	1				

Semester 3

Course	Code	lec	cl	lab	pr	sem
Optional courses: Procedural Programming	MCM033101BK		2			
Electrical installations and supply systems	MCR033231	1	1			
Material Science II E	MCM033102	1	1			
Software Engineering and UML	MCM033005	1				
Mechanics II (Dynamics) E	MCM033006	2	1			
Strength of materials, Mechanics of engineering materials	MCM033007	2	2			
Fundamentals of manufacturing	MCM033008	1				
Electronic Components and Circuits	MCD033001		2			
Ordinary Differential Equations	MAP003062	1	1			
Engineering Statistics	MCD033002	1	1			
Foreign Languages B2 or C1	JZL100707BK		4			

Semester 4

Course	Code	lec	cl	lab	pr	sem
Optional courses: Network communication	MCM034101BK	1	1			
Optional courses: Object Oriented Programming	MCM034102BK		2			
Electrical metrology	MCR034103	1	1			
Fundamentals of control engineering E	MCR034211	2				
Analysis and Synthesis of Kinematic Systems E	MCM034005	2	2			
Fundamentals of manufacturing	MCM034006		3			
Systems for Manufacturing and Assembly	MCM034007	2	1			
Principles of microprocessor technology E	MCD034002	2	2			
Block of Sports Activities	WFW000000BK			2		
Foreign Languages B2	JZL100708BK		4			

Semester 5

Course	Code	lec	cl	lab	pr	sem
Ecology in industrial manufacturing	MCM035201	1				
Technological designe processes	MCM035202	1		1		
Optional courses: Sensing	MCM035101BK	1		2		
Optional courses: Logical Systems	MCM035102BK	1		1		
Safety in electrical engineering	MCR035241	1		1		
Electrical Drives E	MCR035301	2		2		
Fundamentals of control engineering	MCR035211			1		
Elements of control engineering	MCR035212	1		1		
Fundamentals of machine elements design	MCM035003	2		2		
Drive systems, hydraulic components and pneumatic components E	MCM035004	2		1		
Fundamentals of Electronic Design	MCD035001	1				
Applications of optoelectronics	MCD035002	1		2		

Semester 6

Course	Code	lec	cl	lab	pr	sem
Manufacturing automation	MCM036203	2		1		
Design of mechanical assemblies	MCM036204	1		1		
Optional courses: CAD 3D-FEM	MCM036101BK			2		
Optional courses: Interdisciplinary Team Project	MCM036102BK			2		
Optional courses: Signal Processing	MCM036103BK	1		1		
Optional courses: Applications of Microsystems	MCM036104BK	2		2		
Basics of mechatronical design of systems	MCM036004	1		2		
Industrial robots E	MCM036005	2		1		
Project Management	MCM036006	1				
Microsystems (MEMS) E	MCD036001	2		1		
Fundamentals of Electronic Design	MCD036002			2		

Semester 7

Course	Code	lec	cl	lab	pr	sem
Monitoring of machines and processes	MCM037205	1		1		
Numerical methods	MCM037206			1		
Programing of machine numerical controled	MCM037207	2		1		
SCADA i HMI	MCM037208	1				
Block of humanistic courses	HMH100035BK				1	
Diploma seminar	MCM037001					2
Diploma thesis	MCM037002					12
Practice	MCM037003Q					

Semester summaries

	sem. 1	sem. 2	sem. 3	sem. 4	sem. 5	sem. 6	sem. 7
ECTS	30	30	30	30	30	30	30
lec cl lab pr sem	20 7 3 0 0 0	19 6 5 0 0 0	13 11 6 0 0 0	12 3 12 2 0 1	16 0 10 4 0 0	12 0 11 7 0 0	5 0 1 4 4 16
	23	25	26	27	28	27	12
	15 5 3 0 0 0	15 5 5 0 0 0	11 10 5 0 0 0	9 4 10 2 0 2	14 0 11 3 0 0	12 0 8 7 0 0	4 0 1 2 3 2

total

lec	cl	lab	pr	sem	
80	24	43	14	3	4

total: 168

ECTS 210

Education Level: 1st level   **full-time**   **Main Field of Study: MECHATRONICS**   **Degree Profile: - Mechatronic Systems**

Column hour headers (repeated for each semester): lec | cl | lab | pr | sem

Semester 1

Course	Code	lec/cl/lab/pr/sem
Metrology principles	MCR031101	1
Engineering Graphics	MCM031005	1 / 2
Management Essentials	MCM031006	1
Information Technology	MCM031007	1 / 1
Introduction to Mechatronics	MCM031008	2
Chemistry	MCD031001	2
Algebra and Analytic Geometry E	MAP001140	2 / 1
Mathematical Analysis 1.1 A E	MAP001142	2 / 2
Physics 1.2 E	FZP001058	2 / 2
Block of humanistic courses	HMH100035BK	1

Semester 2

Course	Code	lec/cl/lab/pr/sem
Optional courses: Informatics	MCM032101BK	2 / 2
Fundamentals of Electrotechnics E	MCR032102	2 / 1
Metrology of geometrical quantites	MCM032006	1 / 1
Material Science I	MCM032004	2 / 1
Mechanics I (Statics)	MCM032005	2 / 2
Electronic Components and Circuits	MCD032001	2
Mathematical Analysis 2.1 A E	MAP001156	2 / 2
Physics 2.8 E	FZP003002	1 / 1
Block of humanistic courses	HMH100035BK	1

Semester 3

Course	Code	lec/cl/lab/pr/sem
Optional courses: Procedural Programming	MCM033101BK	2
Electrical installations and supply systems	MCR033231	1 / 1
Material Science II E	MCR033102	1 / 1
Software Engineering and UML	MCM033005	1
Mechanics II (Dynamics) E	MCM033006	2 / 1
Strength of materials, Mechanics of engineering materials	MCM033007	2 / 1
Fundamentals of manufacturing	MCM033008	2
Electronic Components and Circuits	MCD033001	2
Ordinary Differential Equations	MAP003062	1 / 1
Engineering Statistics	MCD033002	1 / 1
Foreign Languages B2 or C1	JZL100707BK	4

Semester 4

Course	Code	lec/cl/lab/pr/sem
Optional courses: Network communication	MCM034101BK	1 / 1
Optional courses: Object Oriented Programming	MCM034102BK	2
Electrical metrology	MCR034103	1 / 1
Fundamentals of control engineering E	MCR034211	2
Analysis and Synthesis of Kinematic Systems E	MCM034005	2 / 2
Fundamentals of manufacturing	MCM034006	3
Systems for Manufacturing and Assembly	MCM034007	2 / 1
Principles of microprocessor technology E	MCD034002	1 / 2
Block of Sports Activities	WFW000000BK	2
Foreign Languages B2	JZL100708BK	4

Semester 5

Course	Code	lec/cl/lab/pr/sem
Electronic Components	MCD035201	2 / 1
Optional courses: Sensing	MCM035101BK	1 / 2
Optional courses: Logical Systems	MCM035102BK	1 / 1
Safety in electrical engineering	MCR035241	1 / 1
Electrical Drives E	MCR035301	2 / 2
Fundamentals of control engineering	MCR035211	1
Elements of control engineering	MCR035212	1 / 1
Fundamentals of machine elements design	MCM035003	2 / 2
Drive systems, hydraulic components and pneumatic components E	MCM035004	2 / 1
Fundamentals of Electronic Design	MCD035001	1
Applications of optoelectronics	MCD035002	1 / 2

Semester 6

Course	Code	lec/cl/lab/pr/sem
Photonics	MCD036201	1 / 2
Micro- and Nanoelectronics	MCD036202	2
Optional courses: CAD 3D-FEM	MCM036101BK	2
Optional courses: Interdisciplinary Team Project	MCM036102BK	2
Optional courses: Signal Processing	MCM036103BK	1 / 1
Optional courses: Applications of Microsystems	MCM036104BK	2 / 2
Basics of mechatronical design of systems	MCM036004	1 / 2
Industrial robots E	MCM036005	2 / 1
Project Management	MCM036006	1
Microsystems (MEMS) E	MCD036001	2 / 1
Fundamentals of Electronic Design	MCD036002	2

Semester 7

Course	Code	lec/cl/lab/pr/sem
Laboratory on micro- and nanoelectronics	MCD037201	1
Numerical methods	MCD037202	1
Packaging of Electronic and Photonics Systems	MCD037203	1 / 1
Peripheral Devices in Computer Systems	MCD037204	2 / 1
Block of humanistic courses	HMH100035BK	1
Diploma seminar	MCD037001	2
Diploma thesis	MCD037002	12
Practice	MCD030002Q	4

Semester summary

	ECTS	lec	cl	lab	pr	sem	—
sem. 1	30	20	7	3	0	0	0
(hours) 23		15	5	3	0	0	0
sem. 2	30	19	6	5	0	0	0
(hours) 25		15	5	5	0	0	0
sem. 3	30	13	11	6	0	0	0
(hours) 26		11	10	5	0	0	0
sem. 4	30	12	3	12	2	0	1
(hours) 27		9	4	10	2	0	2
sem. 5	30	16	0	11	3	0	0
(hours) 28		14	0	12	2	0	0
sem. 6	30	12	0	12	6	0	0
(hours) 27		12	0	9	6	0	0
sem. 7	30	4	0	6	0	4	16
(hours) 12		3	0	4	0	3	2

total

	lec	cl	lab	pr	sem
	79	24	48	10	3	4

total: 168

ECTS 210

Optional courses: Informatics

Course		
Introduction to programming	1	1
MCR032251	2	2
Introduction to programming	1	1
MCM032102	2	2
Fundamentals of Computer Science	1	1
MCD032101	2	2

Optional courses: Procedural Programming

Course	
Programming in Matlab	3
MCR033251	2
C Programming	3
MCM033102	2
The Practice of Programming in C	3
MCD033101	2

Optional courses: Network communication

Course		
Components of computer networks	2	1
MCR034104	1	1
Industrial networks	2	1
MCM034103	1	1
Introduction to Computer Networks	2	1
MCD034103	1	1

Optional courses: Object Oriented Programming

Course	
MATLAB Object Oriented Programming	3
MCR034251	2
C++ Programming	3
MCM034104	2
Object Oriented Programming	3
MCD034102	2

Optional courses: Sensing

Course		
Sensors – properties and applications	1	1
MCR035103	1	2
Sensors in manufacturing systems	1	1
MCM035105	1	2
Sensors in the machine and vehicle construction	1	1
MCM035106	1	2
Sensors and actuators	1	1
MCD035101	1	2

Optional courses: Logical Systems

Course		
Programming of distributed control systems based on PLC	1	2
MCR035303	1	1
Programmable Logic Controllers	1	2
MCM035104	1	1
Logic Circuits Modeling	1	2
MCD035102	1	1

Optional courses: CAD 3D-FEM

Course	
FEM modelling in mechatronics	2
MCR036303	2
CAD/FEM	2
MCM036106	2
Numerical prototyping of microelectronic structures	2
MCD036101	2

Optional courses: Interdisciplinary Team Project

Course	
Interdisciplinary Team Project	3
MCR036103, 6231, 6302	2
Interdisciplinary Team Project	3
MCM036107	2
Interdisciplinary Team Project	3
MCD036102	2

Optional courses: Signal Processing

Course		
Digital signal processing	1	2
MCR036106	1	1
Signal Processing		3
MCM036108	1	1
Methods of Signal Processing	1	2
MCD036103	1	1

Optional courses: Applications of Microsystems

Course		
Microsystems in measurements	1	1
MCR036304	1	1
Microsystems in control	1	1
MCR036305	1	1
Mechatronics in Medicine	1	1
MCM036109	1	1
Mechatronic systems in manufacturing technologies	1	1
MCM036110	1	1
Microsystems in medicine	1	1
MCD036104	1	1
Automotive microsystems	1	1
MCD036105	1	1

1. Set of obligatory and optional courses and groups of courses in semestral arrangement

Semester 1

Obligatory courses number of ECTS points 29

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	Weekly number of hours					Field-of-study educational effect symbol	Number of hours		Number of ECTS points		Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes[1]			university-wide[4]	practical[5]	kind[6]	type[7]
1.	MCR031101W	Metrology principles	1					K1MTR_W03	15	30	1	0,6	T	Z			K	Ob.
2.	MCM031005W	Engineering Graphics	1					K1MTR_W06	15	30	1	0,6	T	Z			K	Ob.
3.	MCM031005L	Engineering Graphics			2			K1MTR_U05, K1MTR_U09, K1MTR_U29	30	60	2	1,4	T	Z		P	K	Ob.
4.	MCM031006W	Management Essentials	1					K1MTR_W04, K1MTR_W28	15	30	1	0,6	T	Z			KO	Ob.
5.	MCM031007W	Information Technology	1					K1MTR_W01, K1MTR_W02	15	30	1	0,6	T	Z			KO	Ob.
6.	MCM031007L	Information Technology			1			K1MTR_U19	15	30	1	0,7	T	Z		P	KO	Ob.
7.	MCM031008W	Introduction to Mechatronics	2					K1MTR_W10, K1MTR_W15, K1MTR_W16, K1MTR_W19, K1MTR_W22, K1MTR_W23, K1MTR_W26	30	60	2	1,2	T	Z			K	Ob.
8.	MCD031001W	Chemisty	2					K1MTR_W07	30	60	2	1,2	T	Z			PD	Ob.
9.	MAP001140W	Algebra and Analytic Geometry	2					K1MTR_W01	30	60	2	1,5	T	E	O		PD	Ob.
10.	MAP001140C	Algebra and Analytic Geometry		1				K1MTR_U01, K1MTR_K01	15	60	2	1,0	T	Z	O	P	PD	Ob.
11.	MAP001142W	Mathematical Analysis 1.1 A	2					K1MTR_W01	30	150	5	3,0	T	E	O		PD	Ob.
12.	MAP001142C	Mathematical Analysis 1.1 A		2				K1MTR_U01	30	90	3	2,0	T	Z	O	P	PD	Ob.
13.	FZP001058W	Physics 1.2	2					K1MTR_W01, K1MTR_W02, K1MTR_W12, K1MTR_K01, K1MTR_K02, K1MTR_K07, K1MTR_K12	30	120	4	4,0	T	E	O		PD	Ob.
14.	FZP001058C	Physics 1.2			2			K1MTR_U01, K1MTR_U02, K1MTR_U12, K1MTR_U24, K1MTR_K01, K1MTR_K02, K1MTR_K07, K1MTR_K12	30	60	2	2,0	T	Z	O	P	PD	Ob.
		Total	**14**	**5**	**3**	**0**	**0**		**330**	**870**	**29**	**20,4**						

Groups of obligatory courses number of ECTS points …….

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

Optional courses (minimum 1 hours in semester, 1 ECTS points)

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	Weekly number of hours					Field-of-study educational effect symbol	Number of hours		Number of ECTS points		Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes[1]			university-wide[4]	practical[5]	kind[6]	type[7]
1.	HMH100035BK	Block of humanistic courses	1					K1MTR_W25, K1MTR_K02, K1MTR_K07	15	30	1	0,6	T	Z	O		KO	W
Total			**1**	**0**	**0**	**0**	**0**		**15**	**30**	**1**	**0,6**						

Groups of optional courses (e.g. name of specialization) (minimum …… hours in semester, ……. ECTS points)

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

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK classes1
lec	cl	lab	pr	sem				
15	**5**	**3**	**0**	**0**	**345**	**900**	**30**	**21**

Semester 2

Obligatory courses number of ECTS points 27

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	Weekly number of hours					Field-of-study educational effect symbol	Number of hours		Number of ECTS points		Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes[1]			university-wide[4]	practical[5]	kind[6]	type[7]
1.	MCR032102W	Fundamentals of Electrotechnics	2					K1MTR_W13	30	90	3	1,8	T	E			K	Ob.
2.	MCR032102C	Fundamentals of Electrotechnics		1				K1MTR_U13	15	30	1	0,7	T	Z		P	K	Ob.
3.	MCM032006W	Metrology of geometrical quantites	1					K1MTR_W03	15	30	1	0,6	T	Z			K	Ob.
4.	MCM032006L	Metrology of geometrical quantites			1			K1MTR_U29, K1MTR_K03, K1MTR_K04, K1MTR_K09	15	30	1	0,7	T	Z		P	K	Ob.
5.	MCM032004W	Material Science I	2					K1MTR_W02, K1MTR_W07	30	60	2	1,2	T	Z			PD	Ob.
6.	MCM032004L	Material Science I			1			K1MTR_U07	15	30	1	0,7	T	Z		P	PD	Ob.
7.	MCM032005W	Mechanics I (Statics)	2					K1MTR_W01, K1MTR_W02, K1MTR_W08	30	90	3	1,8	T	Z			K	Ob.
8.	MCM032005C	Mechanics I (Statics)		2				K1MTR_U08	30	60	2	1,4	T	Z		P	K	Ob.
9.	MCD032001W	Electronic Components and Circuits	2					K1MTR_W14, K1MTR_W29	30	60	2	1,2	T	Z			K	Ob.
10.	MAP001156W	Mathematical Analysis 2.1 A	2					K1MTR_W01	30	120	4	3,0	T	E	O		PD	Ob.
11.	MAP001156C	Mathematical Analysis 2.1 A		2				K1MTR_U01	30	90	3	2,0	T	Z	O	P	PD	Ob.
12.	FZP003002W	Physics 2.8	1					K1MTR_W01, K1MTR_W02, K1MTR_W07, K1MTR_W13, K1MTR_W14, K1MTR_W25	15	60	2	2,0	T	E	O		PD	Ob.
13.	FZP003002L	Physics 2.8			1			K1MTR_U01, K1MTR_U24, K1MTR_U25, K1MTR_K02, K1MTR_K11	15	60	2	2,0	T	Z	O	P	PD	Ob.
		Total	**12**	**5**	**3**	**0**	**0**		**300**	**810**	**27**	**19,1**						

Groups of obligatory courses number of ECTS points …….

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

Optional courses (minimum 5 hours in semester, 3 ECTS points)

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	lec	cl	lab	pr	sem	Field-of-study educational effect symbol	ZZU	CNPS	total	BK classes[1]	Form[2] of course/group of courses	Way[3] of crediting	university-wide[4]	practical[5]	kind[6]	type[7]
1.	HMH100035BK	Block of humanistic courses	1					K1MTR_W05, K1MTR_K09	15	30	1	0,6	T	Z	O		KO	W
	MCM032101BK	**Optional courses:**	2						30	30	1	0,6	T	Z			PD	W
		Informatics			2				30	30	1	0,7	T	Z		P	PD	W
2.	MCR032251W	Introduction to programming	2					K1MTR_W19										
3.	MCR032251L	Introduction to programming			2			K1MTR_U19										
4.	MCM032102W	Introduction to programming	2					K1MTR_W19										
5.	MCM032102L	Introduction to programming			2			K1MTR_U19, K1MTR_K03										
6.	MCD032101W	Fundamentals of Computer Science	2					K1MTR_W19										
7.	MCD032101L	Fundamentals of Computer Science			2			K1MTR_U19										
		Total	**3**	**0**	**2**	**0**	**0**		**75**	**90**	**3**	**1,9**						

Groups of optional courses (e.g. name of specialization) (minimum …… hours in semester, ……. ECTS points)

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	lec	cl	lab	pr	sem	Field-of-study educational effect symbol	ZZU	CNPS	total	BK classes[1]	Form[2] of course/group of courses	Way[3] of crediting	university-wide[4]	practical[5]	kind[6]	type[7]
		Total	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK classes1
lec	cl	lab	pr	sem	**375**	**900**	**30**	**21**
15	**5**	**5**	**0**	**0**				

Semester 3

Obligatory courses number of ECTS points 25

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	lec	cl	lab	pr	sem	Field-of-study educational effect symbol	ZZU	CNPS	total	BK classes[1]	Form[2] of course/group of courses	Way[3] of crediting	university-wide[4]	practical[5]	kind[6]	type[7]
1.	MCR033231W	Electrical installations and supply systems	1					K1MTR_W10	15	30	1	0,6	T	Z			K	Ob.
2.	MCR033231C	Electrical installations and supply systems		1				K1MTR_U01, K1MTR_U02, K1MTR_U03, K1MTR_U04, K1MTR_U05, K1MTR_K01	15	30	1	0,7	T	Z		P	K	Ob.
3.	MCR033102W	Material Science II	1					K1MTR_W07	15	60	2	1,2	T	E			PD	Ob.
4.	MCR033102L	Material Science II			1			K1MTR_U03	15	30	1	0,7	T	Z		P	PD	Ob.
5.	MCM033005W	Software Engineering and UML	1					K1MTR_W19, K1MTR_W32	15	30	1	0,6	T	Z			PD	Ob.
6.	MCM033006W	Mechanics II (Dynamics)	2					K1MTR_W09	30	60	2	1,2	T	E			K	Ob.
7.	MCM033006C	Mechanics II (Dynamics)		1				K1MTR_U01, K1MTR_U02	15	60	2	1,4	T	Z		P	K	Ob.
8.	MCM033007W	Strength of materials, Mechanics of engineering materials	2					K1MTR_W07	30	60	2	1,2	T	Z			K	Ob.
9.	MCM033007C	Strength of materials, Mechanics of engineering materials		2				K1MTR_U01, K1MTR_U02, K1MTR_U09	30	60	2	1,4	T	Z		P	K	Ob.
10.	MCM033008W	Fundamentals of manufacturing	2					K1MTR_W04	30	30	1	0,6	T	Z			K	Ob.
11.	MCD033001L	Electronic Components and Circuits			2			K1MTR_U32, K1MTR_K03	30	60	2	1,4	T	Z		P	K	Ob.
12.	MAP003061W	Applied Statistics	1					K1MTR_W01	15	60	2	1,0	T	Z			PD	Ob.
13.	MAP003061C	Applied Statistics		1				K1MTR_U01, K1MTR_K01	15	60	2	1,0	T	Z		P	PD	Ob.
14.	MCD033002W	Statistics for Engineers	1					K1MTR_W26	15	60	2	1,2	T	Z			PD	Ob.
15.	MCD033002C	Statistics for Engineers		1				K1MTR_U30	15	60	2	1,4	T	Z		P	PD	Ob.
		Total	**11**	**6**	**3**	**0**	**0**		**300**	**750**	**25**	**15,6**						

Groups of obligatory courses number of ECTS points …….

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	lec	cl	lab	pr	sem	Field-of-study educational effect symbol	ZZU	CNPS	total	BK classes[1]	Form[2] of course/group of courses	Way[3] of crediting	university-wide[4]	practical[5]	kind[6]	type[7]
		Total	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**						

Optional courses (minimum 6 hours in semester, 5 ECTS points)

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	Weekly number of hours					Field-of-study educational effect symbol	Number of hours		Number of ECTS points		Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes[1]			university-wide[4]	practical[5]	kind[6]	type[7]
1.	JZL100707BK	Foreign Languages B2 or C1		4				K1MTR_U06, K1MTR_K01	60	60	2	1,5	T	Z	O	P	KO	W
	MCM033101BK	**Optional courses: Procedural Programming**			2				30	90	3	2,1	T	Z		P	PD	W
2.	MCR033251L	Programming in Matlab			2			K1MTR_U19										
3.	MCM033102L	C Programming			2			K1MTR_U19, K1MTR_K01										
4.	MCD033101L	The Practice of Programming in C			2			K1MTR_U19, K1MTR_K03, K1MTR_K04										
		Total	**0**	**4**	**2**	**0**	**0**		**90**	**150**	**5**	**3,6**						

Groups of optional courses (e.g. name of specialization) (minimum …… hours in semester, ……. ECTS points)

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

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK classes1
lec	cl	lab	pr	sem				
11	**10**	**5**	**0**	**0**	**390**	**900**	**30**	**19,2**

Semester 4

Obligatory courses number of ECTS points 20

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	lec	cl	lab	pr	sem	Field-of-study educational effect symbol	ZZU	CNPS	total	BK classes[1]	Form[2] of course/group of courses	Way[3] of crediting	university-wide[4]	practical[5]	kind[6]	type[7]
1.	MCR034103W	Electrical metrology	1					K1MTR_W03	15	30	1	0,6	T	Z			K	Ob.
2.	MCR034103L	Electrical metrology			1			K1MTR_U03	15	60	2	1,4	T	Z		P	K	Ob.
3.	MCR034211W	Fundamentals of control engineering	2					K1MTR_W17	30	90	3	1,8	T	E			K	Ob.
4.	MCM034005W	Analysis and Synthesis of Kinematic Systems	2					K1MTR_W09	30	60	2	1,2	T	E			K	Ob.
5.	MCM034005P	Analysis and Synthesis of Kinematic Systems				2		K1MTR_U09	30	60	2	1,4	T	Z		P	K	Ob.
6.	MCM034006L	Fundamentals of manufacturing			3			K1MTR_U03, K1MTR_U11, K1MTR_U29, K1MTR_K01, K1MTR_K05, K1MTR_K08	45	90	3	2,1	T	Z		P	K	Ob.
7.	MCM034007W	Systems for Manufacturing and Assembly	2					K1MTR_W08, K1MTR_W11, K1MTR_W18	30	60	2	1,2	T	E			K	Ob.
8.	MCM034007L	Systems for Manufacturing and Assembly			1			K1MTR_U11, K1MTR_U18, K1MTR_K03, K1MTR_K04, K1MTR_K06	15	30	1	0,7	T	Z		P	K	Ob.
9.	MCD034002W	Principles of microprocessor technology	1					K1MTR_W16	15	60	2	1,2	T	Z			K	Ob.
10.	MCD034002L	Principles of microprocessor technology			2			K1MTR_U16	30	60	2	1,4	T	Z		P	K	Ob.
		Total	**8**	**0**	**7**	**2**	**0**		**255**	**600**	**20**	**13**						

Groups of obligatory courses number of ECTS points …….

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	lec	cl	lab	pr	sem	Field-of-study educational effect symbol	ZZU	CNPS	total	BK classes[1]	Form[2] of course/group of courses	Way[3] of crediting	university-wide[4]	practical[5]	kind[6]	type[7]
		Total	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**						

Optional courses (minimum 8 hours in semester, 10 ECTS points)

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	lec	cl	lab	pr	sem	Field-of-study educational effect symbol	ZZU	CNPS	total	BK classes[1]	Form[2] of course/group of courses	Way[3] of crediting	university-wide[4]	practical[5]	kind[6]	type[7]
1.	JZL100708BK	Foreign Languages B2 or C1		4				K1MTR_U06, K1MTR_K01	60	90	3	2,5	T	Z	O	P	KO	W
2.	WFW000000BK	Block of Sports Activities		2				K1MTR_K03, K1MTR_K11, K1MTR_K14	30	30	1	1	T	Z	O	P	KO	W
	MCM034101BK	**Optional courses: Network communication**	1						15	60	2	1,2	T	Z			PD	W
				1					15	30	1	0,7	T	Z		P	PD	W
3.	MCR034104W	Components of computer networks	1					K1MTR_W19, K1MTR_W20										
4.	MCR034104L	Components of computer networks			1			K1MTR_U19, K1MTR_U20										
5.	MCM034103W	Industrial networks	1					K1MTR_W20										
6.	MCM034103L	Industrial networks			1			K1MTR_U20										
7.	MCD034103W	Introduction to Computer Networks	1					K1MTR_W20										
8.	MCD034103L	Introduction to Computer Networks			1			K1MTR_U20										
	MCM034102BK	**Optional courses: Object Oriented Programming**			2				30	90	3	2,1	T	Z		P	PD	W
9.	MCR034251L	MATLAB Object Oriented Programming			2			K1MTR_U19, K1MTR_U35, K1MTR_K01										
10.	MCM034104L	C++ Programming			2			K1MTR_U19, K1MTR_U35, K1MTR_K01										
11.	MCD034102L	Object Oriented Programming			2			K1MTR_U19, K1MTR_U35, K1MTR_K01										
		Total	1	4	3	0	0		150	300	10	7,5						

Groups of optional courses (e.g. name of specialization) (minimum …… hours in semester, ……. ECTS points)

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	lec	cl	lab	pr	sem	Field-of-study educational effect symbol	ZZU	CNPS	total	BK classes[1]	Form[2] of course/group of courses	Way[3] of crediting	university-wide[4]	practical[5]	kind[6]	type[7]
		Total	0	0	0	0	0		0	0	0	0						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK classes1
lec	cl	lab	pr	sem				
9	4	10	2	0	405	900	30	20,5

Semester 5

Obligatory courses number of ECTS points 22

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	lec	cl	lab	pr	sem	Field-of-study educational effect symbol	ZZU	CNPS	total	BK classes[1]	Form[2] of course/group of courses	Way[3] of crediting	university-wide[4]	practical[5]	kind[6]	type[7]
1.	MCR035241W	Safety in electrical engineering	1					K1MTR_W27	15	30	1	0,6	T	Z			K	Ob.
2.	MCR035241L	Safety in electrical engineering			1			K1MTR_U31, K1MTR_K13	15	30	1	0,7	T	Z		P	K	Ob.
3.	MCR035301W	Electrical Drives	2					K1MTR_W10	30	90	3	1,8	T	E			K	Ob.
4.	MCR035301L	Electrical Drives			2			K1MTR_U02, K1MTR_U10	30	60	2	1,4	T	Z		P	K	Ob.
5.	MCR035211L	Fundamentals of control engineering			1			K1MTR_U17, K1MTR_K03	15	30	1	0,7	T	Z		P	K	Ob.
6.	MCR035212W	Elements of control engineering	1					K1MTR_W17	15	60	2	1,2	T	Z			K	Ob.
7.	MCR035212L	Elements of control engineering			1			K1MTR_U17, K1MTR_K01	15	30	1	0,7	T	Z		P	K	Ob.
8.	MCM035003W	Fundamentals of machine elements design	2					K1MTR_W07, K1MTR_W09, K1MTR_W10	30	60	2	1,2	T	Z			K	Ob.
9.	MCM035003P	Fundamentals of machine elements design				2		K1MTR_U05, K1MTR_U09, K1MTR_U23, K1MTR_K02, K1MTR_K04	30	90	3	2,1	T	Z		P	K	Ob.
10.	MCM035004W	Drive systems, hydraulic components and pneumatic components	2					K1MTR_W10, K1MTR_W24	30	60	2	1,2	T	E			K	Ob.
11.	MCM035004L	Drive systems, hydraulic components and pneumatic components			1			K1MTR_U10, K1MTR_U23, K1MTR_K04	15	30	1	0,7	T	Z		P	K	Ob.
12.	MCD035001W	Fundamentals of Electronic Design	1					K1MTR_W31	15	30	1	0,6	T	Z			K	Ob.
13.	MCD035002W	Applications of optoelectronics	1					K1MTR_W30	15	30	1	0,6	T	Z			K	Ob.
14.	MCD035002L	Applications of optoelectronics			2			K1MTR_U33	30	30	1	0,7	T	Z		P	K	Ob.
		Total	**10**	**0**	**8**	**2**	**0**		**300**	**660**	**22**	**14,2**						

Groups of obligatory courses number of ECTS points …….

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	lec	cl	lab	pr	sem	Field-of-study educational effect symbol	ZZU	CNPS	total	BK classes[1]	Form[2] of course/group of courses	Way[3] of crediting	university-wide[4]	practical[5]	kind[6]	type[7]
		Total	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**						

Optional courses (minimum 8 hours in semester, 8 ECTS points)

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	lec	cl	lab	pr	sem	Field-of-study educational effect symbol	ZZU	CNPS	total	BK classes[1]	Form[2] of course/group of courses	Way[3] of crediting	university-wide[4]	practical[5]	kind[6]	type[7]
	MCM035101BK	**Optional courses:**	**1**						15	30	1	0,6	T	Z			K	W
		Sensing			**2**				30	30	1	0,7	T	Z		P	K	W
1.	MCR035103W	Sensors – properties and applications	1					K1MTR_W15										
2.	MCR035103L	Sensors – properties and applications			2			K1MTR_U15										
3.	MCM035105W	Sensory w systemacha wytwórczych	1					K1MTR_W03, K1MTR_W15, K1MTR_W16										
4.	MCM035105L	Sensory w systemacha wytwórczych			2			K1MTR_U03, K1MTR_U10, K1MTR_U15										
3.	MCM035106W	Sensors in the machine and vehicle construction	1					K1MTR_W03, K1MTR_W15, K1MTR_W16										
4.	MCM035106L	Sensors in the machine and vehicle construction			2			K1MTR_U03, K1MTR_U10, K1MTR_U15										
5.	MCD035101W	Sensors and actuators	1					K1MTR_W15										
6.	MCD035101L	Sensors and actuators			2			K1MTR_U15										
	MCM035102BK	**Optional courses:**	**1**						15	30	1	0,6	T	Z			K	W
		Logical Systems			**1**				15	60	2	1,4	T	Z		P	K	W
7.	MCR035303W	Programming of distributed control systems based on PLC	1					K1MTR_W10, K1MTR_W17, K1MTR_W33										
8.	MCR035303L	Programming of distributed control systems based on PLC			1			K1MTR_U15, K1MTR_U20, K1MTR_U36										
9.	MCM035104W	Programmable Logic Controllers	1					K1MTR_W10, K1MTR_W33										
10.	MCM035104L	Programmable Logic Controllers			1			K1MTR_U16, K1MTR_U36										
11.	MCD035102W	Logic Circuits Modeling	1					K1MTR_W16, K1MTR_W19										
12.	MCD035102L	Logic Circuits Modeling			1			K1MTR_U19, K1MTR_U22										
	MCR035201BK	**Degree Profile**																
	Degree Profile: Mechatronics in Automation and Measurements																	
13.	MCR035302W	Power Electronics	2					K1MTR_MAP_W01	30	60	2	1,2	T	Z			K	W
14.	MCR035302L	Power Electronics			1			K1MTR_MAP_U01	15	30	1	0,7	T	Z		P	K	W
	Degree Profile: • Mechatronics in Machine Building and Vehicles																	
15.	MCM035203W	Ecology in industrial manufacturing	1					K1MTR_M_W05	15	30	1	0,6	T	Z			K	W
16.	MCM035204W	Technological designe processes	1					K1MTR_W06, K1MTR_W11	15	30	1	0,6	T	Z			K	W
17.	MCM035204P	Technological designe processes				1		K1MTR_M_U03, K1MTR_M_U06	15	30	1	0,7	T	Z		P	K	W
	Degree Profile: - Mechatronic Systems																	
18.	MCD035201W	Electronic Components	2					K1MTR_MM_W01	30	60	2	1,2	T	Z			K	W
19.	MCD035201L	Electronic Components			1			K1MTR_MM_U01	15	30	1	0,7	T	Z		P	K	W
	Degree Profile: MiAaM		4	0	4	0	0		120	240	8	5,2						
	Degree Profile:MiBaV		4	0	3	1	0		120	240	8	5,2						
	Degree Profile: MS		4	0	4	0	0		120	240	8	5,2						

Groups of optional courses (e.g. name of specialization) (minimum …… hours in semester, ……. ECTS points)

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

Altogether in semester

	Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK classes1
	lec	cl	lab	pr	sem				
Degree Profile: MiAaM	14	0	12	2	0	420	900	30	19,4
Degree Profile:MiBaV	14	0	11	3	0	420	900	30	19,4
Degree Profile: MS	14	0	12	2	0	420	900	30	19,4

Semester 6

Obligatory courses number of ECTS points 13

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	Weekly number of hours					Field-of-study educational effect symbol	Number of hours		Number of ECTS points		Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes[1]			university-wide[4]	practical[5]	kind[6]	type[7]
1.	MCM036004W	Basics of mechatronical design of systems	1					K1MTR_W24	15	60	2	1,2	T	Z			K	Ob.
2.	MCM036004P	Basics of mechatronical design of systems				2		K1MTR_U23, K1MTR_K02	30	60	2	1,4	T	Z		P	K	Ob.
3.	MCM036005W	Industrial robots	2					K1MTR_W09, 1MTR_W10, 1MTR_W15, K1MTR_W23	30	30	1	0,6	T	E			K	Ob.
4.	MCM036005L	Industrial robots			1			K1MTR_U09, K1MTR_U24, K1MTR_U29	15	60	2	1,4	T	Z		P	K	Ob.
5.	MCM036006W	Project Management	1					K1MTR_W28	15	30	1	0,6	T	Z			KO	Ob.
6.	MCD036001W	Microsystems (MEMS)	2					K1MTR_W15	30	60	2	1,2	T	E			K	Ob.
7.	MCD036001L	Microsystems (MEMS)			1			K1MTR_U15, K1MTR_K03	15	60	2	1,4	T	Z		P	K	Ob.
8.	MCD036002P	Fundamentals of Electronic Design				2		K1MTR_U34, K1MTR_U32, K1MTR_K03, K1MTR_K04	30	30	1	0,7	T	Z		P	K	Ob.
Total			**6**	**0**	**2**	**4**	**0**		**180**	**390**	**13**	**8,5**						

Groups of obligatory courses number of ECTS points …….

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

Optional courses (minimum 15 hours in semester, 17 ECTS points)

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	lec	cl	lab	pr	sem	Field-of-study educational effect symbol	ZZU	CNPS	total	BK classes[1]	Form[2] of course/group of courses	Way[3] of crediting	university-wide[4]	practical[5]	kind[6]	type[7]
	MCM036101BK	**Optional courses: CAD 3D-FEM**			2				30	60	2	1,4	T	Z		P	PD	W
1.	MCR036303L	FEM modelling in mechatronics			2			K1MTR_U01, K1MTR_U02, K1MTR_U13 , K1MTR_K03										
2.	MCM036106L	CAD/FEM			2			K1MTR_U22										
3.	MCD036101L	Numerical prototyping of microelectronic structures			2			K1MTR_U22, K1MTR_K04, K1MTR_K05										
	MCM036102BK	**Optional courses: Interdisciplinary Team Project**				2			30	90	3	2,1	T	Z		P	K	W
4.	MCR036103P, 6231, 6302	Interdisciplinary Team Project				2		K1MTR_U04, K1MTR_U30, K1MTR_K03, K1MTR_K06										
5.	MCM036107P	Interdisciplinary Team Project				2		K1MTR_U04, K1MTR_U30, K1MTR_K03, K1MTR_K06										
6.	MCD036102P	Interdisciplinary Team Project				2		K1MTR_U04, K1MTR_U30, K1MTR_K03, K1MTR_K06										
	MCM036103BK	**Optional courses: Signal Processing**	1						15	30	1	0,6	T	Z			K	W
					1				15	60	2	1,4	T	Z		P	K	W
7.	MCR036106W	Digital signal processing	1					K1MTR_W21										
8.	MCR036106L	Digital signal processing			1			K1MTR_U21, K1MTR_U22										
9.	MCM036108W	Signal Processing	1					K1MTR_W16										
10.	MCM036108L	Signal Processing			1			K1MTR_U19, K1MTR_U21										
11.	MCD036103W	Methods of Signal Processing	1					K1MTR_W21										
12.	MCD036103L	Methods of Signal Processing			1			K1MTR_U01, K1MTR_K06										
	MCM036104BK	**Optional courses: Applications of Microsystems**	2						30	60	2	1,2	T	Z			K	W
					2				30	60	2	1,4	T	Z		P	K	W
13.	MCR036304W	Microsystems in measurements	1					K1MTR_W16										
14.	MCR036304L	Microsystems in measurements			1			K1MTR_U15, K1MTR_U16										
15.	MCR036305W	Microsystems in control	1					K1MTR_W21										
16.	MCR036305L	Microsystems in control			1			K1MTR_U15, K1MTR_U16										
17.	MCM036109W	Mechatronics in Medicine	1					K1MTR_M_W03, K1MTR_W08, K1MTR_W23, K1MTR_W09, K1MTR_W26										
18.	MCM036109L	Mechatronics in Medicine			1			K1MTR_U02, K1MTR_U03, K1MTR_U21, K1MTR_K01, K1MTR_K07										
19.	MCM036110W	Mechatronic systems in manufacturing technologies	1					K1MTR_W09, K1MTR_W15, K1MTR_W23										
20.	MCM036110L	Mechatronic systems in manufacturing technologies			1			K1MTR_U03, K1MTR_U11, K1MTR_U15										
21.	MCD036104W	Microsystems in medicine	1					K1MTR_W15										
22.	MCD036104L	Microsystems in medicine			1			K1MTR_U15, K1MTR_K03										
23.	MCD036105W	Automotive microsystems	1					K1MTR_W15										
24.	MCD036105L	Automotive microsystems			1			K1MTR_U15, K1MTR_K03										

	MCR035201BK	Degree Profile																	
Degree Profile: Mechatronics in Automation and Measurements																			
25.	MCR036102W	Active materials	1					K1MTR_MAP_W02, K1MTR_W02	15	30	1	0,6	T	Z			K	W
26.	MCR036102L	Active materials			1			K1MTR_MAP_U02, K1MTR_U02, K1MTR_U03, K1MTR_U22, K1MTR_U24	15	30	1	0,7	T	Z		P	K	W
27.	MCR036211W	System modelling	1					K1MTR_MAP_W05, K1MTR_MAP_W04	15	30	1	0,6	T	Z			K	W
28.	MCR036211L	System modelling			1			K1MTR_MAP_U04, K1MTR_MAP_U05	15	30	1	0,7	T	Z		P	K	W
29.	MCR036301L	Control Systems Prototyping			1			K1MTR_U19	15	30	1	0,7	T	Z		P	K	W
Degree Profile: • Mechatronics in Machine Building and Vehicles																			
30.	MCM036203W	Manufacturing automation	2					K1MTR_M_W01, K1MTR_M_W02	30	60	2	1,2	T	Z			K	W
31.	MCM036203L	Manufacturing automation			1			K1MTR_M_U02	15	30	1	0,7	T	Z		P	K	W
32.	MCM036204W	Design of mechanical assemblies	1					K1MTR_W07, K1MTR_W09, K1MTR_W10	15	30	1	0,6	T	Z			K	W
33.	MCM036204P	Design of mechanical assemblies				1		K1MTR_M_U01, K1MTR_U09, K1MTR_U22, K1MTR_U23, K1MTR_U24, K1MTR_K02, K1MTR_K04	15	30	1	0,7	T	Z		P	K	W
Degree Profile: - Mechatronic Systems																			
34.	MCD036201W	Photonics	1					K1MTR_MM_W02	15	30	1	0,6	T	Z			K	W
35.	MCD036201L	Photonics			2			K1MTR_MM_U02	30	60	2	1,4	T	Z		P	K	W
36.	MCD036202W	Micro- and Nanoelectronics	2					K1MTR_MM_W01, K1MTR_MM_W03	30	60	2	1,2	T	Z			K	W
Degree Profile: MiAaM			**5**	**0**	**8**	**2**	**0**		**225**	**510**	**17**	**11,4**						
Degree Profile: MiBaV			**6**	**0**	**6**	**3**	**0**		**225**	**510**	**17**	**11,3**						
Degree Profile: MS			**6**	**0**	**7**	**2**	**0**		**225**	**510**	**17**	**11,3**						

Groups of optional courses (e.g. name of specialization) (minimum …… hours in semester, ……. ECTS points)

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

Altogether in semester

	Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK classes1
	lec	cl	lab	pr	sem				
Degree Profile: MiAaM	11	0	10	6	0	405	900	30	19,9
Degree Profile: MiBaV	12	0	8	7	0	405	900	30	19,8
Degree Profile: MS	12	0	9	6	0	405	900	30	19,8

Semester 7

Obligatory courses number of ECTS points …….

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

Groups of obligatory courses number of ECTS points …….

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

Optional courses (minimum 12 hours in semester, 30 ECTS points)

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	Weekly number of hours					Field-of-study educational effect symbol	Number of hours		Number of ECTS points		Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes[1]			university-wide[4]	practical[5]	kind[6]	type[7]
1.	HMH100035BK	Block of humanistic courses					1	K1MTR_U25, K1MTR_K15	15	60	2	1,4	T	Z	O	P	KO	W
	MCR036201BK	**Degree Profile**																
	Degree Profile: Mechatronics in Automation and Measurements																	
2.	MCR037301S MCR037201S MCR037103S	Diploma seminar					2	K1MTR_MAP_U01, K1MTR_MAP_U02, K1MTR_MAP_U03, K1MTR_MAP_U04, K1MTR_MAP_U05, K1MTR_MAP_U06, K1MTR_MAP_U07, K1MTR_MAP_U08, K1MTR_K04, K1MTR_K06	30	60	2	1,4	T	Z		P	K	W
3.	MCR037100D MCR037200D MCR037300D	Diploma thesis				2		K1MTR_U24, K1MTR_K01, K1MTR_K04, K1MTR_K06	30	360	12	12	T	Z		P	K	W
4.	MCR037001Q	Practice						K1MTR_U29	0	120	4	4	T	Z		P	K	W
5.	MCR037231W	Building automation	1					K1MTR_MAP_W06	15	60	2	1,2	T	Z			K	W
6.	MCR037231P	Building automation				2		K1MTR_MAP_U06, K1MTR_K06	30	60	2	1,4	T	Z		P	K	W
7.	MCR037101P	Numerical methods				1		K1MTR_U01, K1MTR_K04, K1MTR_K06	15	60	2	1,4	T	Z		P	K	W
8.	MCR037102W	Thin-layer technologies	1					K1MTR_W02, K1MTR_W18, K1MTR_MAP_W07	15	60	2	1,2	T	Z			K	W
9.	MCR037102L	Thin-layer technologies			2			K1MTR_U02, K1MTR_U03	30	60	2	1,4	T	Z		P	K	W

No.	Code	Name					Learning outcomes											
Degree Profile: • Mechatronics in Machine Building and Vehicles																		
10.	MCM037001S	Diploma seminar				2	K1MTR_U24, K1MTR_K01, K1MTR_K03, K1MTR_K04, K1MTR_K06	30	60	2	1,4	T	Z		P	K	W
11.	MCM037002D	Diploma thesis			2		K1MTR_U24, K1MTR_K01, K1MTR_K04, K1MTR_K06	30	360	12	12	T	Z		P	K	W
12.	MCM037003Q	Practice					K1MTR_U29	0	120	4	4	T	Z		P	K	W
13.	MCM037205W	Monitoring of machines and processes	1				K1MTR_W03, K1MTR_W11, K1MTR_W15, K1MTR_W17	15	60	2	1,2	T	Z			K	W
14.	MCM037205L	Monitoring of machines and processes			1		K1MTR_U02, K1MTR_U03, K1MTR_U17, K1MTR_U21, K1MTR_U19, K1MTR_K01, K1MTR_K02, K1MTR_K04, K1MTR_K05, K1MTR_K06, K1MTR_K07, K1MTR_K08, K1MTR_K09	15	30	1	0,7	T	Z		P	K	W
15.	MCM037206P	Numerical methods				1	K1MTR_U21, K1MTR_U03, K1MTR_K03, K1MTR_K04	15	60	2	1,4	T	Z		P	K	W
16.	MCM037207W	Programing of machine numerical controled	2				K1MTR_M_W04, K1MTR_W11	30	60	2	1,2	T	Z			K	W
17.	MCM037207P	Programing of machine numerical controled				1	K1MTR_M_U05, K1MTR_M_U06, K1MTR_U24	15	60	2	1,4	T	Z		P	K	W
18.	MCM037208W	SCADA i HMI	1				K1MTR_W19	15	30	1	0,6	T	Z			K	W
Degree Profile: - Mechatronic Systems																		
19.	MCD037001S	Diploma seminar				2	K1MTR_MM_W05, K1MTR_MM_U01, K1MTR_MM_U02, K1MTR_MM_U03, K1MTR_MM_U04, K1MTR_MM_U05, K1MTR_MM_U06, K1MTR_U02, K1MTR_U03, K1MTR_U04, K1MTR_U05, K1MTR_U06, K1MTR_U07, K1MTR_U08, K1MTR_U09, K1MTR_U10, K1MTR_U11, K1MTR_U12, K1MTR_U13, K1MTR_U14, K1MTR_U15, K1MTR_U16, K1MTR_U17, K1MTR_U18, K1MTR_U20, K1MTR_U21, K1MTR_U22, K1MTR_U23, K1MTR_U24, K1MTR_U25, K1MTR_U26, K1MTR_U27, K1MTR_U28, K1MTR_U29, K1MTR_U30, K1MTR_U31, K1MTR_K03	30	60	2	1,4	T	Z		P		

No.	Course code	Name	lec	cl	lab	pr	sem	Field-of-study educational effect symbol	ZZU	CNPS	total	BK classes	Form	Way	university-wide	practical	kind	type
20.	MCD037002D	Diploma thesis				2		K1MTR_MM_U01, K1MTR_MM_U02, K1MTR_MM_U03, K1MTR_MM_U04, K1MTR_MM_U05, K1MTR_MM_U06, K1MTR_U01, K1MTR_U02, K1MTR_U03, K1MTR_U04, K1MTR_U05, K1MTR_U06, K1MTR_U07, K1MTR_U08, K1MTR_U09, K1MTR_U10, K1MTR_U11, K1MTR_U12, K1MTR_U13, K1MTR_U14, K1MTR_U15, K1MTR_U16, K1MTR_U17, K1MTR_U18, K1MTR_U19, K1MTR_U20, K1MTR_U21, K1MTR_U22, K1MTR_U23, K1MTR_U24, K1MTR_U25, K1MTR_U26, K1MTR_U27, K1MTR_U28, K1MTR_U29, K1MTR_U30, K1MTR_U31, K1MTR_K03, K1MTR_K10	30	360	12	12	T	Z		P	K	W
21.	MCD030002Q	Practice						K1MTR_U04 K1MTR_U29 K1MTR_K02 K1MTR_K03	0	120	4	4	T	Z		P	K	W
22.	MCD037201L	Laboratory on micro- and nanoelectronics			1			K1MTR_MM_U03	15	60	2	1,4	T	Z		P	K	W
23.	MCD037202L	Numerical methods			1			K1MTR_MM_W04, K1MTR_MM_U04	15	60	2	1,4	T	Z		P	K	W
24.	MCD037203W	Packaging of Electronic and Photonics Systems	1					K1MTR_W18	15	60	2	1,2	T	Z			K	W
25.	MCD037203L	Packaging of Electronic and Photonics Systems			1			K1MTR_U18	15	30	1	0,7	T	Z		P	K	W
26.	MCD037204W	Peripheral Devices in Computer Systems	2					K1MTR_MM_W02, K1MTR_MM_W06	30	60	2	1,2	T	Z			K	W
27.	MCD037204L	Peripheral Devices in Computer Systems			1			K1MTR_MM_U02, K1MTR_K03	15	30	1	0,7	T	Z		P	K	W
	obszar: MwAiP		2	0	2	5	3		180	900	30	25,4						
	obszar: MwBMiP		4	0	1	4	3		180	900	30	25,3						
	obszar: MM		3	0	4	2	3		180	900	30	25,4						

Groups of optional courses (e.g. name of specialization) (minimum …… hours in semester, ……. ECTS points)

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

Altogether in semester

	Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK classes1
	lec	cl	lab	pr	sem				
Degree Profile: MiAaM	2	0	2	5	3	180	900	30	25,4
Degree Profile: MiBaV	4	0	1	4	3	180	900	30	25,3
Degree Profile: MS	3	0	4	2	3	180	900	30	25,4

2. Set of examinations in semestral arrangement

Course code	Names of courses ending with examination	Semester
MAP001140W MAP001142W FZP001058W	1. Algebra and Analytic Geometry 2. Mathematical Analysis1.1 A 3. Physics 1.2	1
MCR032102W MAP001156W FZP003002W	1. Fundamentals of Electrotechnics 2. Mathematical Analysis 2.1 A 3. Physics 2.8	2
MCR033102W MCM033006W	1. Material Science II 2. Mechanics II (Dynamika)	3
MCR034211W MCM034005W MCM034007W	1. Fundamentals of control engineering 2. Analysis and Synthesis of Kinematic Systems 3.Systems for Manufacturing and Assembly	4
MCR035301W MCM035004W	1. Electrical Drives 2. Drive systems, hydraulic components and pneumatic components	5
MCM036005W MCD036001W	1. Industrial robots 2. Microsystems (MEMS)	6

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

Semester	Allowable deficit of ECTS points after semester
1	13
2	13
3	13
4	10
5	7
6	5
7	0

Faculty:	**Microsystem Electronics and Photonics**	
Field of study:	**Mechatronics**	
Studies:	**1st level, full-time**	

Faculty Council resolution from:	**29.09.2015**
In effect from:	**01.10.2015**

COURSE CATALOG

Subject cards for courses that are realized in the *Mechatronics* field of study and are supervised by the Faculty of Electrical Engineering and the Faculty of Mechanical Engineering, as well as the subject cards for humanities, management, sport and language courses are posted on the Wrocław University of Technology ECTS information catalog (http://www.portal.pwr.wroc.pl/syllabus,241.dhtml).

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Chemia**	
Name in English:	**Chemistry**	
Main field of studies:	**Mechatronics**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**MCD031001**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Z				
Number of ECTS points	2				
Including number of ECTS points for practical (P) classes	0				
Including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of chemistry required at high school level
2. Knowledge of mathematics required at high school level
3. Knowledge of physics required at high school level

SUBJECT OBJECTIVES

C01 To acquaint students with the basis of chemistry in the field of study, particularly in an atomic and compounds structure, crystallography

C02 To acquaint students with the kinetics of chemical reactions and factors influencing on rate and direction of chemical reactions

C03 To acquaint students with the chemistry and metal electrochemistry including chemical and electrochemical corrosion

C04 To acquaint students with significant elements of organic chemistry and classification of organic compounds

C05 To acquaint students with chemistry of polymers

C06 Preliminary preparation to carry out the researches in fields related to micro- and nanoelectronics

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01   Student has knowledge in basis of chemistry, particularly in crystallography and physicochemical properties of inorganic and organic materials - understand the relationship between their properties and structure from the perspective of materials science

PEK_W02   The student knows the basic methods, techniques, tools and materials used in solving simple engineering problems from the studied field of study

Relating to skills

PEK_U01   Student can identify and describe the chemical and electrochemical phenomena. Moreover can determine the chemical properties of basic chemicals and to determine their behavior under various conditions

PEK_U02   The student is able to plan and carry out experiments, including measurements and computer simulations, interpret the acquired results and draw conclusions

Relating to social competences

PEK_K01   Student understands the need and knows the possibility of lifelong learning (studies II and III degree, postgraduate courses) - increase professional, personal and social competence

PEK_K02   Student is aware of the importance and understanding of non-technical aspects and impacts of engineering, including its impact on the environment, and the related responsibility for decisions

PEK_K03   The student is able to think and act in an entrepreneurial way

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Atom structure, the periodic table	2
Le_02	Molecular structures	2
Le_03	States of matter and its properties	2
Le_04	Crystallographic elements	2
Le_05	The chemical reactions and chemical kinetics	2
Le_06	Chemical equilibrium	2
Le_07	Chemistry of solutions	2
Le_08	Electrochemistry	2
Le_09	Metal chemistry	2
Le_10	Corrosion of metals	2
Le_11	Non-metal chemistry	2
Le_12	Nanomaterial properties	2
Le_13	Introduction to organic chemistry	2
Le_14	Polymers chemistry	2
Le_15	Test	2
	TOTAL	30

TEACHING TOOLS USED

ND_01   Traditional lecture with presentation and discussion
ND_02   Consultations
ND_03   Preparation of selected problems raised during the lecture
ND_04   Individual work – self-study and preparation for test

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Discussion, final test

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. I. Barycka, K. Skudlarski, Podstawy chemii, Oficyna Wydawnicza Politechniki Wrocławskiej, 2001
2. Group work under supervision of Jacek Banaś and Wojciech Stolarski, Chemia dla inżynierów, AGH Kraków, 2008

Secondary literature

1. F. A. Otton, G. Wilkinson, P.L. Gaus, Chemia nieorganiczna, WNT, 1995
2. L. Pauling, P. Pauling, Chemia, WNT, 1997

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Chemistry

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_W07	C01-C05	Le_01-Le_14	ND_01-ND_03
PEK_W02	InzA_W02	C01-C06	Le_01-Le_14	ND_01-ND_03
PEK_U01 (skills)	K1MTR_U02	C01-C05	Le_01-Le_14	ND_02-ND_04
PEK_U02	InzA_U01	C01-C06	Le_01-Le_14	ND_01-ND_03
PEK_K01 (competences)	K1MTR_K01	C01	Le_01-Le_14	ND_01-ND_04
PEK_K02	K1MTR_K02	C01, C02, C05	Le_01-Le_14	ND_01-ND_04

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Elementy i układy elektroniczne**	
Name in English:	**Electronic Elements and Devices**	
Main field of studies:	**Mechatronics**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**MCD032001**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Z				
Number of ECTS points	2				
Including number of ECTS points for practical (P) classes	0				
Including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
1. Basic physics - Electricity and Magnetism

SUBJECT OBJECTIVES
C01 To learn basic physical properties and operation of semiconductor devices
C02 To learn parameters and characteristics of electronic components
C03 To learn how to choose proper electronic device for circuit design
C04 To gain ability to define priorities in engineering tasks
C05 To provide background in scientific research competence in the areas of micro- and nanoelectronics and passive and active electronic components

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01   Understands basic physics of semiconductors, operation of semiconductor devices and their applications

PEK_W02   The student knows the basic methods, techniques, tools and materials used in solving simple engineering problems from the studied field of study

Relating to skills

PEK_U01   Can use electronic component data sheets. Have skill of using semiconductor elements in electronic circuits.

PEK_U02   The student is able to plan and carry out experiments, including measurements and computer simulations, interpret the acquired results and draw conclusions

Relating to social competences

PEK_K01   Have ability to set-up priorities in engineering tasks

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Introduction. Basic electric circuit laws. R, L, C components	2
Le_02	Properties of semiconductors. Energy band model	2
Le_03	Influence of temperature, light and magnetic field on semiconductors	2
Le_04	The p-n junction. Types of diodes and applications	2
Le_05	Rectifying and voltage regulator circuits	2
Le_06	Bipolar transistor: principle of operation, dc bias	2
Le_07	Midterm test	2
Le_08	Bipolar transistor characteristics and parameters. Equivalent circuits	2
Le_09	Transistor amplifier circuits	2
Le_10	Field effect transistors - JFET, MESFET, MOSFET	2
Le_11	Switching devices: thyristors, triacs, IGBT	2
Le_12	Optoelectronic components	2
Le_13	Introduction to analog ICs, OP-AMP applications	2
Le_14	Digital TTL and CMOS circuits	2
Le_15	Final test	2
	TOTAL	30

TEACHING TOOLS USED

ND_01   Lecture with slide presentation and discussion
ND_02   Office hours – tutorials
ND_03   Individual study with lecture material
ND_04   Student work - preparation to the class tests

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02, PEK_U01, PEK_U02, PEK_K01	Tests, discussions

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. A. Świt, J. Pułtorak, Przyrządy półprzewodnikowe, WNT, 1988
2. B. Boratyński, Notatki z wykładu, kopie (pliki .pdf) materiałów wykładowcy, 2011
3. W. Marciniak, Przyrządy półprzewodnikowe i układy scalone, WNT, 1984

Secondary literature

1. A. Guziński, Liniowe elektroniczne układy analogowe, WNT, 1983
2. G. Rizzoni, Fundamentals of Electrical Engineering, McGraw-Hill, 2010

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Electronic Elements and Devices

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_MM_W02, K1MTR_MM_W14	C01-C03	Le_01-Le_14	ND_01-ND_04
PEK_W02	InzA_W02	C01-C03, C05	Le_01-Le_14	ND_01-ND_04
PEK_U01 (skills)	K1MTR_MM_U03, K1MTR_MM_U14	C01-C03	Le_01-Le_14	ND_01-ND_04
PEK_U02	InzA_U01	C01-C03, C05	Le_01-Le_14	ND_01-ND_04
PEK_K01 (competences)	K1MTR_K04	C04	Le_01-Le_14	ND_01-ND_04

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Podstawy informatyki**	
Name in English:	**Fundamentals of Computer Science**	
Main field of studies:	**Mechatronics**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**MCD032101**	
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)	30		30		
Form of crediting	Z		Z		
Number of ECTS points	1		1		
Including number of ECTS points for practical (P) classes	0		1		
Including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
1.   Completed the course material: Information technology

SUBJECT OBJECTIVES
C01   Gaining theoretical knowledge about C and C++ languages referred to in Le_01-Le_14
C02   Gaining practical skills (programming C and C++ applications) through laboratory tasks La_01-La_14

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge
PEK_W01   He knows the basics of C/C++

Relating to skills
PEK_U01   He can develop a simple application in C/C++ implementing the selected algorithm

Relating to social competences
PEK_K01   Able to interact and work in a group of laboratory, taking in the different roles

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Encoding information. Character encodings: ASCII, ISO 8859-2, UNICODE. Representation of integers in the U1, U2, + N, BCD, BCD+3. The IEEE 754 and the limits of calculation accuracy	2
Le_02	Portability of code and data: code reuse across platforms, data exchange between different systems and processors of different architectures	2
Le_03	Single- and multi-dimensional arrays. Pointers and pointer arithmetic. Conditions and loops	2
Le_04	Dynamic memory allocation. Exceptions	2
Le_05	Binary and text files. Introduction to the data serialization	2
Le_06	Structures, unions, organization of fields of structures in memory	2
Le_07	Functions, function parameters, recursion. Error prevention against stack overflow. Different conventions for function calls and their impact on performance and code portability	2
Le_08	Data processing: sorting algorithms. The use of function pointers	2
Le_09	Classes in C++ as a smart structures	2
Le_10	Operator overloading. Defining custom data types	2
Le_11	Polymorphism and paradigms of object-oriented programming	2
Le_12	Features of C# and Java as object-oriented languages	2
Le_13	Basics of programming TCP/IP	2
Le_14	Communication and data exchange between Java and C++ applications. Using 16-bit big-endian and 32-bit little-endian processor and data portability.	2
Le_15	Final test	2
	TOTAL	30

Form of classes - Laboratory		Quantity
La_01	Configuration of the Integrated Development Environment	2
La_02	Basic data types. Standard input-output. Operations on numeric variables	2
La_03	Debugger. Type conversions	2
La_04	Strings, arrays, files	2
La_05	Selected algorithms for processing strings in C	2
La_06	Local, global, static variables. Functions	2
La_07	Conditional statements and multiple-choice switch case instruction	2
La_08	Dynamic allocation of memory and pointer arithmetics	2
La_09	Introduction to classes and objects	2
La_10	Object-oriented I/O in C++	2
La_11	Sorting algorithms and complexity of algorithms	2
La_12	Applications of function pointers	2
La_13	Completion of the final project (application in C)	2
La_14	Presentation of successful completion of the final project	2
La_15	Additional (spare) classes	2
	TOTAL	30

TEACHING TOOLS USED

ND_01   The traditional lecture with presentations and discussion
ND_02   Program completion quizzes to verify the current curriculum
ND_03   Consultation
ND_04   Self study - preparation of selected topics in the lecture
ND_05   Self study - preparation of selected topics in the laboratory
ND_06   Laboratories

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01	Discussions and final test
P2 = F2 (lab)	PEK_U01, PEK_K01	Partial tests and quizzes, lab reports

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Prata, S., Język C. Szkoła programowania. Wydanie V, Helion, 2006
2. Kerningham B. W., Ritchie D. M., Język ANSI C, WNT, 2001
3. Kuczmarski, Karol, Kurs C++, http://avocado.risp.pl, 2012

Secondary literature

1. Bartlet, Jonathan, Programming from the Ground Up, http://www.bartlettpublishing.com/, 2012
2. Stroustrup, Bjarne, The C++ programming language, ADDISON-WESLEY PUBL. CO., 1991

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Fundamentals of Computer Science

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_W19	C01	Le_01-Le_14	ND_01-ND_04
PEK_U01 (skills)	K1MTR_U19, K1MTR_U21	C02	La_01-La_14	ND_02, ND_03, ND_05, ND_06

| PEK_K01 (competences) | K1MTR_K03 | C02 | La_01-La_14 | ND_05, ND_06 |

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Elementy i układy elektroniczne**	
Name in English:	**Electronic Elements and Devices**	
Main field of studies:	**Mechatronics**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**MCD033001**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			60		
Form of crediting			Z		
Number of ECTS points			2		
Including number of ECTS points for practical (P) classes			2		
Including number of ECTS points for direct teacher-student contact (BK) classes			1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
1. Basic physics - Electricity and Magnetism
2. Lecture: Electronic Elements and Circuits

SUBJECT OBJECTIVES
C01 To learn basic physical properties of semiconductors
C02 To learn parameters and characteristics of diodes, transistors and integrated circuits
C03 To learn how to choose proper electronic device for circuit design
C04 To learn how to analyse simple electronic circuits
C05 Team work skill development
C06 To provide background in scientific research competence in the areas of micro- and nanoelectronics and passive and active electronic components

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01   Understanding of basic physics of semiconductors, operation of semiconductor devices and their applications

PEK_W02   The student knows the basic methods, techniques, tools and materials used in solving simple engineering problems from the studied field of study

Relating to skills

PEK_U01   Ability to use data sheets to choose proper electronic component for specific application. Skill of using semiconductor elements in electronic circuits.

PEK_U02   The student is able to plan and carry out experiments, including measurements and computer simulations, interpret the acquired results and draw conclusions

Relating to social competences

PEK_K01   Independent and team work ability in laboratory experiments

PROGRAMME CONTENT

Form of classes - Laboratory		Quantity
La_01	Introduction to the Laboratory	3
La_02	The p-n junction characteristics	3
La_03	Rectifying diodes and circuits	3
La_04	Voltage regulator with a Zener diode	3
La_05	Bipolar transistor characteristics	3
La_06	Bipolar transistor amplifier	3
La_07	MOSFET characteristics and application	3
La_08	Bipolar transistor characteristics and parameters. Equivalent circuits	3
La_09	CMOS gates	3
La_10	Make-up lab meeting	3
	TOTAL	30

TEACHING TOOLS USED

ND_01 Oral introduction to the experiments, 10-minute quizzes
ND_02 Office hours – tutorials
ND_03 Individual study -preparation for lab experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lab)	PEK_W01, PEK_W02, PEK_U01, PEK_U02	Short tests and oral quizes

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. A. Świt, J. Pułtorak, Przyrządy półprzewodnikowe, WNT, 1988
2. B. Boratyński, Notatki z wykładu, kopie (pliki .pdf) materiałów wykładowcy, 2010
3. B. Streetman, Przyrządy półprzewodnikowe, WNT, 1984
4. W. Marciniak, Przyrządy półprzewodnikowe i układy scalone, WNT, 1984
5. Group work, Instructions to laboratory exercises (.pdf files), 2012

Secondary literature

1. A. Guziński, Liniowe elektroniczne układy analogowe, WNT, 1983
2. G. Rizzoni, Fundamentals of Electrical Engineering, McGraw-Hill, 2010

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Electronic Elements and Devices

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_MM_W02	C01-C03	La_01-La_10	ND_01-ND_03
PEK_W02	InzA_W02	C01-C03, C06	La_01-La_10	ND_01-ND_03
PEK_U01 (skills)	K1MTR_MM_U03	C01-C03	La_01-La_10	ND_01-ND_03
PEK_U02	InzA_U01	C01-C03, C06	La_01-La_10	ND_01-ND_03
PEK_K01 (competences)	K1MTR_K03	C04, C05	La_01-La_10	ND_01-ND_03

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Statystyka inżynierska**	
Name in English:	**Engineering Statistics**	
Main field of studies:	**Mechatronics**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**MCD033002**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	15			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	Z	Z			
Number of ECTS points	2	2			
Including number of ECTS points for practical (P) classes	0	2			
Including number of ECTS points for direct teacher-student contact (BK) classes	1.2	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
1. Knows the elements of probability corresponding to high school at the primary level

SUBJECT OBJECTIVES
C01 Acquisition of knowledge of basic probability distributions, their properties and applications
C02 Acquisition of knowledge on the role of statistical methods in engineering activities; data collection methods, descriptive analysis and graphical presentation of experimental data
C03 Acquisition of skills solve problems independently from the application of probabilistic models and statistical methods in engineering practice
C04 Consolidation of student awareness regarding the need to use statistical methods in engineering activities

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01   Has knowledge of basic probabilistic models, methods of data collection and presentation of statistical data, he knows the basic methods of statistical data analysis

Relating to skills

PEK_U01   Is able to select and use appropriate tools to solve selected problems of statistical data analysis, is able to draw conclusions on the basis of their analysis

Relating to social competences

PEK_K01   Can work as a team member to solve engineering problems using statistical methods

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Introduction. Rules. Probability and the role of statistics in engineering. Collection of empirical data	1
Le_02	Geometric probability, independent events, conditional probability, Bayes' theorem. Random variables. Moments of random variables, distribution function	2
Le_03	Distributions of functions of random variables (binomial, geometric, Poisson, exponential, tables of normal distribution, standardization, random variable, Student-t distribution, chi-square)	2
Le_04	Moments of trial, Descriptive statistics (stem and leaf, quantile of the trial, histogram, box plots, graphs timelines)	2
Le_05	Approximation of distributions of discrete normal distribution. Independence of random variables. Covariance and correlation. Central limit theorem. Estimators and their properties	2
Le_06	Estimation methods. Confidence intervals	2
Le_07	Selected statistical tests	2
Le_08	Passing test	2
	TOTAL	15

Form of classes - Classes		Quantity
Cl_01	Introductory exercises, range of exercises, principles of assessment	1
Cl_02	Solving basic tasks in the field of probability, calculation of moments	2
Cl_03	Solving the scope of the selected probability distributions	2
Cl_04	The use of descriptive statistics in data analysis - problem solving	2
Cl_05	The use of descriptive statistics in data analysis - problem solving	2
Cl_06	Central limit theorem – solving selected examples	2
Cl_07	Estimation methods – solving selected examples	2
Cl_08	Selected statistical tests – solving examples	2
	Total	15

TEACHING TOOLS USED	
ND_01	Traditional lectures using multimedia presentations and discussion
ND_02	Consultation
ND_03	Self - preparation for the lecture inflicted issues
ND_04	Self - preparation for exercise
ND_05	Self - self-inflicted solving problems during exercise
ND_06	Exercises: a short, 15-minute tests at the beginning of classes

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01	Writing test
P2 = F2 (classes)	PEK_U01, PEK_K01	Solving exercises, discussions, short test during classes

PRIMARY AND SECONDARY LITERATURE
Primary literature
1. W. Krysicki et al., Rachunek prawdopodobieństwa i statystyka matematyczna w zadaniach, PWN, Warszawa 1995
2. W. Kordecki, Rachunek prawdopodobieństwa i statystyka matematyczna. Definicje, twierdzenia, wzory, Oficyna Wydawnicza GiS, Wrocław 2003
Secondary literature
1. D.C. Montgomery, G.C. Runger, Applied Statistics and probability for engineers; Students solutions Manual, Wiley&Sons, 2006, 4th Ed.,
2. Roman Nowak, Statystyka dla fizyków, PWN, 2002
3. R. Lyman Ott, Michael Longnecker, An introduction to statistical methods and data analysis, Brooks/Cole Cemgage Learning, 6th, Ed., 2010
4. Dr. Graham Currell, Dr. Antony Dowman, Essential Mathematics and Statistics for Science, 2nd Edition, Wiley, 2009

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Engineering Statistics

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_W01	C01, C02	Le_01-Le_08	ND_01-ND_03

PEK_U01 (skills)	K1MTR_U01	C03	Cl_01-Cl_08	ND_04-ND_06
PEK_K01 (competences)	K1MTR_K03	C04	Cl_01-Cl_08	ND_01-ND_06

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Praktyka programowania w języku C**	
Name in English:	**The Practice of Programming in C**	
Main field of studies:	**Mechatronics**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Optional**	**/ Faculty**
Subject code:	**MCD033101**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			90		
Form of crediting			Z		
Number of ECTS points			3		
Including number of ECTS points for practical (P) classes			3		
Including number of ECTS points for direct teacher-student contact (BK) classes			2.1		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed the course material: Information technology
2. Completed the course material: Introduction to computer science

SUBJECT OBJECTIVES

C01   Ability to program microcontroller based devices in C language

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01   Gaining theoretical knowledge referred to in La_01-La_09

Relating to skills

PEK_U01   Gaining practical skills through laboratory tasks La_01-La_09

Relating to social competences

PEK_K01   Gaining experience working in a development team

PROGRAMME CONTENT

	Form of classes - Laboratory	Quantity
La_01	Introduction to the chosen IDE for microcontrollers	3
La_02	Software implementation of OSI layers 2-4. Using the Ethernet interface. Synthesis and decoding of IP/UDP packets in network microcontrollers	3
La_03	Extensions for C in microcontrollers and standard ANSI C	3
La_04	Boot sequences of selected microcontrollers - from power-on to the main() function	3
La_05	Servicing interrupts in C. UART programming	3
La_06	AT command support - software communication with GSM / GPRS	3
La_07	Floating-point arithmetic and other mathematical operations a microcontroller, or how to live without FPU. When we use fixed-point arithmetic instead of floating point	3
La_08	RF - OOK: transmitting the data, synthesis of bitstream with NRZ coding	3
La_09	RF - OOK: receiving and decoding the bit-oriented data (state machine of a decoder)	3
La_10	Additional (spare) classes	3
	TOTAL	30

TEACHING TOOLS USED

ND_01 Program completion quizzes to verify the current curriculum
ND_02 Consultation
ND_03 Self study - preparation of selected topics in the laboratory
ND_04 Laboratory exercises using microcontrollers

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lab)	PEK_W01, PEK_U01, PEK_K01	Program completion quizzes, lab reports

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Kernighan, Brian W., Lekcja programowania: najlepsze praktyki, Helion, 2011
2. King, K. N., Język C: nowoczesne programowanie, Helion, 2011

Secondary literature

1. Krzysztof Urbański, Laboratory instructions, 2012

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

The Practice of Programming in C

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_W19	C01	La_01-La_09	ND_01-ND_04
PEK_U01 (skills)	K1MTR_U16, K1MTR_U24	C01	La_01-La_09	ND_02-ND_04
PEK_K01 (competences)	K1MTR_K03	C01	La_01-La_09	ND_04

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish: **Podstawy techniki mikroprocesorowej**

Name in English: **Basics in Microprocessor Engineering**

Main field of studies: **Mechatronics**

Level and form of studies: **I level** **/ Full time**

Kind of subject: **Obligatory** **/ Faculty**

Subject code: **MCD034002**

Group of courses: **NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	E		Z		
Number of ECTS points	2		2		
Including number of ECTS points for practical (P) classes	0		2		
Including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge in the field of electronic components and circuits
2. Basic knowledge in the field of computer programming

SUBJECT OBJECTIVES

C01 Gaining the knowledge of the design and operation of microprocessors
C02 Gaining the knowledge of the microcontroller peripherals
C03 Gaining experience in programming of microprocessors and their peripherals
C04 Preliminary preparation to carry out the researches in fields related to digital electronics

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Knowledge about the architecture and operation of microprocessors
PEK_W02 Knowledge of peripheral devices in single-chip microcontrollers
PEK_W03 The student knows the basic methods, techniques, tools and materials used in solving simple engineering problems from the studied field of study

Relating to skills

PEK_U01   Ability to microprocessors low-level programming
PEK_U02   Ability to use microcontroller peripherals
PEK_U03   The student is able to identify and formulate a specification of simple and practical engineering tasks, characteristic for the studied field of study

Relating to social competences

PEK_K01   The student is aware of the importance and understands the non-technical aspects and results of engineering activity, including its impact on the environment, and the associated responsibility for made decisions

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Architecture of the RISC processor basing on the ATMEGA8535 as an example	2
Le_02	ATMEGA8535 microcontroller instruction set	2
Le_03	Peripherals - handling with I/O ports, analog to digital converter	2
Le_04	Interrupts - mechanism and programming	2
Le_05	Peripherals - programmable timers/counters	2
Le_06	Styles of low-level programming	2
Le_07	Peripherals - serial interfaces SPI, UART, I2C	2
Le_08	Summary	1
	TOTAL	15

Form of classes - Laboratory		Quantity
La_01	Introduction - how to handle with programming tools and educational kits	4
La_02	Programming of ports, loops, jumps and procedures	4
La_03	Interrups, use of the analog to digital converter, cooperation of the peripheral devices - design of the microprocessor voltmeter	4
La_04	Driving of stepper motors,counters - counting of external pulses and timing	4
La_05	Counters - generation of rectangular waveform with variable duty factor	4
La_06	SPI interface, programming the 7-segment displays drivers, programming of text information	4
La_07	Programming the EEPROM, communication with RAM, controlling the LCD display	4
La_08	Additional term	2
	TOTAL	30

TEACHING TOOLS USED
ND_01 Traditional lecture supported by multimedia presentation
ND_02 Own work - preparation for classes and exam
ND_03 Exercises
ND_04 Own work - preparation for laboratory.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01-PEK_W03	Written exam
P2 = F2 (lab)	PEK_U01-PEK_U03	Evaluation of laboratory exercises

PRIMARY AND SECONDARY LITERATURE

Primary literature
1. Hitachi HD44780 LCD Controller, technical documentation
2. Maxim MAX7219/MAX7221, technical documentation
3. Atmel ATMega8535, technical documentation

Secondary literature
1. R. Baranowski, Mikrokontrolery AVR ATmega w praktyce, BTC, 2005

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Basics in Microprocessor Engineering

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_W16	C01, C02	Le_01-Le_08	ND_01, ND_02, ND_04
PEK_W02	K1MTR_W16	C01, C02	Le_01-Le_08	ND_01, ND_02, ND_04
PEK_W03	InzA_W02	C02-C04	Le_01-Le_08	ND_01, ND_02, ND_04
PEK_U01 (skills)	K1MTR_U16	C03	La_01-La_15	ND_03
PEK_U02	K1MTR_U16	C03	La_01-La_15	ND_03
PEK_U03	InzA_U06	C01-C04	Le_01-Le_08	ND_03
PEK_K01 (competences)	InzA_K01	C01-C04	Le_01-Le_08	ND_01, ND_03

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Programowanie obiektowe**	
Name in English:	**Object Oriented Programming**	
Main field of studies:	**Mechatronics**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Optional**	**/ Faculty**
Subject code:	**MCD034102**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			90		
Form of crediting			Z		
Number of ECTS points			3		
Including number of ECTS points for practical (P) classes			3		
Including number of ECTS points for direct teacher-student contact (BK) classes			2.1		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1.   Completed the course material: Introduction to computer science

SUBJECT OBJECTIVES

C01   The ability to design and implementation of applications in object-oriented programming language

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01   Gaining theoretical knowledge referred to in La_01-La_07

Relating to skills

PEK_U01   Gaining practical skills through laboratory tasks La_01-La_07

Relating to social competences

PEK_K01   Gaining experience working in a development team

PROGRAMME CONTENT

Form of classes - Laboratory		Quantity
La_01	Introduction to .NET and C # language. Discussion of the objectives of the project target (robot or machine controller)	4
La_02	Introduction to UML. Design target driver functions in groups	4
La_03	Development of diagrams: use case and activity classes for the driver. User Interface Design	4
La_04	Principles of good GUI design. Designing of the user interface for controller	4
La_05	Gaining knowledge about the class that realizes UDP network communication. Design your own application testing its operation	4
La_06	The implementation of application implementing the assumption of La_02	4
La_07	Functional tests and add exception handling (optional)	4
La_08	Additional (spare) classes	2
	TOTAL	30

TEACHING TOOLS USED

ND_01 Quizzes to master the material needed to verify the current curriculum
ND_02 Consultation
ND_03 Self study - preparation of selected topics in the laboratory
ND_04 Laboratories
ND_05 Giving the knowledge necessary to carry out laboratory activities

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lab)	PEK_W01, PEK_U1, PEK_K01	Program completion quizzes, lab reports

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Rasheed, Faraz, Programmer-s Heaven C# School Book, http://www.programmersheaven.com/ebooks/csharp_ebook.pdf, 2012
2. Petzold, Charles, Programming Microsoft Windows with C#, Microsoft Press, 2001
3. Kubik, Tomasz, UML and service description languages : information systems modelling, PRINTPAP, 2011

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Object Oriented Programming

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_W19	C01	La_01-La_07	ND_02, ND_03, ND_05
PEK_U01 (skills)	K1MTR_U19,K1MTR_U21	C01	La_01-La_07	ND_04
PEK_K01 (competences)	K1MTR_K03	C01	La_01-La_07	ND_01-ND_05

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Wprowadzenie do sieci komputerowych**	
Name in English:	**Introduction to Computer Networks**	
Main field of studies:	**Mechatronics**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Optional**	**/ Faculty**
Subject code:	**MCD034103**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Z		Z		
Number of ECTS points	1		1		
Including number of ECTS points for practical (P) classes	0		1		
Including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
1.   Completed the course material: Information technology
2.   Completed the course material: Introduction to computer science

SUBJECT OBJECTIVES
C01   Gaining theoretical knowledge referred to in La_01-La_07
C02   Gaining practical skills through laboratory tasks La_01-La_07
C03   Gaining theoretical knowledge referred to in Le_01-Le_07

SUBJECT EDUCATIONAL EFFECTS
Relating to knowledge

PEK_W01   He knows the principles of operation of computer networks and their security aspects
PEK_W02   He knows the rules of designing network solutions and their programming

Relating to skills

PEK_U01   The ability to design simple and secure computer networks, including the safety aspects

PEK_U02	The ability to practical application of network technology, and to communicate with the measuring systems and devices

Relating to social competences

PEK_K01	Is aware of the need for ethical and legal standards relating to such with access to private and sensitive data processed in computer networks
PEK_K02	Is able to interact and work in a group of laboratory, taking in the different roles

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Introduction: ISO / OSI model, network topologies, protocols	2
Le_02	The ARP protocol. Static and dynamic ARP table entries. Prevention of attacks carried out on the basis of the ARP protocol. Example implementation of the ARP protocol using networked microcontroller	2
Le_03	The IP protocol. Route selection. Address Translation. Overview of the TCP, UDP, ICMP	2
Le_04	High-level network programming: client-server architecture. Portability of data on the network	2
Le_05	Safety: traffic monitoring, attack detection, firewalls, data encryption, certificates, privacy	2
Le_06	Selected network services: DNS, FTP, HTTP. Configuring and securing devices against selected attacks	2
Le_07	Wireless Networks. Bluetooth, Wi-Fi. Configuration, range, safety	2
Le_08	Final test	1
	TOTAL	15

Form of classes - Laboratory		Quantity
La_01	What is the Internet? The most important protocols. Getting familiar with tool WireShark	2
La_02	The principle of operation of L2 and L3 switch. The ARP protocol. MAC spoofing and certain types of attacks	2
La_03	TCP and UDP applications. Client-server architecture. Network programming using the BSD sockets. Multi-threaded server application	2
La_04	Implementation of embedded web server and TCP stack in single chip microcontroller. Remote device control and data acquisition using a Web browser	2
La_05	The HTTP protocol and the DNS system. Configuration of http server, including support for multiple domains	2
La_06	Principle of operation of NAT. Setting up Windows ICS and NAT devices. Port mapping	2
La_07	Setting up and running the SSH and RDP services allow remote access to the computer located behind NAT	2
La_08	Additional (spare) classes	1
	TOTAL	15

TEACHING TOOLS USED
ND_01 Program completion quizzes to verify the current curriculum
ND_02 Consultation
ND_03 Self study - preparation of selected topics in the lecture and laboratory
ND_04 Specialized software to perform the tasks of laboratory
ND_05 Educational kits with networked microcontrollers
ND_06 Giving the knowledge necessary to carry out laboratory activities

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Final test
P2 = F2 (lab)	PEK_U01, PEK_U02, PEK_K01, PEK_K02	Program completion quizzes, lab reports

PRIMARY AND SECONDARY LITERATURE

Primary literature
1. Stevens W. R., Programowanie zastosowań sieciowych w systemie Unix, Helion, 2010
2. Tanenbaum, Andrew S. , Sieci komputerowe, Helion, 2004
3. Schneier, Bruce, Kryptografia dla praktyków: protokoły i programy źródłowe w języku C, WNT, 2002

Secondary literature
1. Danowski, Bartosz, Wi-Fi : domowe sieci bezprzewodowe, Helion, 2010
2. Park, John, Practical data communications for instrumentation and control, Elsevier, 2003

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Introduction to Computer Networks

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_W20	C01	Le_01-Le_07	ND_01, ND_03, ND_04
PEK_W02	K1MTR_W20	C01	Le_01-Le_07	ND_01- ND_06
PEK_U01 (skills)	K1MTR_U20	C02	La_01-La_07	ND_02, ND_03, ND_05, ND_06
PEK_U02	K1MTR_U20	C02	La_01-La_07	ND_02, ND_03, ND_05, ND_06
PEK_K01 (competences)	K1MTR_K02, K1MTR_K05	C01	La_01-La_07	ND_03, ND_06
PEK_K02	K1MTR_K03	C02	La_01-La_07	ND_03, ND_06

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Podstawy projektowania układów elektronicznych**
Name in English:	**Fundamentals of Electronic Design**
Main field of studies:	**Mechatronics**
Level and form of studies:	**I level / Full time**
Kind of subject:	**Obligatory / Faculty**
Subject code:	**MCD035001**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Z				
Number of ECTS points	1				
Including number of ECTS points for practical (P) classes	0	0	0	0	0
Including number of ECTS points for direct teacher-student contact (BK) classes	0.6	0	0	0	0

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of electrical engineering and analog technique
2. Basic knowledge of issues related to semiconductor devices

SUBJECT OBJECTIVES

C01   To acquaint students with basic electronic systems, properties and applications of electronic circuits
C02   To acquaint students with basics of analog and digital circuits design
C03   Preliminary preparation to carry out the researches in fields related to micro- and nanoelectronics

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01   Students have systematic and theoretically founded knowledge of basic digital and analogue circuits

PEK_W02   The student knows the basic methods, techniques, tools and materials used in solving simple engineering problems from the studied field of study

Relating to skills

PEK_U01 Student are able to analyse basic parameters and characteristics of measurement and control electronics

PEK_U02 The student is able to identify and formulate a specification of simple and practical engineering tasks, characteristic for the studied field of study

Relating to social competences

PEK_K01 Student are able to identify priorities needed to realise defined engineering task, connected with design, analysis and measurement of basic parameters of analog and digital circuits

PEK_K02 Student are able to identify which tasks are to realize individually or in group

PEK_K03 The student is able to think and act in an entrepreneurial way

PROGRAMME CONTENT

	Form of classes - Lecture	Quantity
Le_01	Properties and characteristics of operational amplifiers	2
Le_02	Linear and nonlinear circuits designed with operational amplifiers	2
Le_03	Properties and characteristics of instrumental and differentia amplifiers	2
Le_04	Circuits for acquisition of photodetector signals	2
Le_05	Current and voltage sources	2
Le_06	Digital to analog and analog to digital converters	2
Le_07	Input and output circuits for analog to digital and digital to analog converters	2
Le_08	Test in writing	1
	TOTAL	15

TEACHING TOOLS USED

ND_01 Traditional lecture with discussion
ND_02 Multimedia lecture with discussion
ND_03 Consultations
ND_04 Individual work – preparation of selected topics of the lecture
ND_05 Individual work – preparation for test

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Test in writing

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. J. Baranowski, G. Czajkowski, Układy analogowe nieliniowe i impulsowe, WNT, 2004
2. P. Górecki, Wzmacniacze operacyjne, Wydawnictwo BCT, 2004
3. S. Kuta, Układy elektroniczne, Uczelniane Wydawnictwa Naukowo-Dydaktyczne AGH, Kraków, 1995

Secondary literature

1. P. Horowitz, W. Hill, Sztuka elektroniki, Wydawnictwo Komunikacji i Łączności, 2009
2. S. Kuta, Elementy i układy elektroniczne cz.2, Uczelniane Wydawnictwa Naukowo-Dydaktyczne AGH, Kraków, 2000

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Fundamentals of Electronic Design

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_W16	C01	Le_01-Le_08	ND_01-ND_05
PEK_W02	InzA_W02	C01, C03	Le_01-Le_08	ND_01- ND_05
PEK_U01 (skills)	K1MTR_MM_U01	C02	Le_01-Le_08	ND_03, ND_04
PEK_U02	InzA_U06	C02, C03	Le_01-Le_08	ND_01-ND_05
PEK_K01 (competences)	K1MTR_K03	C02	Le_01-Le_08	ND_03
PEK_K02	K1MTR_K04	C02	Le_01-Le_08	ND_03
PEK_K03	InzA_K02	C02, C03	Le_01-Le_08	ND_01-ND_05

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Zastosowanie optoelektroniki**	
Name in English:	**The Use of Optoelectronics**	
Main field of studies:	**Mechatronics**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**MCD036201**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Z		Z		
Number of ECTS points	1		1		
Including number of ECTS points for practical (P) classes	0		1		
Including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of physics (including geometric optics) and foundations of solid state physics
2. Completion of Fundamentals of Electrical Engineering course
3. Completion of Electronics Elements and Devices course

SUBJECT OBJECTIVES

C01 To familiarize students with the basic optical phenomena in semiconductors, including the transmission of light in semiconductors and optical fiber

C02 Students become acquainted with the structure, parameters and conditions of optoelectronic components

C03 Persisting the ability to work in a group

C04 Preparing to conduct research with applications using fiber optics, light emitters and detectors

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01   Student has ordered in terms of theoretical knowledge of photonics, including the knowledge necessary to understand the physical basis of optical components telecommunications track and knows areas of photonic systems application in particular in the automotive, energy and microsystems

PEK_W02   The student has a basic knowledge of the life cycle of the technical equipment, facilities, and systems

Relating to skills

PEK_U01   Student can use optical fiber systems and simple elements known in engineering practice

PEK_U02   The student is able to plan and carry out experiments, including measurements and computer simulations, interpret the acquired results and draw conclusions

Relating to social competences

PEK_K01   Student is able to interact and work in laboratory group, taking in her different roles

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Introduction to optoelectronics	1
Le_02	The basics of optical phenomena in semiconductors	2
Le_03	Optical fiber technique	3
Le_04	Light sources	2
Le_05	Photodetectors	2
Le_06	Basics of the solar cells	1
Le_07	Areas of application of optoelectronic devices	3
Le_08	Test	1
	TOTAL	15

Form of classes - Laboratory		Quantity
La_01	Attenuation of a multisegment optical fiber transmission system measurement	2
La_02	Study of the attenuation of optical fibers	2
La_03	Testing of optical polarizer	2
La_04	Investigation of spectrum characteristics of light sources	2
La_05	Investigation of matching efficiency of optical connectors in different transmission optical windows	2
La_06	Machine Vision for manufacturing quality assurance	2
La_07	Optical microscope and interferometry measurements for 2D/3D	2
La_08	Measurement of surface scattering and photometric light characteristics	2
La_09	Industrial laser technologies	2
La_10	Methods of laser beam measurement and process monitoring	2
La_11	Panels and solar cells	2
La_12	Optical fiber sensors	2
La_13	Optotelecommunication track	2

La_14	Optical fiber connection technology (welding of fiber optics, measurement of the geometry of the optical fiber)	2
La_15	Semiconductor lighting systems	2
	TOTAL	30

TEACHING TOOLS USED

ND_01 Traditional lecture with presentations and discussion
ND_02 Self work – independent studies and preparing for the test
ND_03 Tutorials
ND_04 Self study – preparation for laboratory class
ND_05 A brief test at the beginning of the laboratory activities

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Discussions, test
P2 = F2 (lab)	PEK_U01, PEK_U02, PEK_K01	Test at the beginning of the exercises, laboratory reports, evaluation class implementation exercises

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. B. Mroziewicz, M. Bugajski, Wł. Nakwaski, Lasery półprzewodnikowe, WNT, 1985
2. B. Ziętek, Optoelektronika, Wyd. UMK, 2004
3. J. E. Midwinder, Y. L. Guo, Optoelektronika i technika światłowodowa, WKŁ, 1995
4. J. I. Pankove, Zjawiska optyczne w półprzewodnikach, WNT, 1984
5. J. Piotrowski, A. Rogalski, Półprzewodnikowe detektory podczerwieni, WNT, 1985
6. Z. Bielecki, A. Rogalski, Detekcja sygnałów optycznych, WNT, 2001

Secondary literature

1. A. Smoliński, Optoelektronika światłowodowa, WKŁ, 1985
2. G. Einarsson, Podstawy telekomunikacji światłowodowej, WKŁ, 1983
3. J. Godlewski, Generacja i detekcja promieniowania optycznego, PWN, 1974
4. J. Hennel, Podstawy elektroniki półprzewodnikowej, WNT, 1986
5. J. Siuzdak, Wstęp do współczesnej telekomunikacji światłowodowej, WKŁ, 1997
6. K. Booth, S. Hill, Optoelektronika, WKŁ, 2001
7. M. Marciniak, Łączność światłowodowa, WKŁ, 1998

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

The Use of Optoelectronics

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_W30	C01, C02, C04	Le_01-Le_07	ND_01-ND_03
PEK_W02	InzA_W01	C01, C02, C04	Le_01-Le_07	ND_01-ND_03
PEK_U01 (skills)	K1MTR_U35	C02, C04	La_01-La_15	ND_01-ND_05
PEK_U02	InzA_U01	C02, C04	La_01-La_15	ND_01-ND_05
PEK_K01 (competences)	K1MTR_K03	C03	La_01-La_15	ND_02, ND_04

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Sensory i aktuatory**	
Name in English:	**Sensors and Actuators**	
Main field of studies:	**Mechatronics**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Optional**	**/ Faculty**
Subject code:	**MCD035101**	
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)	30		30		
Form of crediting	Z		Z		
Number of ECTS points	1		1		
Including number of ECTS points for practical (P) classes	0		1		
Including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
1. No requirements

SUBJECT OBJECTIVES
C01 Organization of knowledge in the fields of micromechanic sensors and actuators
C02 To familiarize oneself with basic properties of micromechanic sensors
C03 To familiarize oneself with methods and algorithms of analog and digital conditioning of signals from micromechanic sensors
C04 Preliminary preparation to conduct research in areas related to the integration and use of sensor systems using MEMS sensors

SUBJECT EDUCATIONAL EFFECTS
Relating to knowledge

PEK_W01   Has knowledge in the field of sensor techniques, knowledge necessary to understand physical and mechanical principles of operation of micromechanical sensors and actuators, knows dependencies between operation parameters and the construction, has knowledge of technology of micromechanical sensors

Relating to skills

PEK_U01   Is able to select and apply proper sensors to measure different physical parameters, and to apply the sensors in various measurement systems. Is able to present principle of operation and apply selected microsystems and sensor. Is able to verify proper operation of the sensor

PEK_U02   Is able to plan measurement experiment, to choose proper measurement devices and circuits, to estimate measurement errors and to work out results of experiment

PEK_U03   The student is able to plan and carry out experiments, including measurements and computer simulations, interpret the acquired results and draw conclusions

PEK_U04   The student is able to use the analytical, simulation and experimental methods for formulating and solving engineering tasks

PEK_U05   The student is able to see system and non-technical aspects of engineering tasks during their formulating and solving

Relating to social competences

PEK_K01   Realizes the significance and understands non-technical aspects and consequences of engineering activity and especially its influence on the natural environment and the related responsibility for decisions

PEK_K02   Is able to cooperate and work in a group, taking up different roles

PEK_K03   The student is aware of the importance and understands the non-technical aspects and results of engineering activity, including its impact on the environment, and the associated responsibility for made decisions

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Review of chosen methods of actuation and sensing utilized with MEMS	3
Le_02	Introduction to fundamental mechanics of microstructures, bending, tensing in various micromechanic structures	2
Le_03	Piezoresitive pressure sensor – principle of operation, construction	2
Le_04	Piezoresitive pressure sensor – parameters, conditioning of electric signal, examples of realizations	2
Le_05	Acceleration sensors, gyroscopes – principles of operation, construction, parameters and examples of realizations	2
Le_06	Micromachines as devices with various sensors and actuators	2
Le_07	Final colloquium	2
	TOTAL	15

Form of classes - Laboratory		Quantity
La_01	Piezoresitsive pressure sensor	3
La_02	Barometric altitude meter	3
La_03	XYZ accelerometer	3
La_04	E-compas	3
La_05	Simulation and optimization of the silicon membrane of the pressure sensor	3
	TOTAL	15

TEACHING TOOLS USED
ND_01 Lecture
ND_02 Laboratory exercises

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01	Discussions and final test
P2 = F2 (lab)	PEK_U01- PEK_U05, PEK_K01, PEK_K02	Partial tests and quizzes, lab reports

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. M. Bao, Analysis and Design Principles of MEMS Devices, Elsevier, 2005

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Sensors and Actuators

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_W15	C01-C03	Le_01-Le_06	ND_01
PEK_U01 (skills)	K1MTR_U03	C01-C03	La_01-La_05	ND_02
PEK_U01	K1MTR_U15	C01-C03	La_01-La_05	ND_02
PEK_U02	InzA_01	C01-C04	La_01-La_05	ND_02
PEK_U03	InzA_02	C01-C04	La_01-La_05	ND_02
PEK_U04	InzA_03	C01-C04	La_01-La_05	ND_02
PEK_U05	K1MTR_K02	C01-C03	Le_01-Le_06, La_01-La_05	ND_01, ND_02
PEK_K01 (competences)	KIMTR_K03	C01-C03	Le_01-Le_06, La_01-La_05	ND_01, ND_02
PEK_K02	InzA_K01	C01-C03	Le_01-Le_06, La_01-La_05	ND_01, ND_02
PEK_K03	K1MTR_W15	C01-C03	Le_01-Le_06	ND_01

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Modelowanie układów logicznych**	
Name in English:	**Logic Circuits Modelling**	
Main field of studies:	**Mechatronics**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Optional**	**/ Faculty**
Subject code:	**MCD035102**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Z		Z		
Number of ECTS points	1		2		
Including number of ECTS points for practical (P) classes	0		2		
Including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

No requirements

SUBJECT OBJECTIVES

C01 Understanding of logic circuits
C02 Gaining the skill of logic circuits modeling

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Knowledge of the logic circuits
PEK_W02 The student knows the area of logic circuits application and know how to model them
PEK_W03 The student knows the basic method, techniques, tools and materials used in solving simple engineering problems from the studied field of study
PEK_W04 The student knows the typical engineering technologies in the area of studied field of study

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Introduction to VLSI digital technology	2
Le_02	VHDL basics	2
Le_03	Modeling of combinational circuits	2
Le_04	Introduction to digital sequential circuits	2
Le_05	Modeling sequential circuits	2
Le_06	State machines	2
Le_07	Serial-to-parallel interface	2
Le_08	Final test	1
	TOTAL	15

Form of classes - Laboratory		Quantity
La_01	Introduction to VLSI digital technology	2
La_02	VHDL basics	2
La_03	Modeling of combinational circuits	2
La_04	Introduction to digital sequential circuits	2
La_05	Modeling sequential circuits	2
La_06	State machines	2
La_07	Serial-to-parallel interface	1
La_08	Final test	2
	TOTAL	15

TEACHING TOOLS USED

ND_01 Lecture with discussion
ND_02 Self - preparation for final test
ND_03 computer laboratory

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01-PEK_W04	Final test
P2 = F2 (lab)	PEK_U01-PEK_U04	Evaluation of the laboratory program implementation

PRIMARY AND SECONDARY LITERATURE
Primary literature
1. M. Zwoliński, Projektowanie układów cyfrowych z wykorzystaniem języka VHDL, WKŁ, 2007

SUBJECT SUPERVISOR
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Logic Circuits Modelling

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_W16, K1MTR_W24	C01, C02	Le_01-Le_08	ND_01, ND_02
PEK_W02	K1MTR_W16, K1MTR_W24	C01, C02	Le_01-Le_08	ND_01, ND_02
PEK_W03	InzA_W02	C01, C02	Le_01-Le_08	ND_01, ND_02
PEK_W04	InzA_W05	C01, C02	Le_01-Le_08	ND_01, ND_02
PEK_U01 (skills)	K1MTR_U14, K1MTR_U16	C01, C02	Le_03-Le_05, La_01-La_08	ND_01, ND_03
PEK_U02	K1MTR_U14, K1MTR_U16	C01, C02	Le_02-Le_07, La_01-La_08	ND_01, ND_03
PEK_U03	K1MTR_U14, K1MTR_U16	C01, C02	Le_02-Le_07, La_01-La_08	ND_01, ND_03
PEK_U04	InzA_U08	C01, C02	Le_02-Le_07, La_01-La_08	ND_01, ND_03
PEK_K01 (competences)	K1MTR_K03	C01, C02	La_01-La_08	ND_03

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish: **Mikrosystemy (MEMS)**

Name in English: **Microsystems (MEMS)**

Main field of studies: **Mechatronics**

Level and form of studies: **I level** / **Full time**

Kind of subject: **Obligatory** / **Faculty**

Subject code: **MCD036001**

Group of courses: **NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	E		Z		
Number of ECTS points	2		2		
Including number of ECTS points for practical (P) classes	0		2		
Including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

No requirements

SUBJECT OBJECTIVES

C01 Familiarizing students with the basics of micromachines technology with elements of nanotechnology, the basics of design and application of the modern microsensors, microsystems MEMS, MEOMS, microactuators and micromachines, also chosen solutions micro- and nanorobots

C02 Acquiring skills in working with selected microsystems

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Student has structured and theoretically founded knowledge of the operation, construction and basic parameters of the micromechanical actuators, sensors and certain mechanical and electrical microsystems

Relating to skills

PEK_U01	The student is able to formulate the principle of operation of selected micro, select and apply appropriate sensors to measure various physical quantities and use them in systems of measurement, monitoring, control
PEK_U02	The student is able to plan and carry out experiments, including measurements and computer simulations, interpret the acquired results and draw conclusions
PEK_U03	The student is able to use the analytical, simulation and experimental methods for formulating and solving engineering tasks
PEK_U04	The student is able to see system and non-technical aspects of engineering tasks during their formulating and solving

Relating to social competences

PEK_K01	Able to interact and work in a group, taking in the different roles

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	The scope of the lecture, the history of microsystems, the role and position in the market.Materials and technological basics: a review of the planar procedures	2
Le_02	Materials and technological basics: a review of the planar procedures	2
Le_03	Technological basics cont.: a review of procedures of the deep silicon micromechanics	2
Le_04	3D silicon structures: the use in the construction of micro-sensors and actuators	2
Le_05	Technological basics: LIGA and non-photolithographic methods microforming 3D	2
Le_06	Pressure sensors from a chip to encapsulated sensor: design, parameters, types, technical	2
Le_07	Movement in a microscale: static and dynamic microstructures	2
Le_08	The accelerometers, sensors of vibration, force, displacement, construction and usage	2
Le_09	Complex systems MEMS, MEOMS	2
Le_10	Basics of microfluidics, micromechanical components for the control and flow measurement; dispensers, mixers, micropumps, valves, etc.	2
Le_11	From microreactors to bio/med lab-chips and point-of-care systems	2
Le_12	The use of microsystems in technics: automotive, aviation, military technology, household appliances, etc.	2
Le_13	Micromachines; from simple static micro constructions to micro robots	2
Le_14	Nanosystems; technological base, examples of solutions, nanoelectronics 3D	2
Le_15	Summary, the development in the next 10 years. Test	2
	TOTAL	30

Form of classes - Laboratory		Quantity
La_01	The piezoresistive pressure sensor: modeling of silicon membranes, the basic element piezoresistive pressure sensor	3
La_02	The piezoresistive pressure sensor: measuring the deflection of the membrane of silicon using a fiber optic meter distance	3
La_03	The piezoresistive pressure sensor: measurement and determination of metrological parameters of the sensor and pressure sensor	3
La_04	Microscale flow management: gas micropump	3
La_05	Fiber optical MEMS switch	3
	TOTAL	15

TEACHING TOOLS USED	
ND_01	Lecture with presentation and discussion.
ND_02	Prepare for laboratory, short test the knowledge
ND_03	Consultation
ND_04	Own work - prepare for the test and the exam
ND_05	Analysis of the results and prepare of the report

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (lecture)	PEK_W01	Test
F2	PEK_W01	Exam
F3 (lab)	PEK_U01-PEK_U04, PEK_K01	Short tests at the beginning of the exercises, discussion.
F4	PEK_U01-PEK_U04, PEK_K01	Evaluation of the reports of the exercises.
P1 (lecture) = 0,5*(F1 + F2)		
P2 (lab) = 0,5*(F3 + F4)		

PRIMARY AND SECONDARY LITERATURE
Primary literature
1. J. Dziuban, Technologia i zastosowanie mikromechanicznych struktur krzemowych i krzemowo-szklanych w technice mikrosystemów, Oficyna Wydawnicza Politechniki Wrocławskiej, 2002
Secondary literature
1. Introduction to microsystem technology, Wiley, 2010
2. MacDouk, MEMS Handbook, MC, New York, 2009

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Microsystems (MEMS)

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_W15	C01	Le_01-Le_15	ND_01, ND_03, ND_04
PEK_U01 (skills)	K1MTR_U15	C02	La_01-La_05	ND_02, ND_05
PEK_U02	InzA_U01	C01, C02	La_01-La_05	ND_02, ND_05
PEK_U03	InzA_U02	C02-C04	La_01-La_05	ND_02, ND_05
PEK_U04	InzA_U03	C02-C04	La_01-La_05	ND_02, ND_05
PEK_K01 (competences)	K1MTR_K03	C02	La_01-La_05	ND_02, ND_05

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Podstawy projektowania układów elektronicznych**	
Name in English:	**Fundamentals of Electronic Design**	
Main field of studies:	**Mechatronics**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**MCD036002**	
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)				30	
Form of crediting				Z	
Number of ECTS points				1	
Including number of ECTS points for practical (P) classes				1	
Including number of ECTS points for direct teacher-student contact (BK) classes				0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of electrical engineering and analog technique
2. Basic knowledge of issues related to semiconductor devices

SUBJECT OBJECTIVES

C01 To acquaint students with basic electronic systems, properties and applications of electronic circuits
C02 To educate students how to select components of electronic circuits to realize defined engineering task
C03 Preliminary preparation to carry out the researches in fields related to micro- and nanoelectronics

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Students have systematic and theoretically founded knowledge of basic digital and analogue circuits
PEK_W02 The student knows the basic methods, techniques, tools and materials used in solving simple engineering problems from the studied field of study

Relating to skills

PEK_U01 Students are able to design electronic circuits responsible for measurement and acquisition of sensor signals and depending on the system complexity to conduct, test and characterize the fabricated analog and digital circuits

PEK_U02 The student is able to identify and formulate a specification of simple and practical engineering tasks, characteristic for the studied field of study

Relating to social competences

PEK_K01 Students are able to identify priorities needed to realise defined engineering task, connected with design, analysis and measurement of basic parameters of analog and digital circuits

PEK_K02 Students are able to identify which tasks are to realize individually or in group

PEK_K03 The student is able to think and act in an entrepreneurial way

PROGRAMME CONTENT		
Form of classes - Project		Quantity
Pr_01	Introduction, security training, regulations how to realise the project tasks, introduction to measurement experimental techniques	2
Pr_02	Discussion and valuation of block diagram of the designed linear and or analog electronic circuit	2
Pr_03	Design of schematic diagram of the constructed electronic circuit - Part I system supply and passive components	2
Pr_04	Design of schematic diagram of the constructed electronic circuit - Part II active components	2
Pr_05	Theoretical analysis of the designed circuit	2
Pr_06	Simulation of the designed circuit	2
Pr_07	Discussion and correction of mechanical setup of the designed electronic circuit	2
Pr_08	Introduction of list of project	2
Pr_09	Discussion on selected project tasks	2
Pr_10	Design of dedicated printed circuit board-Part I supply and passive components	2
Pr_11	Design of dedicated printed circuit board-Part II supply and active components	2
Pr_12	Fabrication of printed circuit board	2
Pr_13	Assembly of selected blocks of the designed electronic circuit	2
Pr_14	Launching of the fabricated system	2
Pr_15	Project presentation and defense	2
	TOTAL	30

TEACHING TOOLS USED
ND_01 Multimedia presentation
ND_02 Consultations
ND_03 Individual work – analysis of indicated project tasks
ND_04 Individual work – study of project related issues

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (project)	PEK_U01, PEK_U02, PEK_K01-PEK_K03	Written reports

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. J. Baranowski, G. Czajkowski, Układy analogowe nieliniowe i impulsowe, WNT, 2004
2. P. Górecki, Wzmacniacze operacyjne, Wydawnictwo BCT, 2004
3. S. Kuta, Układy elektroniczne, Uczelniane Wydawnictwa Naukowo-Dydaktyczne AGH, Kraków, 1995

Secondary literature

1. P. Horowitz, W. Hill, Sztuka elektroniki, Wydawnictwo Komunikacji i Łączności, 2009
2. S. Kuta, Elementy i układy elektroniczne cz.2, Uczelniane Wydawnictwa Naukowo-Dydaktyczne AGH, Kraków, 2000

SUBJECT SUPERVISOR
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Fundamentals of Electronic Design

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_W16	C01	Pr_01-Pr_04	ND_01, ND_02
PEK_W02	InzA_W02	C01, C03	Pr_01-Pr_14	ND_01-ND_04
PEK_U01 (skills)	K1MTR_MM_U01	C02	Pr_01-Pr_14	ND_02-ND_04
PEK_U02	InzA_U06	C01, C03	Pr_01-Pr_14	ND_01-ND_04
PEK_K01 (competences)	K1MTR_K03	C01	Pr_15	ND_02, ND_04
PEK_K02	K1MTR_K04	C01	Pr_15	ND_02, ND_04
PEK_K03	InzA_K02	C02, C03	Pr_01-Pr_14	ND_01-ND_04

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Projektowanie numeryczne konstrukcji mikroelektronicznych**	
Name in English:	**Numerical Design of Microelectronic Structures**	
Main field of studies:	**Mechatronics**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Optional**	**/ Faculty**
Subject code:	**MCD036101**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			60		
Form of crediting			Z		
Number of ECTS points			2		
Including number of ECTS points for practical (P) classes			2		
Including number of ECTS points for direct teacher-student contact (BK) classes			1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge on mathematics and physics
2. Basic knowledge on numerical methods
3. Basic computer skills and programming

SUBJECT OBJECTIVES

C01 To acquaint students with methods used in numerical prototyping of microelectronic structures such as: optimization, design of experiments, etc., and to acquire professional skills in typical computer programs, eg. finite element method (FlexPDE, Ansys), optimization and design for quality (GNumeric, PSPP)

C02 Skills consolidation of self work as well as in collaboration with other people and with available educational materials

C03 Subject is associated with the research work in the area of numerical prototyping of microelectronic structures

C04 Student knows typical methods, techniques and software tools used in microelectronic structures prototyping

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01   Student has a basic, orderly and theoretically founded knowledge on techniques, methods and numerical computer tools in order to design microelectronic structures

PEK_W02   Student knows and understands the basic numerical methods and tools used for numerical modeling of simple engineering tasks in the field of microelectronic structures design

Relating to skills

PEK_U01   Student is able to select appropriate methods and tools for computer-aided engineering, as FlexPDE, AutoDesk, Gnumeric, in order to apply numerical design for microelectronic structures

PEK_U02   Student is capable in order to prototype microelectronic structures appropriate tools and methods, both analytical and simulation based

Relating to social competences

PEK_K01   Can appropriately define the priorities for implementation of specified tasks either by himself or other

PEK_K02   Can distinguish and understand the technical and non-technical aspects of contemporary engineering activities

PROGRAMME CONTENT		
Form of classes - Laboratory		Quantity
La_01	Introduction to numerical prototyping	2
La_02	Introduction to numerical modelling in FlexPDE	2
La_03	Functions and equations – gravitational field	2
La_04	Electrostatic field - Poisson's / Laplace's equation	2
La_05	Analysis of electrical resistance problem	2
La_06	Analysis of stress and strain state	2
La_07	Analysis of heat transfer	2
La_08	Analysis of thermomechanical stresses and strains	2
La_09	Laminar and turbulent flows	2
La_10	Electromagnetic field	2
La_11	Response surface modelling	2
La_12	Optimization	2
La_13	Sensitivity analysis	2
La_14	Tolerance design	2
La_15	Individual project / Assessment	2
	TOTAL	30

TEACHING TOOLS USED
ND_01 Laboratory: 5-minutes introduction and 5-minutes introductory tests
ND_02 Consultation
ND_03 Individual work: preparation for laboratories
ND_04 Individual work: laboratory reports

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (lab)	PEK_W01, PEK_W02	Introductory laboratory tests
F2	PEK_U01, PEK_U02, PEK_K01, PEK_K02	Laboratory reports
P1 (laboratory) = 0,5*(F1 + F2)		

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Kreyszig E., Advanced Engineering Mathematics, John Wiley and Sons, 2006
2. Thompson E., Introduction to the Finite Element Method, John Wiley and Sons, 2005
3. Zienkiewicz O.C., Taylor R.L., The Finite Element Method: Volumes 1-3, Butterworth-Heinemann, London, 2000

Secondary literature

1. Montgomery D., Design and Analysis of Experiments, John Wiley and Sons, 2005
2. Montgomery D., Runger G., Applied Statistics and Probability for Engineers, John Wiley and Sons, 2007
3. William D., Materials Science and Engineering an Introduction, John Wiley and Sons, 2007

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Numerical Design of Microelectronic Structures

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_W22	C01, C02	La_01	ND_01, ND_02
PEK_W02	InzA_W02	C01, C02	La_01	ND_01, ND_02
PEK_U01 (skills)	K1MTR_ U22	C03	La_02-La_12	ND_03, ND_04
PEK_U02	InzA_U02	C04	La_02-La_12	ND_03, ND_04
PEK_K01 (competences)	K1MTR_K04, K1MTR_K05	C03	La_13-La_15	ND_03, ND_04

| PEK_K02 | InzA_K02 | C04 | La_13-La_15 | ND_03, ND_04 |

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Interdyscyplinarny projekt zespołowy**	
Name in English:	**Interdisciplinary team project**	
Main field of studies:	**Mechatronics**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Optional**	**/ Faculty**
Subject code:	**MCD036102**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				90	
Form of crediting				Z	
Number of ECTS points				3	
Including number of ECTS points for practical (P) classes				3	
Including number of ECTS points for direct teacher-student contact (BK) classes				2.1	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completion of any course related to semiconductor devices and electronic circuits
2. Completion of any course related to programming of microcontrollers

SUBJECT OBJECTIVES

C01 Acquiring skills of design, execution and measurements of analog electronic circuits
C02 Acquiring skills of programming and use of microprocessors and microcontrollers for engineering purposes
C03 Strengthening teamwork skills
C04 Preliminary preparation to carry out the researches in fields related to mechatronics

SUBJECT EDUCATIONAL EFFECTS

Relating to skills

PEK_U01 The student is able to design, run, and test electronic analog circuits.
PEK_U02 The student is able to program a microcontroller and to evaluate its functionality
PEK_U03 The student is able to plan and carry out experiments, including measurements and computer simulations, interpret the acquired results and draw conclusions

Relating to social competences

PEK_K01   The student is able to interact and work in a group , taking part in a variety of roles

PEK_K02   The student is aware of the importance and understands the non-technical aspects and results of engineering activity, including its impact on the environment, and the associated responsibility for made decisions

PROGRAMME CONTENT

Form of classes - Project		Quantity
Pr_01	Device project selection and development of the concept of its implementation	6
Pr_02	Electronic circuit simulation in LTspice and design in Eagle	4
Pr_03	Execution, commissioning and measurements of the electronic circuit	6
Pr_04	Microcontroller programming	4
Pr_05	Installation and commissioning of the complete mechatronic device	6
Pr_06	Report elaboration	4
	TOTAL	30

TEACHING TOOLS USED

ND_01   Own work - preparing for classes

ND_02   Report elaboration

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (project)	PEK_U01-PEK_U03, PEK_K01, PEK_K02	Team work evaluation, final test of the device

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. J. Izydorczyk, PSPICE, komputerowa symulacja układów elektronicznych, Helion, 1993
2. Atmel AVR XMEGA AU Manual – technical documentation

Secondary literature

1. Disscusion forum LTSpice, http://tech.groups.yahoo.com/group/LTspice/, Internet
2. Doliński J., Mikrokontrolery AVR w praktyce

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Interdisciplinary team project
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_U01 (skills)	K1MTR_U23, K1MTR_U36	C01, C02	Pr_01-Pr_06	ND_01, ND_02
PEK_U02	K1MTR_U16, K1MTR_U23	C01, C02	Pr_01-Pr_06	ND_01, ND_02
PEK_U03	InzA_U01	C01, C02, C04	Pr_01-Pr_06	ND_01, ND_02
PEK_K01 (competences)	K1MTR_K03	C03	Pr_01-Pr_06	ND_01, ND_02
PEK_K02	InzA_K01	C03, C04	Pr_01-Pr_06	ND_01, ND_02

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Metody przetwarzania sygnałów**	
Name in English:	**Methods of Signal Processing**	
Main field of studies:	**Mechatronics**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Optional**	**/ Faculty**
Subject code:	**MCD036103**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Z		Z		
Number of ECTS points	1		2		
Including number of ECTS points for practical (P) classes	0		2		
Including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
1.   Knowledge of mathematical analysis, linear algebra, probability and statistics

SUBJECT OBJECTIVES
C01   Learning of basic techniques of signal processing and analysis
C02   Learning of implementation of basic digital signal processing algorithms with script languages (offline processing)
C03   Bringing the need for application of digital techniques of signal processing and analysis to attention of students

SUBJECT EDUCATIONAL EFFECTS
Relating to knowledge
PEK_W01   Students will possess knowledge of processing and analysis of deterministic and stochastic signals in time and frequency domain
PEK_W02   The student knows the basic methods, techniques, tools and materials used in solving simple engineering problems from the studied field of study

Relating to skills

PEK_U01   Using scripting languages, student can analyze signals by means of the Fourier transform, design digital, band, FIR and IIR filters

PEK_U02   The student is able to use the analytical, simulation and experimental methods for formulating and solving engineering tasks

Relating to social competences

PEK_K01   Student will understand the necessity of using of signal processing techniques in engineering. He can predict results of a processing in a given engineering problem.

PEK_K02   The student is able to think and act in an entrepreneurial way

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Potential applications of signal processing techniques. Basic terms and definitions in time domain	2
Le_02	The family of Fourier transforms - representation of signals in frequency domain	2
Le_03	Linear systems, superposition principle, properties in time and frequency domain	2
Le_04	Test no. 1	2
Le_05	Laplace and Z transform in linear systems	2
Le_06	Analog to digital and digital to analog conversion - sampling, quantization, reconstruction and properties of DACs and ADCs	2
Le_07	Digital filtering - band filters design	2
Le_08	Test no. 2	1
	TOTAL	15

Form of classes - Laboratory		Quantity
La_01	Introductory classes, familiarizing with a development environment	3
La_02	Discrete Fourier Transform	3
La_03	DFT properties	3
La_04	Band finite impulse response filters (FIR)	3
La_05	Band infinite impulse response filters (IIR)	3
	TOTAL	15

TEACHING TOOLS USED
ND_01   Presentation with audiovisual aids
ND_02   Computer classes with scripting environment for engineering calculations
ND_03   Office hours
ND_04   Self-study - given issues preparation
ND_05   Self-study - preparation for classes
ND_06   Self-study and preparation for tests

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Tests no. 1 and 2
P2 = F2 (lab)	PEK_U01, PEK_U02, PEK_K02, PEK_K02	Assessment of preparations and work at the laboratory

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. J. Szabatin, Podstawy teorii sygnałów, WKŁ Warszawa, 2007
2. R.G. Lyons, Wprowadzenie do cyfrowego przetwarzania sygnałów, WKŁ Warszawa, 2007
3. S. W. Smith, Cyfrowe przetwarzanie sygnałów - praktyczny poradnik dla inżynierów i naukowców, BTC Warszawa, 2007

Secondary literature

1. A. Papoulis, Probability, Random Variables and Stochastic Processes, MacGraw-Hill, 1991
2. R.N. Bracewell, The Fourier Transform and Its Applications, MacGraw-Hill, 2000
3. V. K. Madisetti, D.B. Williams, Digital Signal Processing Handbook, Chapman&Hall/CRC, 1999

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Methods of Signal Processing

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_W21	C01	Le_01-Le_08	ND_01, ND_03, ND_04, ND_06
PEK_W02	InzA_W02	C01	Le_01-Le_08	ND_01, ND_03, ND_04, ND_06
PEK_U01 (skills)	K1MTR_U01	C02	La_01-La_05	ND_02, ND_05
PEK_U02	InzA_U02	C02	La_01-La_05	ND_02, ND_05
PEK_K01 (competences)	K1MTR_K06	C03	Le_01-Le_08, La_01-La_05	ND_03, ND_04, ND_06
PEK_K03	InzA_K02	C01-C03, C06	Le_01-Le_08, La_01-La_05	ND_03, ND_04, ND_06

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Mikrosystemy w medycynie**	
Name in English:	**Microsystems in Medicine**	
Main field of studies:	**Mechatronics**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Optional**	**/ Faculty**
Subject code:	**MCD036104**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Z		Z		
Number of ECTS points	1		1		
Including number of ECTS points for practical (P) classes	0		1		
Including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
No requirements

SUBJECT OBJECTIVES
C01 Familiarizing students with the design and operation of selected microsystems and possibilities of their application in biology and medicine, as well as devices and apparatus microsystems for specific tasks
C02 Learning how to work with the selected microsystems for specific tasks in biology/medicine
C03 Fusing ability to work independently and in a team
C04 Preliminary preparation to conduct research on the use of microsystems in biology and medicine

SUBJECT EDUCATIONAL EFFECTS
Relating to knowledge

PEK_W01 Student has a general knowledge of the structure and operation of the selected microsystem devices, and possibilities of their application in biology and medicine, he knows some devices and microsystem instruments for specific tasks in biology / medicine

Relating to skills

PEK_U01   Student can work with selected microsystem devices and instruments designed for specific tasks in biology / medicine

PEK_U02   Student is able to plan and carry out experiments, including measurements and computer simulations, interpret the acquired results and draw conclusions

PEK_U03   Student is able to use the analytical, simulation and experimental methods for formulating and solving engineering tasks

PEK_U04   The student is able to see system and non-technical aspects of engineering tasks during their formulating and solving

Relating to social competences

PEK_K01   Student is able to work independently and in laboratory group by adopting different roles

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Microtechnologies in molecular genetics	2
Le_02	Cardiac assist devices, artificial heart	2
Le_03	Artificial sense organs: electronic hearing, bionic eye	4
Le_04	Invasive and non-invasive microsystems for measuring blood pressure	2
Le_05	Tonometer, sensors and microsystems for medical diagnosis	1
Le_06	Lab-on-a-chips and biochips	2
Le_07	Test	2
	TOTAL	15

Form of classes - Laboratory		Quantity
La_01	Flow and mixing of the liquids in the microchannels	3
La_02	Dosing of micro- and nanovolumes with conductivity detection	3
La_03	Droplet microfluidic system	3
La_04	Microcytometer to study biological cells	3
La_05	Microsystems for measuring blood pressure	3
	TOTAL	15

TEACHING TOOLS USED

ND_01 Traditional lecture with the use of slides, and discussion
ND_02 Laboratory: short tests beginning laboratory
ND_03 Consultations
ND_04 Self study - preparation for laboratory exercises
ND_05 Self study - independent studies and prepare for test

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01	Test
P2 = F2 (lab)	PEK_U01-PEK_U04, PEK_K01	Short tests at the beginning of the laboratory classes, laboratory reports and participation in discussions

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. A. Manz, H. Becker, Microsystem technology in chemistry and life sciences, Springer-Verlag, 1999
2. James D. Watson & Francis Crick, Molecular structure of Nucleic Acids: A Structure for Deoxyribose Nucleic Acid, Nature, 1953
3. M. Sładek, Pediatria Współczesna, Gastroenterologia, Hepatologia i Ż ywienie Dziecka , 2008
4. Paul Berg, Maxine Singer, Język genów. Poznawanie zasad dziedziczenia, Prószyński i S-ka, 1997

Secondary literature

1. Journals: Sensors and Actuators, Journal of Micromechanics and Microengineering
2. A. Górecka-Drzazga, lecture notes

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Microsystems in Medicine

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_W15	C01	Wy_01-Wy_07	ND_01, ND_03, ND_05
PEK_U01 (skills)	K1MTR_U15	C02, C03	La_01-La_05	ND_02, ND_04
PEK_U02	InzA_U01	C02-C04	La_01-La_05	ND_02, ND_04
PEK_U03	InzA_U02	C02-C04	La_01-La_05	ND_02, ND_04
PEK_U04	InzA_U03	C02-C04	La_01-La_05	ND_02, ND_04
PEK_K01 (competences)	K1MTR_K03	C03	La_01-La_05	ND_04

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Mikrosystemy w motoryzacji**	
Name in English:	**Automotive Microsystems**	
Main field of studies:	**Mechatronics**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Optional**	**/ Faculty**
Subject code:	**MCD036105**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Z		Z		
Number of ECTS points	1		1		
Including number of ECTS points for practical (P) classes	0		1		
Including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1.   It is recommended to listen courses in semiconductor devices, electronics systems and metrology

SUBJECT OBJECTIVES

C01   To familiarize students with the basic microsystems (sensor systems), used in automotive engineering
C02   Introduction to the structure, working conditions and measurement of the main parameters used in the above-mentioned sensor systems
C03   Strengthening teamwork skills
C04   Preliminary preparation to carry out the researches in fields related to mechatronics

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01   Has the basic knowledge of the operation, construction, properties and characteristics of sensor systems and sensors (including intelligent and microsensors) used in vehicles
PEK_W02   The student knows the basic methods, techniques, tools and materials used in solving simple engineering problems from the studied field of study

Relating to skills

PEK_U01   Able to select and use the appropriate sensors to measure various physical quantities, investigate the fundamental characteristics of the sensors and use them to control systems and control vehicles

PEK_U02   The student is able to assess the usefulness of routine methods and tools used for solving of a simple and practical engineering task, characteristic for the studied field of study and to select and apply the appropriate method and tools

Relating to social competences

PEK_K01   Able to interact and work in a group (a group of laboratory), taking part in a variety of roles

PEK_K02   The student is aware of the importance and understands the non-technical aspects and results of engineering activity, including its impact on the environment, and the associated responsibility for made decisions

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Sensor systems for automotive - historical overview	2
Le_02	Fuel supply systems - tasks, principles of operation, sensors	2
Le_03	Ignition systems - tasks, principles of operation, sensors	2
Le_04	Combustion control systems of air-fuel mixture	2
Le_05	Microsystems for active and passive safety	3
Le_06	Microsystems for navigation and driver information	2
Le_07	Test	2
	TOTAL	15

Form of classes - Laboratory		Quantity
La_01	Lambda sensor for stoichiometric mixture	3
La_02	Sensors: throttle position, absolute pressure (MAP), oil pressure, fuel level	3
La_03	Sensors for the position and speed of the crankshaft	3
La_04	Accelerometers	3
La_05	Additional term	3
	TOTAL	15

TEACHING TOOLS USED
ND_01 Traditional lecture with the use of transparencies and slides ND_02 Self study – preparation for laboratory class ND_03 Report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Final test
P2 = F2 (lab)	PEK_U01, PEK_U02, PEK_K01	Partial tests and quizzes, lab reports

PRIMARY AND SECONDARY LITERATURE
Primary literature
1. Herner A., Elektronika w samochodzie, WKŁ Warszawa, 2001
2. Marek J., Sensors for Automotive Technology, Wiley-VCH, Darmstadt, 2003
3. Nwagboso Ch., Automotive Sensory Systems, Chapman&Hall, London, 1993
Secondary literature
1. Technical catalogue, Czujniki w pojazdach samochodowych, f-ma Bosch, 2002
2. Technical catalogue, Mikroelektronika w pojazdach, f-ma Bosch, 2002
3. Technical catalogue, Układy bezpieczeństwa i komfortu jazdy, f-ma Bosch, 2002

SUBJECT SUPERVISOR
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Automotive Microsystems

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K!MTR_W15	C01, C02	Le_01-Le_06	ND_01
PEK_W02	InzA_W02	C01, C02, C04	Le_01-Le_06	ND_01
PEK_U01 (skills)	K1MTR_U15	C01, C02	La_01-La_05	ND_02, ND_03
PEK_U02	InzA_U07	C01, C02, C04	La_01-La_05	ND_02, ND_03
PEK_K01 (competences)	K1MTR_K03	C03	La_01-La_05	ND_03
PEK_K02	InzA_K01	C03, C04	La_01-La_05	ND_03

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Fotonika**	
Name in English:	**Photonics**	
Main field of studies:	**Mechatronics**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Optional**	**/ Faculty**
Subject code:	**MCD036201**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Z		Z		
Number of ECTS points	1		2		
Including number of ECTS points for practical (P) classes	0		2		
Including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
1. Basic knowledge of Physics (including geometric optics) and fundamentals of the physics of solid-state
2. Successful completion of the course: Fundamentals of electrical engineering, Electronics Elements and Devices, Applications of the optoelectronics

SUBJECT OBJECTIVES
C01 To familiarize students with the basic optical phenomena in semiconductors, including the transmission of light in semiconductors and optical fiber, structure, parameters and conditions of optoelectronic components supply
C02 To familiarize with the semiconductor detectors and sources of light, their design and working conditions
C03 Persisting the ability to work in a group
C04 Pre-treatment of research that uses fiber optic, light emitters and detectors

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01   Student has ordered and supported in theory, knowledge of photonics, including the knowledge necessary to understand the physical basis of optical components and systems for application areas as well as student knows telecommunications optical track in particular in the automotive, energy and microsystems

PEK_W02   The student has a basic knowledge of the life cycle of the technical equipment, facilities, and systems

Relating to skills

PEK_U01   Student can use known methods and mathematical models as well computer simulations for the analysis and performance evaluation of optoelectronic components and simple optical fiber systems, student can correctly use the selected methods and facilities to enable the measurement of the basic parameters of elements and integrated optoelectronic. Student can develop documentation for implementation of engineering tasks and prepare a text containing an overview of the results of the implementation of this task

PEK_U02   The student is able to plan and carry out experiments, including measurements and computer simulations, interpret the acquired results and draw conclusions

PEK_U03   The student is able to use the analytical, simulation and experimental methods for formulating and solving engineering tasks

Relating to social competences

PEK_K01   Able to interact and work in a group of laboratory, taking in the different roles

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PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Introduction. Optical phenomena in semiconductor	1
Le_02	Color theory I	2
Le_03	Materials for optoelectronics	1
Le_04	Techniques for producing optoelectronic structures	2
Le_05	Optoelectronic lighting devices	2
Le_06	Displays	2
Le_07	Optoelectronics in technology	4
Le_08	Test	1
	TOTAL	15

Form of classes - Laboratory		Quantity
La_01	Introduction	3
La_02	Color theory I	3
La_03	Color theory II	3
La_04	Fiber Optics	3
La_05	Semiconductor light source characteristics	3
La_06	Light radiation detectors	3
La_07	Optocouplers	3
La_08	Solar cells I	3
La_09	Solar cells II	3
La_10	Make-up lab meeting	3
	TOTAL	30

TEACHING TOOLS USED

ND_01	Traditional lecture with presentations and discussion
ND_02	Laboratory: a short, 10-minute test at the beginning of the exercises
ND_03	Self work – preparing for the lab exercises
ND_04	Self work – independent studies and preparation for the test
ND_05	Tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01	Discussions and final test
P2 = F2 (lab)	PEK_U01-PEK_U03, PEK_K01	Test at the beginning of the exercises, laboratory reports, evaluation class implementation exercises

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. B. Mroziewicz, M. Bugajski, Wł. Nakwaski, Lasery półprzewodnikowe, WNT, 1985
2. B. Ziętek, Optoelektronika, Wyd. UMK, 2004
3. J. E. Midwinder, Y. L. Guo, Optoelektronika i technika światłowodowa, WKŁ, 1995
4. J. I. Pankove, Zjawiska optyczne w półprzewodnikach, WNT, 1984
5. J. Piotrowski, A. Rogalski, Półprzewodnikowe detektory podczerwieni, WNT, 1985
6. Z. Bielecki, A. Rogalski, Detekcja sygnałów optycznych, WNT, 2001

Secondary literature

1. A. Smoliński, Optoelektronika światłowodowa, WKŁ, 1985
2. G. Einarsson, Podstawy telekomunikacji światłowodowej, WKŁ, 1983
3. J. Godlewski, Generacja i detekcja promieniowania optycznego, PWN, 1974
4. J. Hennel, Podstawy elektroniki półprzewodnikowej, WNT, 1986
5. J. Siuzdak, Wstęp do współczesnej telekomunikacji światłowodowej, WKŁ, 1997
6. K. Booth, S. Hill, Optoelektronika, WKŁ, 2001
7. M. Marciniak, Łączność światłowodowa, WKŁ, 1998
8. R. Bacewicz, Optyka ciała stałego, Oficyna Wydawnicza Politechniki Warszawskiej, 1995

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Photonics

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_MM_W02	C01, C02, C04	Wy_01-Wy_08	ND_01-ND_05
PEK_W02	InzA_W01	C01, C02, C04	Wy_01-Wy_08	ND_01-ND_05
PEK_U01 (skills)	K1MTR_MM_U02	C01-C04	La_01-La_10	ND_02, ND_03, ND_05
PEK_U02	InzA_U01	C04	La_01-La_10	ND_02, ND_03, ND_05
PEK_U03	InzA_U02	C04	La_01-La_10	ND_02, ND_03, ND_05
PEK_K01 (competences)	K1MTR_K03	C03, C04	La_01-La_10	ND_01-ND_05

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Mikro- i nanoelektronika**	
Name in English:	**Micro- Nano- Electronics**	
Main field of studies:	**Mechatronics**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Optional**	**/ Faculty**
Subject code:	**MCD036202**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Z				
Number of ECTS points	2				
Including number of ECTS points for practical (P) classes	0				
Including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge in physics
2. Basic knowledge in chemistry
3. Basic knowledge in mathematics

SUBJECT OBJECTIVES

C01   Acquaint students with fabrication techniques modern micro- and nano-electronic circuits and elements
C02   Acquaint students with the properties of elements fabricated using micro- and nanoelectronic techniques
C03   Acquaint students with state of the art and development trends of micro- and nanoelectronic technologies
C04   Preliminary preparation to carry out the researches in fields related to mikro- and nanoelectronics

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01	Student has ordered and theoretically grounded knowledge concerning materials, technology, structure as well as specific electrical properties and stability of classical and modern components and passive elements of electronic circuits in mechatronic systems
PEK_W02	Student knows and understands technological processes associated with the fabrication of micro- and nano-devices used in mechatronics. Is familiar with the current state and developing trends in micro- and nano-electronic technologies
PEK_W03	The student knows the basic methods, techniques, tools and materials used in solving simple engineering problems from the studied field of study
PEK_W04	The student knows the typical engineering technologies in the area of studied field of study

Relating to skills

PEK_U01	Student is able to design a technological process for the fabrication of an basic electronic element device
PEK_U02	The student is able to use the analytical, simulation and experimental methods for formulating and solving engineering tasks
PEK_U03	The student is able to identify and formulate a specification of simple and practical engineering tasks, characteristic for the studied field of study

Relating to social competences

PEK_K01	Student understands the need and knows the possibilities of lifetime learning process (2-nd and 3-rd level studies, post- graduate studies, courses) in raising the professional, personal and social competences
PEK_K02	Student correctly recognizes and settles dilemmas associated with performing professional activities; is conscious of the social role of technical university graduates. Understands the need to formulate and share in society the information concerning technical achievements and other aspects of engineering activity; is able to share such information and opinion in a clear way, justifying various points of view
PEK_K03	The student is aware of the importance and understands the non-technical aspects and results of engineering activity, including its impact on the environment, and the associated responsibility for made decisions

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Introduction, technology roadmap of modern semiconductor technology, overview of basic processes of micro- and nanotechnology	2
Le_02	Advanced micro- and nano-lithographic techniques (photolithography, electron-beam lithography, X-ray lithography, ion-beam lithography, nanoimprint, interference lithography, scanning probe lithography)	2
Le_03	Doping of layers: diffusion and ion implantation, annealing (RTA)	2
Le_04	Wafer cleaning, dry and wet etching of layers and MEMS and NEMS	2
Le_05	Metallic contact and interconnects fabrication (silicides, AL, Cu), thin layers materials for diffusion barriers and etch stop layers	2
Le_06	Properties of individual nanoparticles, carbon nanotubes, carbon nanotube transistor	2
Le_07	Fundamentals of Thick and Thin Film technology	2
Le_08	Wafer fabrication (doped silicon, strained silicon, SiGe, SOI and SON technologies) silicon epitaxy	2
Le_09	Thermal oxidation of silicon, dielectric layers and polysilicon fabrication by LPCVD, high-k and low-k dielectric, ULK porous materials	2
Le_10	Design rules of Thick Film elements	2
Le_11	High temperature Thick Film - materials, processes, properties, applications	2

Le_12	Polymer Thick Film - materials, processes, properties, applications	2
Le_13	LTCC (Low Temperature Cofired Ceramics) technology - materials, processes, properties	2
Le_14	Application of LTCC in microelectronics and microsystems	2
Le_15	Future trends of micro- nanotechnologies	2
	TOTAL	30

TEACHING TOOLS USED
ND_01 Lecture ND_02 Multimedia presentation ND_03 Consultations

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01-PEK_W04	Partial test at the end of the lecture no. 8 and 15

PRIMARY AND SECONDARY LITERATURE
Primary literature 1. A. Dziedzic, Grubowarstwowe rezystywne mikrokompozyty polimerowo-węglowe, Oficyna Wydawnicza Politechniki Wrocławskiej, 2001 2. L. Golonka, Zastosowanie ceramiki LTCC w mikroelektronice, Oficyna Wydawnicza Politechniki Wrocławskiej, 2001 3. S. Dimitrijev, Understanding Semiconductor Devices, OUP, USA, 2000 4. T. Norio, Nanotechnology: Integrated Processing Systems for Ultra-Precision and Ultra-Fine Products, OUP, England, 2000

SUBJECT SUPERVISOR
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Micro- Nano- Electronics

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_MM_W01	C01, C02	Le_01-Le_15	ND_01-ND_03
PEK_W02	K1MTR_MM_W03	C01, C03	Le_01-Le_15	ND_01-ND_03

PEK_W03	InzA_W02	C01, C03, C04	Le_01-Le_15	ND_01-ND_03
PEK_W04	InzA_W05	C01, C04	Le_01-Le_15	ND_01-ND_03
PEK_U01 (skills)	K1MTR_U18	C01-C03	Le_01-Le_15	ND_01-ND_03
PEK_U02	InzA_U02	C01, C04	Le_01-Le_15	ND_01-ND_03
PEK_U03	InzA_U06	C04	Le_01-Le_15	ND_01-ND_03
PEK_K01 (competences)	K1MTR_K01	C01-C03	Le_01-Le_15	ND_01-ND_03
PEK_K02	K1MTR_K03	C01-C03	Le_01-Le_15	ND_01-ND_03
PEK_K03	InzA_K01	C04	Le_01-Le_15	ND_01-ND_03

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish: **Praktyka zawodowa**

Name in English: **Student's practice**

Main field of studies: **Mechatronics**

Level and form of studies: **I level** / **Full time**

Kind of subject: **Obligatory** / **Faculty**

Subject code: **MCD030002**

Group of courses: **NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					
Number of hours of total student workload (CNPS)					
Form of crediting					
Number of ECTS points					
Including number of ECTS points for practical (P) classes					
Including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
No requirements

SUBJECT OBJECTIVES
C01 Presentation of the using knowledge which was learned
C02 Presentation of working company

SUBJECT EDUCATIONAL EFFECTS

Relating to skills

PEK_U01 Have got knowledge how choose materials, parts and construction of devices for technical demands and utilization conditions
PEK_U02 Have got knowledge how to use safety instructions

Relating to social competences

PEK_K01 Is working independent and with team.
PEK_K02 The student is able to think and act in an entrepreneurial way

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1	PEK_U1, PEK_U02, PEK_K01, PEK_K02	Opinion of the practice administrator

SUBJECT SUPERVISOR
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Student's practice
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_U01 (skills)	K1MTR_U04	C01, C02		
PEK_U02	K1MTR_U29	C01, C02		
PEK_K01 (competences)	K1MTR_K02	C01, C02		
PEK_K02	K1MTR_K03	C01, C02		

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Seminarium dyplomowe**	
Name in English:	**Diploma Seminar**	
Main field of studies:	**Mechatronics**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Optional**	**/ Faculty**
Subject code:	**MCD037001**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					30
Number of hours of total student workload (CNPS)					60
Form of crediting					Z
Number of ECTS points					2
Including number of ECTS points for practical (P) classes					2
Including number of ECTS points for direct teacher-student contact (BK) classes					1.4

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
1. ECTS credit no greater than it is due to the resolution of the Council of the Faculty

SUBJECT OBJECTIVES
C01 Persisting the ability to work in a group
C02 Preparing to conduct research in the field of mechatronics

SUBJECT EDUCATIONAL EFFECTS
Relating to knowledge
PEK_W01 The student has an ordered and build on the theory, knowledge of required study Mechatronics

Relating to skills
PEK_U01 Student can present their own skills with a range of knowledge, skills and social competences typical for the direction of Mechatronics

Relating to social competences

PEK_K01   Student is able to think and act in a way that is creative and enterprising, he can interact and work in a group

PROGRAMME CONTENT

	Form of classes - Lecture	Quantity
Se_01	Introduction to the course	1
Se_02	Information about diploma work and diploma exam - requirements	1
Se_03	Overview and scope of the topics diploma works foreseen and the rules for creating the correct technical and scientific texts	4
Se_04	Multimedia presentations, CV (expanded version), discussion	4
Se_05	Discussion of the issues concerning diploma exam, comments	8
Se_06	Multimedia presentations of the diploma works, discussion	6
Se_07	Presentation and preparations for the diploma exam	4
Se_08	Summary of coursework and grading	2
	TOTAL	30

TEACHING TOOLS USED

ND_01 Presentation of selected issues relating to the thesis and discussion
ND_02 Preparing a multimedia presentation on the task issues - self work
ND_03 Independent study and preparation for diploma thesis final exam - self work
ND_04 Tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (sem)	PEK_W01	The nature and quality of the presentation of the given topics
F2	PEK_U01, PEK_K01	The ability to discuss the issues raised in the discussion, activity in the course classes
P1 (seminar) = F1 + F2		

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Rules of studies at Wroclaw University of Technology

2. Publications from the scope of the thesis carried out

3. Lecture materials and other carried out courses

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Diploma Seminar

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_W01-K1MTR_W28 K1MTR_MM_W01-K1MTR_MM_W06	C01, C02	Se_03-Se_07	ND_01, ND_02, ND_04
PEK_U01 (skills)	K1MTR_U01-K1MTR_U33, K1MTR_MM_U01-K1MTR_MM_U06	C01, C02	Se_03-Se_07	ND_01, ND_02, ND_04
PEK_K01 (competences)	K1MTR_K03	C01	Se_02-Se_07	ND_01-ND_03

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Praca dyplomowa**	
Name in English:	**Diploma Thesis**	
Main field of studies:	**Mechatronics**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Optional**	**/ Faculty**
Subject code:	**MCD037002**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					
Number of hours of total student workload (CNPS)					
Form of crediting					
Number of ECTS points					
Including number of ECTS points for practical (P) classes					
Including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1.   ECTS deficit no greater than it is due to the resolution of the Faculty Council

SUBJECT OBJECTIVES

C01   Conduct by the student thesis on the basis of the acquired while studying structured, underpinned by the theory of general and detailed knowledge with a range of science and technical areas relevant to the direction of Mechatronics
C02   Writing by a student
C03   Persisting the ability to work independently and in a team
C04   Preparing to conduct research in the field of mechatronics

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge
PEK_W01   Made the thesis based on gained knowledge during his studies for the direction of Mechatronics

Relating to skills	
PEK_U01	Student can create technical texts ("thesis") and multimedia presentations from the scope of the field of the Mechatronics

Relating to social competences	
PEK_K01	Student can work independently and interact in a group, taking different roles

TEACHING TOOLS USED

ND_01	Presentation of selected issues relating to the thesis and discussion
ND_02	Own work - study of literature from the scope of the topic of the thesis and research work
ND_03	Own work - writing technical and scientific text controlled by the promoter
ND_04	Consultation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1	PEK_W01, PEK_U01, PEK_K01	Tests, discussions

PRIMARY AND SECONDARY LITERATURE

Primary literature
1. Different authors, literature agreed with the promoter

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Diploma Thesis

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_W01-K1MTR_W28 K1MTR_MM_W01-K1MTR_MM_W06	C01, C04		ND_01, ND_02, ND_04
PEK_U01 (skills)	K1MTR_U01-K1MTR_U33, K1MTR_MM_U01-K1MTR_MM_U06	C02, C04		ND_01, ND_02, ND_04
PEK_K01 (competences)	K1MTR_K03	C03		ND_01-ND_03

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Mikro- i nanoelektronika**	
Name in English:	**Micro- Nano- Electronics**	
Main field of studies:	**Mechatronics**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Optional**	**/ Faculty**
Subject code:	**MCD037201**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			15		
Number of hours of total student workload (CNPS)			60		
Form of crediting			Z		
Number of ECTS points			2		
Including number of ECTS points for practical (P) classes			2		
Including number of ECTS points for direct teacher-student contact (BK) classes			1,4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge in physics
2. Basic knowledge in chemistry
3. Basic knowledge in mathematics

SUBJECT OBJECTIVES

C01 Acquaint students with fabrication techniques of modern micro- and nano-electronic circuits and elements
C02 Acquaint students with the properties of elements fabricated using micro- and nanoelectronic techniques
C03 Acquaint students with state of the art and development trends of micro- and nanoelectronic technologies
C04 Preliminary preparation to carry out the researches in fields related to mikro- and nanoelectronics

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01   Student knows and understands technological processes associated with the fabrication of micro- and nano- devices used in mechatronics. Is familiar with the current state and developing trends in micro- and nano electronic technologies

PEK_W02   The student knows the basic methods, techniques, tools and materials used in solving simple engineering problems from the studied field of study

PEK_W03   The student knows the typical engineering technologies in the area of studied field of study

Relating to skills

PEK_U01   Student is able to design a technological process for the fabrication of an electronic device, taking into account assumed application and economic criteria, with the use of proper methods, techniques, tools and materials

PEK_U02   Student is able to obtain thin-films with desired electrical properties and assess the influence of technological parameters on the values of these properties

PEK_U03   The student is able to use the analytical, simulation and experimental methods for formulating and solving engineering tasks

PEK_U04   The student is able to identify and formulate a specification of simple and practical engineering tasks, characteristic for the studied field of study

Relating to social competences

PEK_K01   Student is able to co-operate and work in a team, taking up different roles

PEK_K02   Student is able to define priorities in realization of a task established by self or someone else

PEK_K03   The student is aware of the importance and understands the non-technical aspects and results of engineering activity, including its impact on the environment, and the associated responsibility for made decisions

PROGRAMME CONTENT

Form of classes - Laboratory		Quantity
La_01	Clean room - operation, construction, maintenance, basic technologies	3
La_02	Bonding and characterisation of fabricated semiconductor device	3
La_03	Selected thick films technologies	3
La_04	Fabrication of multilayered LTCC systems	3
La_05	Modern techniques of pattern fabricationcreation	3
	TOTAL	15

TEACHING TOOLS USED

ND_01   Consultation

ND_02   Laboratory experiment

ND_03   Unassisted preparation of the students to the laboratory

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (lab)	PEK_U01-PEK_U04	Short test before the laboratory
F2	PEK_U01, PEK_K01-PEK_K03	Evaluation of the prepared report
P1 (laboratory) = 0,5*(F1 + F2)		

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. A. Dziedzic, Grubowarstwowe rezystywne mikrokompozyty polimerowo-węglowe, Oficyna Wydawnicza Politechniki Wrocławskiej, 2001
2. L. Golonka, Zastosowanie ceramiki LTCC w mikroelektronice, Oficyna Wydawnicza Politechniki Wrocławskiej, 2001
3. Marc J. Madou, Fundamentals of Microfabrication and Nanotechnology, Third Edition, Boca Raton, USA, 2011

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Micro- Nano- Electronic

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_W42	C01-C03	La_01-La_05	ND_01-ND_03
PEK_W02	InzA_W02	C01-C04	La_01-La_05	ND_01-ND_03
PEK_W03	InzA_W05	C01-C04	La_01-La_05	ND_01-ND_03
PEK_U01 (skills)	K1MTR_U18	C01-C03	La_01-La_05	ND_01-ND_03
PEK_U02	K1MTR_U18	C01-C03	La_01-La_05	ND_01-ND_03
PEK_U03	InzA_U02	C01-C04	La_01-La_05	ND_01-ND_03
PEK_U04	InzA_U06	C01-C04	La_01-La_05	ND_01-ND_03
PEK_K01 (competences)	K1MTR_K03, K1MTR_K04	C01-C03	La_01-La_05	ND_01-ND_03
PEK_K02	K1MTR_K03, K1MTR_K04	C01-C03	La_01-La_05	ND_01-ND_03
PEK_K03	InzA_K01	C01-C04	La_01-La_05	ND_01-ND_03

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Metody numeryczne**	
Name in English:	**Numerical Methods**	
Main field of studies:	**Mechatronics**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Optional**	**/ Faculty**
Subject code:	**MCD037202**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	
Number of hours of total student workload (CNPS)				60	
Form of crediting				Z	
Number of ECTS points				2	
Including number of ECTS points for practical (P) classes				2	
Including number of ECTS points for direct teacher-student contact (BK) classes				1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge on basics of mathematics and physics
2. Knowledge on basics of computer programming
3. Basic computer skills

SUBJECT OBJECTIVES

C01 To familiarize students with the basic numerical algorithms and methods used in engineering including restrictions, disadvantages and advantages of numerical techniques. In addition, gaining skills in using the Python scripting language

C02 Consolidation ability to work independently and in collaboration with the available educational materials

C03 The course is connected with the research activities in the area of numerical prototyping

C04 Application of numerical methods for solving simple engineering problems

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Has a basic, orderly and theoretically founded knowledge on the numerical methods used in engineering. The scope of knowledge includes an analysis of errors, methods, numerical differentiation and integration, solving systems of linear and nonlinear equations, interpolation and approximation methods, algorithms, single- and multicriteria optimization and design of experiments methods

PEK_W02 Knows and understands the basic numerical methods and tools for solving typical engineering problems

Relating to skills

PEK_U01 Is able to select and apply in a practical way right tools, programs, methods and numerical algorithms to solve typical problems in the field of numerical prototyping in engineering. Additionally, is able to interpret the results, and use the appropriate methods for validation of measurement results

PEK_U02 Student is able to plan experiments and numerical simulations including interpretation of the acquired results and draw conclusions

Relating to social competences

PEK_K01 Can appropriately define the priorities for implementation of specified tasks

PEK_K02 Can properly distinguished and understand technical and none technical aspects of a contemporary engineering

PROGRAMME CONTENT

	Form of classes - Project	Quantity
Pr_01	Introduction to numerical methods and engineering computing with Python programming language	2
Pr_02	Numerical computing errors - sources and types	2
Pr_03	Numerical differentiation and integration	2
Pr_04	Linear and nonliner equations and set of equations	2
Pr_05	Interpolation, approximation and extrapolation	2
Pr_06	Optimization and design of experiments	2
Pr_07	Partial differential equations	2
Pr_08	Individual project / Assessment	1
	TOTAL	15

TEACHING TOOLS USED

ND_01 Laboratory: 5-minutes introduction and 5-minutes introductory tests
ND_02 Consultation
ND_03 Individual work: preparation for laboratories
ND_04 Individual work: laboratory reports

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (project)	PEK_W01, PEK_W02, PEK_U01, PEK_U02, PEK_K01, PEK_K02	Short tests and lab reports

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Feynmann R.P., Feynmana wykłady z fizyki, tom I i II, PWN, 1968
2. Janowski WE., Matematyka, tom I i II, PWN,1968
3. Volk W., Statystyka stosowana dla inżynierów, WNT, 1973

Secondary literature

1. Kreyszig E., Advanced Engineering Mathematics, John Wiley and Sons, 2006
2. Montgomery D., Design and Analysis of Experiments, John Wiley and Sons, 2005
3. Pang T., An Introduction to Computational Physics, Cambridge University Press, 2006

SUBJECT SUPERVISOR
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Numerical Methods

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_MM_W04	C01, C02	Pr_01	ND_01, ND_02
PEK_W02	InzA_W02	C01, C02	Pr_01	ND_01, ND_02
PEK_U01 (skills)	K1MTR_MM_U04	C03, C04	Pr_02-Pr_07	ND_03, ND_04
PEK_U02	InzA_U01	C03, C04	Pr_02-Pr_07	ND_03, ND_04
PEK_K01 (competences)	K1MTR_K01, K1MTR_K04	C03, C04	Pr_08	ND_03, ND_04
PEK_K02	InzA_K01	C03, C04	Pr_08	ND_03, ND_04

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Montaż zespołów elektronicznych i fotonicznych**
Name in English:	**Packaging of Electronic and Photonics**
Main field of study:	**Mechatronics**
Level and form of studies:	**I level / Full time**
Kind of subject:	**Optional / Faculty**
Subject code:	**MCD037203**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Z		Z		
Number of ECTS points	2		1		
Including number of ECTS points for practical (P) classes	0		1		
Including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The knowledge gained in this course: Electronic Components

SUBJECT OBJECTIVES

C01 Mastery of theoretical knowledge specified in Wy_01-Wy_09
C02 Gaining practical skills through laboratory tasks L_01-L_06
C03 Able to work in a group of laboratory, taking in the different roles

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Structured and theoretical knowledge in the field of electronic packaging allows independent design of electronic systems based on the available electronic components and packaging techniques
PEK_W02 The knowledge of electronic packaging allows independent performance electronic systems

Relating to skills

PEK_U01   Ability for proper selection and applying the techniques of electronic packaging according to the design requirements and reliability made devices

Relating to social competences

PEK_K01   Ability for setting priorities in the use of adequate techniques for of electronic packaging
PEK_K02   Ability for cooperation and work in a group of laboratory, taking in the different roles

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	The scope of the lecture; packaging levels	1
Le_02	Elements and architecture of connections	2
Le_03	Substrates. Printed circuit boards	2
Le_04	Wire bonding	1
Le_05	Flip chip bonding	2
Le_06	Soldering technology	2
Le_07	Adhesives for packaging; materials and technology	2
Le_08	Connections and connectors	1
Le_09	Environmental exposure, heat dissipation problems	1
Le_10	Completion of the course	1
	SUM	15

Form of classes - Laboratory		Quantity
La_01	Introduction to laboratory classes, health and safety regulations	2
La_02	Surface mount technology	3
La_03	The use of electrically conductive adhesives for electronic packaging	3
La_04	The study of mechanical strength of solder and adhesive joints	3
La_05	The study of ionic contamination introduced in the packaging processes	3
La_06	Completion of the course	1
	SUM	15

TEACHING TOOLS USED
ND_01 Lecture with multimedia presentations and discussion
ND_02 Laboratory: a brief 10-minute introduction to the course and knowledge test
ND_03 Consultation
ND_04 Self-study and preparation for test
ND_05 Self-study and preparation for laboratory classes

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture	PEK_W01	Final test
P2 = F 2 (lab)	PEK_W02, PEK_U01, PEK_K01, PEK_K02	Summary results of the work carried out within the framework of the laboratory

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. J. Felba, Montaż w elektronice, Oficyna Wydawnicza Politechniki Wrocławskiej, 2010

SECONDARY LITERATURE

1. K. Bukat, H. Hackiewicz, Lutowanie bezołowiowe, Wydawnictwo BTC, Warszawa, 2007
2. R. Kisiel, Podstawy technologii dla elektroników, Wydawnictwo BTC Korporacja, 2012

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Packaging of Electronic and Photonics Systems

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_W18	C01	Le_01-Le_09	ND_01, ND_03, ND_04
PEK_W02	K1MTR_W18	C02	La_01-La_05	ND_02, ND_03, ND_05
PEK_U01 (skills)	K1MTR_U18	C01, C02	Le_01-Le_09, La_01-La_05	ND_01-ND_05
PEK_K01 (competences)	K1MTR_K04	C01, C02	Le_01-Le_09, La_01-La_05	ND_01-ND_05
PEK_K02	K1MTR_K03	C03	La_01-La_05	ND_02, ND_03, ND_05

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Urządzenia peryferyjne systemów komputerowych**
Name in English:	**Peripheral Devices in Computer Systems**
Main field of studies:	**Mechatronics**
Level and form of studies:	**I level** / **Full time**
Kind of subject:	**Optional** / **Faculty**
Subject code:	**MCD037204**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Z			Z	
Number of ECTS points	2			1	
Including number of ECTS points for practical (P) classes	0			1	
Including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic PC computer skills
2. Basic knowledge in the field of information technology and information transmission

SUBJECT OBJECTIVES

C01 Mastering the intermediate level of knowledge of the principles of operation and maintenance of peripheral devices used in computer systems

C02 Knowledge and skill in standard modes of communication with PC peripherals, principles of data transmission, processing and collection

C03 Preparing students to carry out research in the field of digital electronics, mechatronics, electronic and optoelectronic sensors

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Theoretical and practical knowledge of a wide range of peripheral devices used in computer systems

Relating to skills

PEK_U01 Ability to use and practical application of peripherals, including advanced acquisition and data systems

PEK_U02 The student is able to plan and carry out experiments, including measurements and computer simulations, interpret the acquired results and draw conclusions

PEK_U03 The student is able to use the analytical, simulation and experimental methods for formulating and solving engineering tasks

Relating to social competences

PEK_K01 The student is able to interact and work in a project group, assuming different roles in the project

PROGRAMME CONTENT

	Form of classes - Lecture	Quantity
Le_01	Classification of peripheral computer systems, integration of peripheral devices in computer systems - interfaces and control protocols	3
Le_02	Monitors and graphics adapters	3
Le_03	Data storage. Physical rules for recording information on a different medium	3
Le_04	Graphics devices. Ways to create characters and graphics	3
Le_05	Sound cards - digital recording and sound synthesis	3
Le_06	Keyboard and pointing devices	3
Le_07	Wired communication interfaces	3
Le_08	Wireless communication interfaces	3
Le_09	The measuring equipment running on ISA, PCI, PCI Express busses.	3
Le_10	Test	3
	TOTAL	30

	Form of classes - Project	Quantity
Pr_01	The development of theoretical assumptions of the proposed device	4
Pr_02	Carrying out computer simulation of the designed device	4
Pr_03	The preparation of documentation of designed device	7
	TOTAL	15

TEACHING TOOLS USED

ND_01 Traditional lecture supported by presentations and interactive elements of the knowledge evaluation
ND_02 Proof test in the mid of the course
ND_03 Laboratory: short, 10-minute tests on the beginning of the exercises
ND_04 Own work - preparation for laboratory exercises
ND_05 Self-study and preparation for test
ND_06 Consultations
ND_07 Final test

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01	Final written test

P2 = F2 (project)	PEK_U01-PEK_U03, PEK_K01	Assessment of the performed exercises, evaluating the effectiveness of the implementation of exercises

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Halsall F., Data Communications, Computer Networks and Open Systems, Addison-Wesley, 1992
2. Kolan Z., Urządzenia techniki komputerowej, SCREEN, Wrocław, 1994
3. Kolan Z., Urządzenia peryferyjne mikrokomputerów, CWK, Wrocław, 1992
4. Rembold U., Armbruster K., Ulzmann W., Interface technology for computer controlled manufacturing processes,, Marcel Dekker Inc., New York, 1983
5. Smith N., Drukarki laserowe HP Laser Jet, MIKOM, 1995
6. Wojtuszkiewicz K., Urządzenia techniki komputerowej, Cz.2 Urządzenia peryferyjne i interfejsy, MIKOM, 2007

Secondary literature

1. Gniadek K., Optyczne przetwarzanie informacji, PWN, Warszawa, 1992
2. Kopacz T., Karty graficzne VGA i SVGA, MIKOM, 1995
3. Prendergast R., Brekke D., Modemy, krótki kurs, ZNI MIKOM, 1996

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Peripheral Devices in Computer Systems

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_MM_W02	C01-C03	Le_01-Le_10	ND_01, ND_02, ND_05, ND_06
PEK_U01 (skills)	K1MTR_MM_U02	C03	Pr_01-Pr_03	ND_03, ND_04, ND_06
PEK_U02	InzA_U01	C03	Pr_01-Pr_03	ND_03, ND_04, ND_06
PEK_U03	InzA_U02	C01-C03, C06	Pr_01-Pr_03	ND_03, ND_04, ND_06
PEK_K01 (competences)	K1MTR_K03	C04, C05	Pr_01-Pr_03	ND_03, ND_04, ND_06

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Fizyka 1.2**	
Name in English:	**Physics 1.2**	
Main field of studies:	**Mechatronics**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**FZP001058**	
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)	120	60			
Form of crediting	E	Z			
Number of ECTS points	4	2			
Including number of ECTS points for practical (P) classes	0	2			
Including number of ECTS points for direct teacher-student contact (BK) classes	2.4	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
1. Competence in mathematics and physics at the level of secondary school

SUBJECT OBJECTIVES
C01 Acquisition of basic knowledge, taking into account aspects of applications, from the following sections of classical physics: classical mechanics, oscillatory and wave motion, thermodynamics
C02 Acquiring the ability of qualitative understanding, interpretation and quantitative analysis - based on the laws of physics - selected physical phenomena and processes in the field: classical mechanics, oscillatory and wave motion, thermodynamics
C03 Acquisition and consolidation of social competencies including emotional intelligence skills involving the cooperation in the group of students aiming to effectively solve problems. Responsibility, honesty and fairness in the proceedings; observance force in academia and society

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01   Has a basic knowledge of classical mechanics, wave motion and thermodynamics, knows the importance of discoveries and achievements in physics for technical sciences and the progress of civilization

PEK_W02   Knows the basics and principles of dimensional analysis to estimate the values of physical quantities

PEK_W03   Knows the basics of vector calculus in a rectangular coordinate system

PEK_W04   Has knowledge of kinematics description rectilinear and curvilinear motion (projections: vertical, horizontal, diagonal, circular motion, the angular size of the kinematic relationships with linear kinematic quantities)

PEK_W05   Has knowledge of the fundamentals and applications of dynamics; has detailed knowledge of: a) the reference systems (inertial and non-inertial), b) understanding the importance of the dynamics of physical mass and strength, c) the types of interactions the primary and types of forces observed in nature (conservative, non-conservative, central, friction, inertia) d) the principles of Newton and scope of their application, e) the correct formulation of the equations of motion, f) knowledge and understanding of the physical meaning of the transformation of Galileo g) the dynamics of particles / body in curvilinear motion in the inertial reference system, h) the dynamics of particles / bodies in non-inertial systems reference i) the physical sense of inertia, together with an indication of their manifestations and consequences

PEK_W06   Has knowledge of the conservative and non-conservative forces observed in nature and everyday life; known concepts: a) conservative forces, b) a force field at the field strength conservative c) of the work and power mechanical force, d) the kinetic and potential energy; knows the theorem of work and kinetic energy; has the knowledge to explain the relationship conservative forces of potential energy; knows, with mathematical justification, the principle of conservation of mechanical energy particles / body in the field of conservative forces

PEK_W07   Knows and understands the terms: a) drive strength b) particles and the momentum of the mechanical system of material points; knows the formulation of the second law of dynamics using the concept of momentum; has knowledge concerning: a) the principles of conservation of momentum particles and the material system and the conditions of its applicability, b) elastic collision and inelastic; knows and understands the concept of a system of points and its center of gravity; has knowledge about the dynamics of the center of mass of the material points

PEK_W08   Is familiar with the term: a) with respect to torque / rotation axis, b) the angular momentum of a particle, system of particles and rigid bodies with respect to / axis of rotation, c) moment of inertia: a particle system of particles and rigid bodies with respect to the axis of rotation; he knows the second law of dynamics for rotational motion of a rigid body about a fixed axis of rotation; knowledgeable about. kinetic energy of the rotation, work and power in rotation; knows the correct qualitative and quantitative description of the phenomenon of precession and reciprocating rigid body; has knowledge concerning: a) the principle of conservation of angular momentum of a particle, the system of particles and rigid bodies with respect to a fixed axis of rotation, b) the conditions of applicability of the principle of conservation of angular momentum

PEK_W09   Knows the vector character of the law of universal gravitation; knows the concept: a) current and potential gravitational field, b) the gravitational potential energy of the body and the body; has knowledge concerning: a) the principle of conservation of mechanical energy of the body / the bodies in a gravitational field, b) of the potential of the intensity of the field and the gravitational force of gravitational energy potential, b) Kepler's laws and their justification on the basis of the law of universal gravitation and the law of conservation the angular momentum of the planet; familiar with the concept of I, II and III space velocity

PEK_W10   Knows the basics of statics of solids and elastic properties of liquids and solids

PEK_W11   Know the basics of hydrostatics and hydrodynamics of fluids; has detailed knowledge of: hydrostatic pressure, Pascal's and Archimedes' rights, surface tension and the effects it caused, types of ideal fluid flows and non-ideal, continuity and Bernoulli's equation, viscosity and the effects it caused, the dynamics of motion of bodies in a viscous medium, law Stokes

PEK_W12   Has knowledge on the basics of kinematics and dynamics and oscillating motion applications; has detailed knowledge of: a) simple harmonic motion oscillating pendulum: mathematical, physical, torsion and the particles subjected to the force potential, and performing small oscillations about the point where the potential energy assumes a minimum value, b) the vibratory motion suppressed, c) forced vibration outer sinusoidal force; He has knowledge of the physics of the phenomenon of mechanical resonance

PEK_W13	Has knowledge on the basics of wave motion and its applications; has detailed knowledge of: a) generating and basic properties of mechanical waves, b) the kinds of waves, c) the wave equation flat monochrome d) the basic physical quantities wave motion (length and frequency of the wave, the wave vector, the frequency circular) and their units of measurement, e) the speed associated with the operation waveform (phase, particles resort, group), f) depending on velocity of longitudinal and transverse of the elastic properties of the medium (units: Young's modulus, shear and elastic volume), g) the transport of mechanical energy by the waves (energy and power average, the intensity, the average energy density wave in the resort) h) depending on the intensity of the wave on the distance from the source
PEK_W14	Has detailed knowledge concerning: a) generating, types and characteristics of acoustic waves (speed of sound in air, the volume / intensity of the wave energy transfer), b) the law of refraction and reflection, c) the pressure and force exerted by the wave incident on the surface d) Doppler e) uses ultrasound, f) the wave interference (superposition), g), standing waves and sound sources, h) beats, s) selected applications of sound and ultrasound
PEK_W15	Has knowledge of the zero and the first law of thermodynamics; knows the basic concepts (macroscopic system, equilibrium thermodynamic parameters, functions of state, thermodynamic processes, gas ideal gas equation of state of ideal and actual); has detailed knowledge of: a) the temperature thermodynamic temperature scale and measurement units in various applicable scales, b) definition of the unit of measure Kelvin, c) the concept of internal energy of the system, d) the value of the elementary work done on the gas the ideal e) the work done over / by and with the environment of said heat in thermodynamic processes ideal gas
PEK_W16	Has a basic knowledge of the second and third law of thermodynamics; has detailed knowledge of: a) reversible and irreversible processes, b) the entropy of a macroscopic system, content II principles and the elementary values of entropy change of the system, c) methods for the quantitative determination of entropy change ideal gas, d) thermodynamic machine / thermal engines and their performance in cycles simple and inverse e) the third law of thermodynamics
PEK_W17	Has knowledge on the basics of statistical thermodynamics; has detailed knowledge of: a) objectives and mathematical formalism (probability and mathematical statistics) statistical thermodynamics, b) macroscopic thermodynamic parameter as a random variable; c) microstate, macrostate and weight statistics, d) statistical interpretation of the Boltzmann-Planck entropy, e) the function of the Boltzmann distribution (barometric formula), f) the distribution function Maxwell velocity of the gas molecules ideal g) the speed of the most probable and the average speed of the square of the gas molecules of ideal , h) of the average particle energy of degrees of freedom, i) microscopic interpretation of temperature and pressure ideal gas, j) rules equipartition heat
Relating to skills	
PEK_U01	Is able to correctly and efficiently apply the learned principles and laws of physics to qualitative and quantitative analysis of selected physical problems of engineering. Is able to: a) identify and justify discoveries and achievements in physics, which contributed to the progress of civilization, b) explain the basics of physical activity everyday consumer devices
PEK_U02	Is able to: a) apply the basic principles of dimensional analysis and qualitative analysis; b) The estimated value of the physical quantities of simple and complex
PEK_U03	Is able to: a) to distinguish between scalar of vector b) provide size vector in the Cartesian coordinate system, c) use have met the elements of vector calculus, in particular knows how to set: the vectors, angles between vectors, intersections: scalar, vector, mixed and triple
PEK_U04	Is able to set - using the transformation of Galileo - the size of the kinematic moving relative to each other inertial reference systems
PEK_U05	Is able to identify and determine the kinematic quantities (vectors: position, velocity, acceleration total, tangential acceleration, acceleration of normal) in progressive movements and rotational and quantitative relationships between linear and angular kinematic quantities
PEK_U06	Is able to correctly identify the forces acting on a given particle / body system and identify the resultant force in an inertial and non-inertial set
PEK_U07	Is able to apply principles of dynamics to describe the motion of the body in the inertial frame of reference, in particular, can: a) correctly formulate the equations of motion vector character and his scalar character in the selected coordinate system, b) solve the formulated scalar equations of motion with regard to the initial conditions
PEK_U08	Is able to apply principles of dynamics to describe the motion of the body in non-inertial frame of reference, in particular knows how: a) indicate the forces acting on a given particle / body and properly formulate the equation of motion in a non-inertial set b) explain the observed effects associated with the Earth's rotation

PEK_U09	Is able to properly use the concept of work and energy to the description of physical phenomena, in particular to apply the principle of conservation of energy to solve problems related to kinematics and dynamics of motion of the particles / bodies concerned / a; knows how to determine the value of: a) the mechanical work and the power of fixed and variable force, kinetic and potential energy, b) changes in the kinetic energy of the particle / body with the use of claims about work and kinetic energy, c) the conservative forces on the basis of a particular analytical form of potential energy
PEK_U10	Is able to apply principles of dynamics to describe a system of points, in particular set of values: drive force acting on the body, momentum particles / material system and the position of the center of mass of a system of points and quantitatively analyze the movement of the center of mass of the material points under the influence of the resultant of external forces
PEK_U11	Is able to properly apply the principle of conservation of momentum for quantitative and qualitative analysis of the dynamic properties of the material points, in particular for the quantitative analysis of elastic collision and inelastic
PEK_U12	Is able to apply the concept of torque and momentum to analyze simple problems related to kinematics and dynamics of rotation of rigid body around a fixed axis, in particular knows how to determine the value of: a) the moment of the force about point / axis of rotation, b) the angular momentum of a particle system of particles and rigid bodies with respect to / axis of rotation, c) formulate and solve the equation of motion of a rigid body rotating around a fixed axis of rotation, d) qualitatively describe the phenomenon of precession e) to formulate and solve the equation reciprocating, rotary rigid body
PEK_U13	Is able to apply the principle of conservation of angular momentum to solve selected problems of physical and technical
PEK_U14	Is able to apply the concept of work and kinetic energy of a rigid body to solve the problems associated with rotary motion of the rigid body, in particular, can determine the value of a) the kinetic energy of rotational motion, work and power in rotational motion, b) changes in the kinetic energy of rotation of the particles / body the use of statements about work and kinetic energy to rotational motion
PEK_U15	Is able to a) justify the conservative nature of the gravitational field, b) explain the physical meaning of Kepler's laws, c) properly apply the principle of conservation of mechanical energy of the body / the bodies in a gravitational field, knows how to determine the value of: a) current and potential gravitational field, b) gravity the potential energy of the body and the body, c) I, II and III space velocity
PEK_U16	Is able to analyze and solve simple tasks on hydrostatic and hydrodynamics of fluids, in particular, can calculate the surface tension, the speed and efficiency of fluid flow; able to solve simple tasks related to the dynamics of bodies in fluids, taking into account the forces of resistance
PEK_U17	Is able to properly describe the properties of a periodic movement, and in particular to formulate and solve the differential equations of oscillatory motion for simple cases (pendulum: mathematical, physical, torsion and particles performing small oscillations around the position of stable equilibrium); can analyze kinematic and dynamic properties of harmonic motion in the case of braking forces, and periodic exciting force; can calculate periods of vibration and qualitatively and quantitatively characterize the mechanical resonance phenomenon
PEK_U18	Is able to: a) clarify the relationship of the wave motion of the elastic properties of the medium b) quantitatively characterize the mechanical energy transport by the waves running c) correctly describe quantitatively diffraction, interference, polarization and the pressure exerted by the wave incident on the surface
PEK_U19	Is able to explain, based on knowledge of standing waves, the physical principles generating acoustic waves by the sound source; can explain and determine: a) the frequency of the received wave depending on the traffic source and the receiver (the Doppler effect), b) the frequency beats
PEK_U20	Is able to apply the first law of thermodynamics to the quantitative and qualitative description of the ideal gas transformation and set values: heat mentioned with the environment, the work done on the gas and the ideal gas, internal energy changes in these changes; knows how to graphically represent the ideal gas conversion, can justify / deduce the formula Mayer and put the adiabatic equation
PEK_U21	Is able to calculate, using the first and second law of thermodynamics, the value of: a) changes in the entropy of a thermodynamic system, in particular ideal gas has undergone a certain transformation thermodynamic b) the efficiency of machines / heat engines working in a series of straight or reverse c) describe quantitatively the thermal transfer
PEK_U22	Is able to: a) calculate the dependence of pressure from the height using the function of the Boltzmann distribution, b) provide statistical interpretation of entropy, c) derived using the distribution function Maxwell, depending on the speed of the most probable and the average speed

of a square particle ideal gas of temperature, d) use equipartition principle of thermal energy, e) determine the microscopic interpretation of temperature and pressure ideal gas

Relating to social competences

Acquisition and consolidation of competences in the field of:

PEK_K01   search for information and its critical analysis,

PEK_K02   team cooperation on improving the methods for the selection of a strategy to optimally solving problems assigned to the group,

PEK_K03   understanding of the need for self-education, including improving the skills of attention and focus on important things, and develop the ability to independently apply their knowledge and skills,

PEK_K04   capacity building self-esteem and self-control and responsibility for the results of actions taken,

PEK_K05   compliance with the customs and rules in academia,

PEK_K06   independent and creative thinking,

PEK_K07   the impact of discoveries and achievements in physics from technical progress, society and the environment through openness and curiosity for knowledge relating to scientific achievements and advanced technologies,

PEK_K08   objectively examine the arguments of rational explanations and justifications own point of view, using the knowledge of physics.

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Organizational matters. The methodology of physics	2
Le_02	Organizational matters. The methodology of physics	2
Le_03	Kinematics. Newton 's laws	2
Le_04	Kinematics. Newton 's laws	2
Le_05	Work and mechanical energy. The principle of conservation of mechanical energy	2
Le_06	Work and mechanical energy. The principle of conservation of mechanical energy	2
Le_07	The dynamics of system of particles and rigid bodies. The principles of conservation of momentum and angular momentum	2
Le_08	The dynamics of system of particles and rigid bodies. The principles of conservation of momentum and angular momentum	2
Le_09	Gravitation	2
Le_10	Oscillatory motion and mechanical waves	2
Le_11	Oscillatory motion and mechanical waves	2
Le_12	Oscillatory motion and mechanical waves	2
Le_13	Phenomenological thermodynamics with elements of classical statistical physics	2
Le_14	Phenomenological thermodynamics with elements of classical statistical physics	2
Le_15	Phenomenological thermodynamics with elements of classical statistical physics	2
	TOTAL	30

Form of classes - Classes		Quantity
Cl_01	Organizational matters. A solution for: dimensional analysis; estimating the value of physical quantities; vector calculus and differential-integral	2
Cl_02	Application of the principles of Newton to solve the equations of motion; Depending on the time setting values of basic kinematic and dynamic still and moving relative to each other inertial and non-inertial reference systems	2
Cl_03	Application of the principles of Newton to solve the equations of motion; Depending on the time setting values of basic kinematic and dynamic still and moving relative to each other inertial and non-inertial reference systems	2

Cl_04	Solving selected issues of movement dynamics using concepts of mechanical work, kinetic and potential energy, theorem of work and energy and the principle of conservation of mechanical energy	2
Cl_05	Solving selected issues of movement dynamics using concepts of mechanical work, kinetic and potential energy, theorem of work and energy and the principle of conservation of mechanical energy	2
Cl_06	Quantitative and qualitative analysis tasks using the concept of center of mass, the law of conservation of momentum applied to the material points, the elastic collision and inelastic	2
Cl_07	A solution for kinematics and dynamics of rigid body rotational motion around a fixed axis and the principle of conservation of angular momentum	2
Cl_08	A solution for kinematics and dynamics of rigid body rotational motion around a fixed axis and the principle of conservation of angular momentum	2
Cl_09	Quantitative and qualitative analysis of selected issues concerning the physics of gravitational field: a) determining the value of the gravitational force, intensity, potential, potential energy; b) motion of bodies in a gravitational field using the principles of behavior (energy orbital angular momentum) and Kepler's laws	2
Cl_10	Analysis and problem solving dynamic range of oscillating motion: simple harmonic (various pendulums, particles executing small oscillations around a stable equilibrium position), damped, forced and mechanical resonance	2
Cl_11	Solving physics mechanical and acoustic waves. Calculating the values of basic wave motion, energy transport by waves and wave interference	2
Cl_12	Solving the physics of acoustic waves and relating to: the speed of sound in solids and fluids, pressure and force exerted by the acoustic wave, standing waves, Doppler, beat and sources of acoustic waves	2
Cl_13	Solving problems using the principles of thermodynamics concerning: a) determining values: heat mentioned with the environment, the work done on the gas and the gas, subject to change internal energy in the transformation of ideal gas, b) a graphical representation of the transformations ideal gas, c) the efficiency of thermal machines, d) determining the entropy change of the ideal gas in the thermodynamic conversion, e) thermal conductivity	2
Cl_14	Solving problems using the principles of thermodynamics concerning: a) determining values: heat mentioned with the environment, the work done on the gas and the gas, subject to change internal energy in the transformation of ideal gas, b) a graphical representation of the transformations ideal gas, c) the efficiency of thermal machines, d) determining the entropy change of the ideal gas in the thermodynamic conversion, e) thermal conductivity	2
Cl_15	Solving problems using the principles of thermodynamics concerning: a) determining values: heat mentioned with the environment, the work done on the gas and the gas, subject to change internal energy in the transformation of ideal gas, b) a graphical representation of the transformations ideal gas, c) the efficiency of thermal machines, d) determining the entropy change of the ideal gas in the thermodynamic conversion, e) thermal conductivity	2
Total		30

TEACHING TOOLS USED	
ND_01	Traditional lecture using transparency and slides
ND_02	Tutorials - discussion of solutions jobs
ND_03	Tutorials - short 10 min. written tests
ND_04	Teaching materials available on the website
ND_05	Consultations
ND_06	Self - preparation for exercise
ND_07	Self - self-study and exam preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01-PEK_W17	Exam
P2 = F2 (classes)	PEK_U01-PEK_U22, PEK_K03-PEK_K07	Oral answers, discussions, written tests

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. D. Halliday, R. Resnick, J. Walker, Podstawy fizyki, tom 1. i 2., Wydawnictwo Naukowe PWN, Warszawa 2003
2. J. Walker, Podstawy fizyki. Zbiór zadań, PWN, Warszawa 2005
3. I.W. Sawieliew, Wykłady z fizyki, tom 1 i 2, Wydawnictwa Naukowe PWN, Warszawa, 2003
4. K. Jezierski, B. Kołodka, K. Sierański, Zadania z rozwiązaniami, cz. 1., i 2., Oficyna Wydawnicza SCRIPTA, Wrocław 1999-2003
5. W. Salejda, Fizyka a postęp cywilizacyjny, opracowanie dostępne w pliku do pobrania pod adresem http://www.if.pwr.wroc.pl/dokumenty/jkf/fizyka_a_postep_cywilizacyjny.pdf
6. W. Salejda, Metodologia fizyki, opracowanie dostępne w pliku do pobrania pod adresem http://www.if.pwr.wroc.pl/dokumenty/jkf/metodologia_fizyki.pdf

Secondary literature

1. J. Massalski, M. Massalska, Fizyka dla inżynierów, cz. 1., WNT, Warszawa 2008
2. J. Orear, Fizyka, tom 1., WNT, Warszawa 2008
3. Z. Kleszczewski, Fizyka klasyczna, Wyd. Politechniki Śląskiej, Gliwice 2001
4. L. Jacak, Krótki wykład z fizyki ogólnej, Oficyna Wydawnicza PWr, Wrocław 2001; podręcznik dostępny na stronie Dolnośląskiej Biblioteki Cyfrowej
5. K. Sierański, K. Jezierski, B. Kołodka, Wzory i prawa z objaśnieniami, cz. 1. i 2., Oficyna Wydawnicza SCRIPTA, Wrocław 2005;
6. K. Sierański, J. Szatkowski, Wzory i prawa z objaśnieniami, cz. 3., Oficyna Wydawnicza SCRIPTA, Wrocław 2008
7. W. Salejda, M.H. Tyc, Zbiór zadań z fizyki, Wrocław 2001, podręcznik internetowy dostępny pod adresem http://www.if.pwr.wroc.pl/dokumenty/jkf/listamechanika.pdf
8. W. Salejda, R. Poprawski, J. Misiewicz, L. Jacak, Fizyka dla wyższych szkół technicznych, Wrocław 2001; dostępny jest obecnie rozdział Termodynamika pod adresem: http://www.if.pwr.wroc.pl/dokumenty/podreczniki_elektroniczne/termodynamika.pdf
9. Witryna dydaktyczna Instytutu Fizyki PWr; http://www.if.pwr.wroc.pl/index.php?menu=studia zawiera duży zbiór materiałów dydaktycznych
10. H.D. Young, R. A. Freedman, SEAR'S AND ZEMANSKY'S UNIVERSITY PHYSICS WITH MODERN PHYSICS, Addison-Wesley Publishing Company, wyd. 10, 2000; wyd. 12. z roku 2007; podgląd do wydania 12. z roku 2008
11. D. C. Giancoli, Physics Principles with Applications, 6th Ed., Addison-Wesley, 2005; Physics: Principles with Applications with MasteringPhysics, 6th Ed., Addison-Wesley 2009.
12. R R. A. Serway, Physics for Scientists and Engineers, 8th Ed., Brooks/Cole, Belmont 2009; Physics for Scientists and Engineers with Modern Physics, 8th Ed., Brooks/Cole, Belmont 2009
13. Paul A. Tipler, Gene Mosca, Physics for Scientists and Engineers, Extended Version, W. H. Freeman 2007

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Physics 1.2

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03 (knowledge)	K1MTR_W01	C01	Le_01, Le_02	ND_01, ND_05, ND_07
PEK_W04-PEK_W14	K1MTR_W02	C01	Le_03-Le_12	ND_01, ND_05, ND_07
PEK_W15-PEK_W17	K1MTR_W02, K1MTR_W12	C01	Le_13-Le_15	ND_01, ND_05, ND_07
PEK_U01-PEK_U19 (skills)	K1MTR_U01, K1MTR_U02, K1MTR_U24	C02	Cl_01-Cl_12	ND_02-ND_07
PEK_U20-PEK_U22	K1MTR_U12, K1MTR_U24	C02	Cl_13-Cl_15	ND_02-ND_07
PEK_K01-PEK_K08 (competences)	K1MTR_K01, K1MTR_K02, K1MTR_K07, K1MTR_K12	C03	Le_01-Le_15 Cl_01-Cl_15	ND_01, ND_07

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish: **Fizyka 2.8**

Name in English: **Physics 2.8**

Main field of studies: **Mechatronics**

Level and form of studies: **I level** / **Full time**

Kind of subject: **Obligatory** / **Faculty**

Subject code: **FZP003002**

Group of courses: **NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	E		Z		
Number of ECTS points	2		2		
Including number of ECTS points for practical (P) classes	0		2		
Including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Competence in the field of mathematical analysis, algebra and physics in terms of the course Physics 1

SUBJECT OBJECTIVES

C01 The acquisition of basic knowledge, taking into account aspects of applications, from the following sections classical electrodynamics: electrostatics, electric current, magnetostatics, electromagnetic induction

C02 The acquisition of basic knowledge, taking into account aspects of applications, from the following sections of modern physics: special relativity, quantum physics, physics of the atomic nucleus

C03 Learning basic techniques and methods of measurement of selected physical quantities

C04 Acquiring skills: planning and execution experience in the Laboratory of Physics (LPF) consisting of the experimental verification of selected laws / rules of physics and measurement of physical quantities, the development of measurement results, estimation of measurement uncertainty, develop a written report from the measurements using utility software

C05 Acquisition and consolidation of social competencies including emotional intelligence skills involving the cooperation in the group of students with a view to effective problem solving, responsibility, honesty and fairness in the proceedings; observance force in academia and society

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Has a basic knowledge of classical electrodynamics (electrostatics, electricity, magnetostatics, electromagnetic induction, electromagnetic waves, optics), selected elements of modern physics (special theory of relativity, quantum physics, physics: atom, atomic nucleus, elementary particles) and astrophysics. He knows and understands the importance of discoveries and achievements of classical electrodynamics and modern physics for technical sciences and the progress of civilization

PEK_W02 Knows the methods of analysis of vector fields

PEK_W03 Has knowledge of electrostatics and its applications; knows and understands: Basic physical size of the vector and scalar associated with static electricity (current and potential field, the principle of superposition, the quantization of charge, charge conservation electric) charge point, discrete system of charges) Gauss' law; has detailed knowledge of: a) flow field intensity vector and the conservative nature of the field, b) electrostatic potential energy of cargo and the cargo c) field dipole electric potential energy of the dipole and torque acting on the dipole placed in an external field, d) conductor located in the field (field shielding effect), e) the dielectric polarization, f) capacitance and capacitor applications

PEK_W04 Has knowledge of physics DC and its uses, in particular knows and understands a) the concept of voltage and current density vector electrical resistance / electrical conductivity / competent, SEM, work, power, electrical current and heat Joule, b) physical electrical conduction mechanisms, c) Ohm's law (in the form of differential and integral) and Kirchhoff's law, d) the principles of quantitative analysis of simple electric circuits

PEK_W05 Has knowledge of magnetostatics and its uses, knows and understands: a) the term of the magnetic field vector magnetic induction and field intensity, b) the concept of the Lorentz force and its impact on the movement of electric charges in a magnetic field, c) the law of Gauss for the magnetic field d) the physical principles of operation: a cyclotron particle speed selector, mass spectrometer, e) the magnetic field guide and frame with the flow

PEK_W06 Has knowledge about. Electromagnetic induction and its applications; know and understand: a) the concept of magnetic flux, b) Faraday's law and Lenz's law, c) inductance self-inductance

PEK_W07 Knows and understands the concept of displacement current and the physical meaning of Maxwell's equations (in the form of integral and differential)

PEK_W08 Has a basic knowledge of electromagnetic waves and their applications

PEK_W09 Has a basic knowledge of the special theory of relativity and its applications

PEK_W10 Has the knowledge of the foundations of quantum physics and its selected applications; has detailed knowledge of: a) the rights of blackbody radiation, thermal radiation of bodies and its applications, b) the Bohr model of the atom of hydrogen (quantization of energy and angular momentum of an electron), and the quantum energy levels of electrons in atoms c) of the photoelectric and Compton, d) corpuscular-wave duality of light and elementary particles (hypothesis de Broglie waves of matter), e) Heisenberg's uncertainty principle, f) of the Schrödinger equation (temporal and timeless), g) a prohibition Pauli h) spatial quantization of the orbital angular momentum and magnetic moment of electrons in an atom

PEK_W11 Has knowledge of the basic physics of the atomic nucleus and its applications, in particular know the quantities characterizing the nucleus, its isotopes and nuclear forces, have knowledge of: a) the binding energy of nucleons and its importance for nuclear power (fusion of heavy nuclei / isotopes), fusion of light nuclei, stability of heavy nuclei, b) the radioactivity of natural / artificial c) the types of radioactive decay, d) the law of radioactive decay e) radioisotope dating methods, f) nuclear reactions, g) nuclear h) the biological effects of radiation

PEK_W12 Knows the safety rules in force in the Laboratory of Physics

PEK_W13 Knows the methods to perform simple and complex measurements of physical quantities

PEK_W14 Knows the methods of processing the results of measurements and uncertainty estimation of simple and complex measurements

Relating to skills

PEK_U01 Is able to: a) independently written or oral expression correctly and succinctly present the issues discussed in the lectures that are the content of these learning outcomes in the field of knowledge (PEK_W01-PEK_W14), b) use the transferred and described above knowledge to the analysis of selected aspects of engineering and experiment planning, measurement of physical quantities, the

	development of the results of measurements in the form of a report or presentation and the estimation of measurement uncertainty with the use of computer tools (word processing, office software, computing environments). Is able to: a) identify and justify discoveries and achievements of classical electrodynamics and modern physics, which contributed to the progress of civilization
PEK_U02	Is able to apply knowledge of electrostatics to) the qualitative and quantitative characteristics of the electrostatic field, the source of which there are loads and loads of point systems, in particular, has the skills to determining, based on Gauss' law, electrostatic field strengths of selected distributions of cargo;) Measurements in the Laboratory of Physics (LPF) and the development of measurement results in the form of a written report
PEK_U03	Is able to apply knowledge of physics DC to: a) quantitative characteristics of the current (amperage electric current density vector) in a simple electrical circuits, b) the designation of work, power, electrical current and heat Joule c) determining the resistance of the battery resistors, d) measurement in the LPF and the development of measurement results in a written report. Can explain the physical mechanisms of electrical conductivity and justify the utility nature of electric current, which is to transport electricity
PEK_U04	Is able to identify the source of the magnetic field and apply knowledge of magnetostatics to: a) the qualitative and quantitative characteristics of the magnetic field (determination of vectors of magnetic induction and intensity) originating from different sources (straight and circular guide with the current, coil toroid), b) motion electric charges in the magnetic field and the determination of the force acting on the conductor in a magnetic field
PEK_U05	Has skills to apply the knowledge in the field of electromagnetic induction to: a) the qualitative and quantitative performance characteristics of generators AC and DC, including the determination of the value generated SEM, b) explain the phenomenon of self-induction
PEK_U06	Is able to correctly explain the physical meaning of Maxwell's equations (in the integral form). Moreover unable to correctly define the equations used in physical size and to determine their unit of measure
PEK_U07	Is able to apply knowledge of the foundations of quantum physics to the quantitative interpretation of selected phenomena and physical effects of the microworld, phenomena and effects that occur over distances of the order of nanometers and smaller; in particular, can: a) show, using the appropriate accounts, quantization of energy in the Bohr model of the atom of hydrogen, b) justified, based on experimental facts, corpuscular nature of light, c) to justify the inadequacy of the use of classical physics to describe the phenomena of the microworld and explain the probabilistic nature quantum phenomena d) apply knowledge of basic physics of quantum measurements performed in the LPF selected physical quantities and to develop measurement results in the form of a written statement / report
PEK_U08	Is able to: a) explain, based on the concept of binding energy of nucleons, the physical principles of energy production in nuclear reactors and tokamaks - devices to carry out controlled thermonuclear fusion b) identify and characterize the positive and negative aspects of nuclear power, c) characterize the types of decays of radioactive d) describe the use of radioactivity, biological effects of radiation, e) describe light nuclei fusion reactions occurring inside the Sun
PEK_U09	Is able to use simple measuring instruments for the measurement of physical quantities
PEK_U10	Is able to perform simple and complex measurements of physical quantities using manual measuring station
PEK_U11	Is able to carry out the measurements, analyze uncertainties and edit report / report of measurements on the LPF using computer tools (word processing, office software, computing environments)

Relating to social competences

Acquisition and consolidation of competences in the field of:

PEK_K01	search for information and its critical analysis,
PEK_K02	team cooperation on improving the methods for the selection of a strategy to optimally solving problems assigned to the group,
PEK_K03	understanding of the need for self-education, including improving the skills of attention and focus on important things, and develop the ability to independently apply their knowledge and skills,
PEK_K04	capacity building self-esteem and self-control and responsibility for the results of actions taken,
PEK_K05	compliance with the customs and rules in academia,
PEK_K06	independent and creative thinking,
PEK_K07	the impact of discoveries and achievements in physics from technical progress, society and the environment through openness and curiosity for knowledge relating to scientific achievements and

PEK_K08	advanced technologies, objectively examine the arguments of rational explanations and justifications own point of view, using the knowledge of physics.

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Organizational matters. Mathematical analysis of vector fields, electrostatics	3
Le_02	The electric current and magnetic field	3
Le_03	Electrostatic induction. Maxwell's equations	2
Le_04	Elements of special theory of relativity	2
Le_05	Quantum physics	3
Le_06	Elements of nuclear physics	2
	TOTAL	15

Form of classes - Laboratory		Quantity
La_01	Lab Introduction to LPF: issues of organization and conduct of classes, to familiarize students with: a) the safety rules for measurements (short health and safety training), b) how to prepare writing reports, c) the basics of the measurement uncertainty analysis. Carrying out simple measurements	2
La_02	Making measurements using analog and digital gauges. Statistical processing of simple and complex results of measurements , estimation of measurement uncertainty, graphical presentation of the results of measurements and measurement uncertainty, the development of the report	2
La_03	Making measurements of selected physical quantities, developing reports	2
La_04	Making measurements of selected physical quantities, developing reports	2
La_05	Making measurements of selected physical quantities, developing reports	2
La_06	Making measurements of selected physical quantities, developing reports	2
La_07	Making measurements of selected physical quantities, developing reports	2
La_08	Supplementary classes, crediting, repetitory	1
	Total	15

TEACHING TOOLS USED	
ND_01	Using traditional lecture, slides, demonstrations and presentations rights / phenomena
ND_01	Self - preparation for laboratory exercises
ND_02	Laboratory - discussion of ways to do measurements, analysis of results and the estimation of measurement uncertainty, evaluation reports / reports
ND_03	Laboratory - a few minutes prior written tests measurements
ND_04	Self - independent measurements
ND_05	Self - self-study and exam preparation
ND_06	Consultations

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01-PEK_W14	Oral and written exam
P2 = F2 (classes)	PEK_U01-PEK_U11, PEK_K01-PEK_K08	Oral response, discussions, quizzes and reports for each class

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. D. Halliday, R. Resnick, J. Walker, Podstawy fizyki, tomy 1-5, Wydawnictwo Naukowe PWN, Warszawa 2003
2. J. Walker, Podstawy fizyki. Zbiór zadań, PWN, Warszawa 2005
3. I.W. Sawieliew, Wykłady z fizyki, tom 1 i 2, Wydawnictwa Naukowe PWN, Warszawa, 2003
4. R. Poprawski, W. Salejda, Ćwiczenia laboratoryjne z fizyki, Cz. I-IV, Oficyna Wydawnicza PWr; wersja elektroniczna 5. wydania cz. 1. dostępna po kliknięciu nazwy Zasady opracowania wyników pomiarów z witryny Dolnośląskiej Biblioteki Cyfrowej; wersje elektroniczne pozostałych części podręcznika dostępne na stronie internetowej LPF pod adresem http://www.if.pwr.wroc.pl/LPF , gdzie znajdują się: regulamin LPF i regulamin BHP, spis ćwiczeń, opisy ćwiczeń, instrukcje robocze, przykładowe sprawozdania i pomoce dydaktycznych
5. W. Salejda, Fizyka a postęp cywilizacyjny, opracowanie dostępne w pliku do pobrania pod adresem http://www.if.pwr.wroc.pl/dokumenty/jkf/fizyka_a_postep_cywilizacyjny.pdf

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2. J. Orear, Fizyka, tom 1., WNT, Warszawa 2008
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8. H.D. Young, R. A. Freedman, SEAR'S AND ZEMANSKY'S UNIVERSITY PHYSICS WITH MODERN PHYSICS, Addison-Wesley Publishing Company, wyd. 10, 2000; wyd. 12. z roku 2007; podgląd do wydania 12. z roku 2008
9. D. C. Giancoli, Physics Principles with Applications, 6th Ed., Addison-Wesley, 2005; Physics: Principles with Applications with MasteringPhysics, 6th Ed., Addison-Wesley 2009.
10. R R. A. Serway, Physics for Scientists and Engineers, 8th Ed., Brooks/Cole, Belmont 2009; Physics for Scientists and Engineers with Modern Physics, 8th Ed., Brooks/Cole, Belmont 2009
11. Paul A. Tipler, Gene Mosca, Physics for Scientists and Engineers, Extended Version, W. H. Freeman 2007

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Physics 2.8

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W08 (knowledge)	K1MTR_W01, K1MTR_W02, K1MTR_W13, K1MTR_W25	C01	Le_01-Le_03	ND_01, ND_06, ND_07
PEK_W09-PEK_W14	K1MTR_W02, K1MTR_W07, K1MTR_W14, K1MTR_W25	C02	Le_04-Le_05	ND_01, ND_06, ND_07
PEK_U01-PEK_U11 (skills)	K1MTR_U01, K1MTR_U024, K1MTR_U25	C03-C05	La_01-La_08	ND_01-ND_07
PEK_K01-PEK_K08 (competences)	K1MTR_K02, K1MTR_K11	C05	La_01-La_08	ND_01-ND_07

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Algebra z geometrią analityczną A**	
Name in English:	**Algebra and Analytic Geometry**	
Main field of studies:	**Mechatronics**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**MAP001140**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	E	Z			
Number of ECTS points	2	2			
Including number of ECTS points for practical (P) classes	0	2			
Including number of ECTS points for direct teacher-student contact (BK) classes	1.2	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It is recommended to know the basic algebraic operations on rational and real numbers, and knowledge of basic geometric figures and shapes

SUBJECT OBJECTIVES

C01 Understanding the basic properties of complex numbers
C02 Learning basic algebraic properties of polynomials
C03 Mastering the concept of a vector, a vector space and the base of a linear space
C04 Learning how to calculate the distance between the points in the space Rn, how to determine the equations of lines and planes and understanding the concept of conic sections
C05 Mastering the concepts of matrices, matrix operations, and learn the methods of solving systems of linear equations

<table>
<tr><td colspan="2" align="center">SUBJECT EDUCATIONAL EFFECTS</td></tr>
<tr><td colspan="2"><u>Relating to knowledge</u></td></tr>
<tr><td>PEK_W01</td><td>Knows basic properties of complex numbers</td></tr>
<tr><td>PEK_W02</td><td>Knows basic algebraic properties of polynomials</td></tr>
<tr><td>PEK_W03</td><td>Knows basic concepts of theory of linear spaces and methods of description of lines, planes and conic sections</td></tr>
<tr><td>PEK_W04</td><td>Knows basic methods of solving systems of linear equations</td></tr>
<tr><td colspan="2"><u>Relating to skills</u></td></tr>
<tr><td>PEK_U01</td><td>Can carry out calculations with complex numbers</td></tr>
<tr><td>PEK_U02</td><td>Can add, multiply and divide polynomials</td></tr>
<tr><td>PEK_U03</td><td>Can find the equations of planes and lines in three dimensional space</td></tr>
<tr><td>PEK_U04</td><td>Can add and multiply matrices and calculate determinants</td></tr>
<tr><td>PEK_U05</td><td>Can solve systems of linear equations</td></tr>
</table>

	PROGRAMME CONTENT	
	Form of classes - Lecture	Quantity
Le_01	Natural, rational and real numbers. Mathematical induction. Newton's binomial formula	2
Le_02	Complex numbers. Basic operations, modulus, complex conjugate	2
Le_03	Polar form of complex number. Multiplication, division and exponentiation in polar form. Roots of complex numbers. The notion of algebraic field	2
Le_04	Polynomials. Addition and multiplication of polynomials. Roots of polynomial. Polynomial remainder theorem. Fundamental theorem of algebra	2
Le_05	The decomposition of a polynomial with real coefficients into product of linear and quadratic factors. Rational functions. Real simple rational factors. Decomposition of the functions into rational simple factors	2
Le_06	Vectors in the space Rn. Addition and multiplication by scalars. Distance between points. Scalar product. Length of vector. Cauchy–Schwarz inequality. The angle between vectors	2
Le_07	Analytic geometry of the plane. Straight line formulas (normal parametric and directional form). Distance of a point from a line. The angle between lines	2
Le_08	Analytic geometry of the space R3. Equations for lines and planes. Distance between point and a plane. Intersection of planes	2
Le_09	Linear combinations of vectors. Linearly independent vectors. The base of a space. Linear mappings. Matrix representation of linear mappings	2
Le_10	Addition and multiplication of matrices and its correlation with operations on linear mappings. Example of matrices	2
Le_11	Permutations and its sign. Definition of determinant and methods of calculation of determinant Algebraic complement of an element of a matrix. Laplace' formula for determinant. Determinant and volume	2
Le_12	Inverse matrix. Systems od linear equations. Cramer's formulas. Examples. Homogeneous and non-homogeneous systems	2
Le_13	Properties of linear mappings (kernel, image, rank). Rouché –Capelli theorem. Gaussian elimination	2
Le_14	Eigenvalues and eigenvectors	2
Le_15	Conic sections	2
	TOTAL	30

Form of classes - Classes		Quantity
Cl_01	Real and complex numbers	2
Cl_02	Polynomials	2
Cl_03	Geometry of the plane	2
Cl_04	Geometry of the space R3	2
Cl_05	Basis and linear mappings	2
Cl_06	Matrices and determinants	2
Cl_07	Systems of linear equations	2
Cl_08	Test	1
	Total	15

TEACHING TOOLS USED

ND_01 Lecture - traditional method
ND_02 Classes - traditional method
ND_03 Student's self-work with the assistance of mathematical packages

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01-PEK_W04	Exam or e-exam
P2 = F2 (classes)	PEK_U01-PEK_U05	Oral answers, quizzes, written tests and/or e-tests

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. A. Białynicki-Birula, Algebra Liniowa z Geometrią, PWN 1976
2. F. Leja, Geometria analityczna, PWN, Warszawa 1972
3. A. Mostowski, M. Stark, Elementy algebry wyższej, PWN, Warszawa 1963
4. G. Banaszak, W. Gajda, Elementy algebry liniowej, część I, WNT, Warszawa 2000

Secondary literature

1. G. Farin, D. Hansford, Practical Linear Algebra: A Geometry Toolbox 2004, AK Peters, 2005
2. T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna. Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław 2011
3. T. Jurlewicz, Z. Skoczylas, Algebra liniowa. Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław 2005
4. T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna.. Definicje, twierdzenia i wzory. Oficyna Wydawnicza GiS, Wrocław 2011
5. T. Jurlewicz, Z. Skoczylas, Algebra liniowa. Definicje, twierdzenia i wzory. Oficyna Wydawnicza GiS, Wrocław 2005
6. E. Kącki, D. Sadowska, L. Siewierski, Geometria analityczna w zadaniach, PWN, Warszawa 1993
7. W. Stankiewicz, Zadania z matematyki dla wyższych uczelni technicznych, Cz. A, PWN, Warszawa 2003

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Algebra and Analytic Geometry

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_W01	C01	Le_01-Le_03, Le_014	ND_01, ND_03
PEK_W02	K1MTR_W01	C02	Le_04, Le_05	ND_01, ND_03
PEK_W03	K1MTR_W01	C03, C04	Le_06-Le_09, Le_015	ND_01, ND_03
PEK_W04	K1MTR_W01	C05	Le_010-Le_013	ND_01, ND_03
PEK_U01 (skills)	K1MTR_U01	C01	Cl_01, Cl_06, Cl_07	ND_01-ND_03
PEK_U02	K1MTR_U01	C02	Cl_02	ND_01-ND_03
PEK_U03	K1MTR_U01	C03, C04	Cl_03- Cl_05	ND_01-ND_03
PEK_U04	K1MTR_U01	C05	Cl_06, Cl_07	ND_01-ND_03
PEK_U05	K1MTR_U01	C05	Cl_06, Cl_07	ND_01-ND_03

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Analiza Matematyczna 1.1 A**	
Name in English:	**Mathematical Analysis 1.1 A**	
Main field of studies:	**Mechatronics**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**MAP001142**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	30			
Number of hours of total student workload (CNPS)	150	90			
Form of crediting	E	Z			
Number of ECTS points	5	3			
Including number of ECTS points for practical (P) classes	0	3			
Including number of ECTS points for direct teacher-student contact (BK) classes	3.0	2.1			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1.   It is recommended that the knowledge of mathematics is equivalent to secondary school certificate at the advanced level

SUBJECT OBJECTIVES

C01   Understanding the basic methods of analysis of the graph of functions of one variable
C02   Understanding the concept of definite integral and its basic properties and methods of determination
C03   Understanding the practical applications of mathematical methods for the analysis of functions of one variable

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01   Knows the basic definitions and theorem from Mathematical Analysis of functions of one variable
PEK_W02   Knows the notion of definite integral and its basic applications

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Mathematical notations (logical connectives, quantifiers), elements of set theory, real numbers, subsets of real numbers (intervals, half-lines). Linear and quadratic functions	2
Le_02	Basic properties of functions (injective and monotonic functions). Composition of functions. The inverse function. Power and exponential functions, and opposite to them. Properties of logarithms	2
Le_03	Trigonometric functions and their inverses. Graphs of trigonometric and of its inverses	2
Le_04	Sequences and limits. Basic formulas and theorems. Number e. Improper limits	2
Le_05	The limit of a function in a point. Directional limits of function. Asymptotics of function	2
Le_06	Continuity of a function in a point and on the interval. Basic properties of continuous functions. Approximate solutions of equations. Points of discontinuity	2
Le_07	The definition of derivative. Basic formulas and theorems. Geometric and physics interpretations. Mean value theorem. De L'Hospital rule	2
Le_08	Extreme values, monotonicity. Higher order derivatives. Convexity of function	2
Le_09	Examination of the graph of a function.	2
Le_10	Taylor formula. Approximation of function. Applications	2
Le_11	Definite integral. Simple examples. Connection between integral and derivative (Fundamental Theorem of Calculus). Simple examples	2
Le_12	Indefinite integral: basic formulas. Areas of simple figures	2
Le_13	The basic methods of calculus of integrals: integration by parts and by substitution	2
Le_14	The basic methods of calculus of integrals: simple rational functions. Area and perimeter of a circle. The volume of rotary figures	2
Le_15	Application of methods of mathematical analysis of one variable functions	2
	TOTAL	30

Form of classes - Classes		Quantity
Cl_01	Tautologies, de Morgan laws, union, intersection and complement of set	2
Cl_02	Natural numbers, integers, rational and real numbers. Logarithm	2
Cl_03	Graphs of simple functions. Inverse function. Composition of functions	2
Cl_04	Trigonometric functions and trigonometric identities	2
Cl_05	Limit of sequences	2
Cl_06	The limit of a function in point	2
Cl_07	Continuous functions	2
Cl_08	Points of discontinuity. Solutions of equations	2
Cl_09	Derivatives. Tangent line to a graph of a function	2

Cl_10	Examination of graphs of functions - I	2
Cl_11	Examination of graphs of functions - II	2
Cl_12	Taylor formula. De L'Hospital rule	2
Cl_13	Integration - I	2
Cl_14	Integration - II	2
Cl_15	Integration - applications	2
	Total	30

TEACHING TOOLS USED

ND_01 Lecture - traditional method
ND_02 Classes - traditional method
ND_03 Student's self-work with the assistance of mathematical packages

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Exam or e-exam
P2 = F2 (classes)	PEK_U01, PEK_U02, PEK_K01	Oral answers, quizzes, written tests and/or e-tests

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. F. Leja, Rachunek Różniczkowy i Całkowy, Wydawnictwo Naukowe PWN, 2012
2. W. Krysicki, L. Włodarski, Analiza Matematyczna w Zadaniach, Cz. I, PWN, Warszawa 2006

Secondary literature

1. K. Kuratowski, Rachunek Różniczkowy i Całkowy. Funkcje Jednej Zmiennej, Wydawnictwo Naukowe PWN, 2012
2. G. M. Fichtenholz, Rachunek Różniczkowy i Całkowy, T. I-II, PWN, Warszawa 2007
3. M. Gewert, Z. Skoczylas, Analiza Matematyczna 1. Przykłady i Zadania, Oficyna Wydawnicza GiS, Wrocław 2011

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Mathematical Analysis 1.1 A

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_W01	C01	Le_01-Le_15, Cl_01-Cl_15	ND_01-ND_03
PEK_W02	K1MTR_W01	C02, C03	Le_11-Le_15, Cl_13-Cl_15	ND_01-ND_03
PEK_U01 (skills)	K1MTR_U01	C01	Le_01-Le_15, Cl_01-Cl_15	ND_01-ND_03
PEK_U02	K1MTR_U01	C01-C03	Le_01-Le_10, Le_15, Cl_01-Cl_10, Cl_15	ND_01-ND_03
PEK_K01 (competences)	K1MTR_K01	C01, C02	Cl_06, Cl_07	ND_01-ND_03

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Analiza Matematyczna 2.1 A**	
Name in English:	**Mathematical Analysis 2.1 A**	
Main field of studies:	**Mechatronics**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**MAP001156**	
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)	120	90			
Form of crediting	E	Z			
Number of ECTS points	4	3			
Including number of ECTS points for practical (P) classes	0	3			
Including number of ECTS points for direct teacher-student contact (BK) classes	2.4	2.1			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Can explore convergence of sequences and calculate the limits of functions of one variable
2. Knows the calculus of functions of one variable and its applications
3. Knows and can use the indefinite integral functions of one variable
4. Knows the basic concepts of linear algebra

SUBJECT OBJECTIVES

C01 Knowing the structure and properties of the definite integral. Acquiring skills in the use of the definite integral (including inappropriate) for engineering calculations

C02 Understanding the basic concepts of differential and integral calculus of several variables

C03 Mastery of basic knowledge about numerical series and power series

C04 Application of acquired knowledge to develop and analyze mathematical models to solve theoretical and practical issues in various fields of science and technology

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01   Knows the structure of the definite integral and its properties, knows the concept of the integral wrong

PEK_W02   Knows the basics of differential and integral calculus of several variables

PEK_W03   Has a basic knowledge of the theory of series and power series, knows the convergence criteria

Relating to skills

PEK_U01   He can calculate and interpret the definite integral, is able to solve engineering problems using integrals

PEK_U02   He can calculate partial derivatives, directional and gradient function of several variables and interpret the values, is able to solve tasks of optimization for the function of many variables

PEK_U03   He can calculate and interpret the multiple integral, is able to solve engineering problems using double and triple integrals

PEK_U04   He can develop functions in power series, knows how to use received results for estimated calculations

PROGRAMME CONTENT

	Form of classes - Lecture	Quantity
Le_01	Mathematical notations (logical connectives, quantifiers), elements of set theory, real numbers, subsets of real numbers (intervals, half-lines). Linear and quadratic functions	2
Le_02	Basic properties of functions (injective and monotonic functions). Composition of functions. The inverse function. Power and exponential functions, and opposite to them. Properties of logarithms	3
Le_03	Trigonometric functions and their inverses. Graphs of trigonometric and of its inverses	2
Le_04	Sequences and limits. Basic formulas and theorems. Number e. Improper limits	2
Le_05	The limit of a function in a point. Directional limits of function. Asymptotics of function	2
Le_06	Continuity of a function in a point and on the interval. Basic properties of continuous functions. Approximate solutions of equations. Points of discontinuity	2
Le_07	The definition of derivative. Basic formulas and theorems. Geometric and physics interpretations. Mean value theorem. De L'Hospital rule	3
Le_08	Extreme values, monotonicity. Higher order derivatives. Convexity of function	2
Le_09	Examination of the graph of a function.	2
Le_10	Taylor formula. Approximation of function. Applications	2
Le_11	Definite integral. Simple examples. Connection between integral and derivative (Fundamental Theorem of Calculus). Simple examples	2
Le_12	Indefinite integral: basic formulas. Areas of simple figures	4
Le_13	The basic methods of calculus of integrals: integration by parts and by substitution	2
	TOTAL	30

	Form of classes - Classes	Quantity
Cl_01	Tautologies, de Morgan laws, union, intersection and complement of set	5
Cl_02	Natural numbers, integers, rational and real numbers. Logarithm	4
Cl_03	Graphs of simple functions. Inverse function. Composition of functions	3
Cl_04	Trigonometric functions and trigonometric identities	4
Cl_05	Limit of sequences	8

Cl_06	The limit of a function in point	4
Cl_07	Continuous functions	2
	Total	30

TEACHING TOOLS USED

ND_01 Lecture - traditional method
ND_02 Classes - traditional method
ND_03 Consultations
ND_04 Student's self-work – preparation to classes

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01-PEK_W03	Exam or e-exam
P2 = F2 (classes)	PEK_U01-PEK_U04	Oral answers, quizzes, written tests and/or e-tests

PRIMARY AND SECONDARY LITERATURE

Primary literature
1. W. Żakowski, W. Kołodziej, Matematyka, Cz. II, WNT, Warszawa 2003
2. W. Żakowski, W. Leksiński, Matematyka, Cz. IV, WNT, Warszawa 2002
3. M. Gewert, Z. Skoczylas, Analiza matematyczna 2. Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław 2012
4. M. Gewert, Z. Skoczylas, Równania różniczkowe zwyczajne. Teoria, przykłady, zadania, Oficyna Wydawnicza GiS, Wrocław 2011
5. W. Krysicki, L. Włodarski, Analiza matematyczna w zadaniach, Cz. I-II, PWN, Warszawa 2006

Secondary literature
1. G. M. Fichtenholz, Rachunek różniczkowy i całkowy, T. I-II, PWN, Warszawa 2007
2. M. Gewert, Z. Skoczylas, Analiza matematyczna 2, Definicje, twierdzenia, wzory. Oficyna Wydawnicza GiS, Wrocław 2012
3. F. Leja, Rachunek różniczkowy i całkowy ze wstępem do równań różniczkowych, PWN, Warszawa 2008
4. R. Leitner, Zarys matematyki wyższej dla studiów technicznych, Cz. 1-2, WNT, Warszawa 2006
5. H. i J. Musielakowie, Analiza matematyczna, T. I, Cz. 1-2 oraz T. II, Cz. 1, Wydawnictwo Naukowe UAM, Poznań 1993 oraz 2000
6. J. Pietraszko, Matematyka. Teoria, przykłady, zadania, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000
7. W. Stankiewicz, Zadania z matematyki dla wyższych uczelni technicznych, Cz. B, PWN, Warszawa 2003

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Mathematical Analysis 2.1 A

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_W01	C01, C04	Le_01-Le_03	ND_01, ND_03, ND_04
PEK_W02	K1MTR_W01	C02, C04	Le_04-Le_11	ND_01, ND_03, ND_04
PEK_W03	K1MTR_W01	C03, C04	Le_12, Le_13	ND_01, ND_03, ND_04
PEK_U01 (skills)	K1MTR_U01	C01, C04	Cl_01	ND_02-ND_04
PEK_U02	K1MTR_U01	C02, C04	Cl_02-Cl_04	ND_02-ND_04
PEK_U03	K1MTR_U01	C02, C04	Cl_05	ND_02-ND_04
PEK_U04	K1MTR_U01	C03, C04	Cl_07	ND_02-ND_04

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Równania różniczkowe zwyczajne**	
Name in English:	**Ordinary Differential Equations**	
Main field of studies:	**Mechatronics**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**MAP003062**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	15			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	Z	Z			
Number of ECTS points	2	2			
Including number of ECTS points for practical (P) classes	0	2			
Including number of ECTS points for direct teacher-student contact (BK) classes	1.2	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES
1. Knows the calculus of functions of one and several variables
2. Knows and knows how to use indefinite and definite integrals of functions of one variable
3. Understands basic concepts of numerical series and a power and knows how to explore the convergence of series
4. Can use in the calculation of complex numbers
5. Knows the basic concepts of linear algebra

SUBJECT OBJECTIVES
C01 Understanding the basic types of ordinary differential equations and methods of solving them
C02 Acquisition of stacking skills of differential equations to describe simple models in physics and engineering
C03 Mastering the Laplace operators methods for solving equations and systems of differential equations
C04 Knowledge of basic methods for testing the stability of systems of differential equations

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01   Knows the most important types of differential equations and methods of solving
PEK_W02   Knows the method for solving systems of linear equations with constant coefficients
PEK_W03   Knows the Laplace operator method of solving differential equations

Relating to skills

PEK_U01   Can arrange and solve a differential equation describing simple physical models
PEK_U02   Can solve basic types of differential equations
PEK_U03   Can solve differential equations with constant coefficients

Relating to social competences

PEK_K01   Is able to search for and use of literature recommended for the course and independently acquire knowledge

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Ordinary differential equations of the first order. Problems leading to differential equations. Differential equations with separated variables. Linear ordinary differential equations of the first order	2
Le_02	Examples of issues that lead to differential equations of the second order. Preliminary notions for linear ordinary differential equations of the second order	1
Le_03	Linear ordinary differential equations second order homogeneous. Lowering the order linear differential equation of second order	2
Le_04	Linear ordinary differential equations second order inhomogeneous. Method of variation of parameters	2
Le_05	Linear ordinary differential equations of the second order with constant coefficients. Method of undetermined coefficients	2
Le_06	Preliminary notions for systems of ordinary differential equations. Homogeneous systems of linear ordinary differential equations	2
Le_07	Systems of linear ordinary differential equations with constant coefficients (simple eigenvalues)	2
Le_08	Applications of Laplace transform to solve initial value problems for linear ordinary differential equations with constant coefficients	2
	TOTAL	15

Form of classes - Classes		Quantity
Cl_01	Construction of differential equations describing the simple physical issues. Solving differential equations with separated variables. Finding solutions to problems early	1
Cl_02	Construction and solving differential equations of the first order	2
Cl_03	Construction and solving differential equations of the second order, and initial value problems for such equations	2
Cl_04	Solving linear ordinary differential equations of the second order non-homogeneous method of variation of parameters	2
Cl_05	Solving linear ordinary differential equations of the second order with constant coefficients method of undetermined coefficients.	2
Cl_06	Solving homogeneous systems of linear ordinary differential equations	2
Cl_07	Solving linear systems of ordinary differential equations with constant coefficients of individual eigenvalues	2
Cl_08	Solve initial value problems for linear ordinary differential equations with constant coefficients by Laplace Transformation	2
	Total	15

TEACHING TOOLS USED
ND_01 Lecture - traditional method
ND_02 Classes - traditional method
ND_03 Consultations
ND_04 Student's self-work – preparation to classes

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01-PEK_W03	Exam or lecture assessment
P2 = F2 (classes)	PEK_U01-PEK_U03, PEK_K01	Classes assessment

PRIMARY AND SECONDARY LITERATURE
Primary literature
1. M. Gewert, Z. Skoczylas, Równania różniczkowe zwyczajne. Teoria, przykłady, zadania, Oficyna Wydawnicza GiS, Wrocław 2007
Secondary literature
1. J. Muszyński, A. D. Myszkis, Równania różniczkowe zwyczajne, PWN, Warszawa 1984
2. M. M. Matwiejew, Zadania z równań różniczkowych zwyczajnych, PWN, Warszawa 1976

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Ordinary Differential Equations

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1MTR_W01	C01, C02	Le_01-Le_09	ND_01-ND_04
PEK_W02	K1MTR_W01	C03	Le_10-Le_13	ND_01-ND_04
PEK_W03	K1MTR_W01	C04	Le_14, Le_15	ND_01-ND_04
PEK_U01 (skills)	K1MTR_U01	C01, C02	Cl_01-Cl_08	ND_01-ND_04

PEK_U02	K1MTR_U01	C03	Cl_01-Cl_08	ND_01-ND_04
PEK_U03	K1MTR_U01	C04	Cl_01-Cl_08	ND_01-ND_04
PEK_K01 (competences)	K1MTR_K01	C01-C04	Cl_01-Cl_08	ND_01-ND_04