

**Field of study educational effects
for *Mechatronics*
second level studies – general academic**

Faculty: Microsystem Electronics and Photonics
Field of study: Electronics and Telecommunication
Level of studies: second level, full time study

Location of the field of study in the area (areas) of education:

Area of education: technical studies

Branch of science: technical studies

Discipline: electronics (main discipline), mechanical engineering, information science

The graduates in the field of *Mechatronics* have interdisciplinary knowledge and skills that allow to solve specific interdisciplinary issues, i.e. electronic, programming and mechanical problems on the level of components, systems and instrumentation.

The concept of studies and their connection with the first level studies

A person applying for the second level study in the field of study *Mechatronics* should possess the first level qualifications and competences necessary for continuing education at the second level study in this field of study. The candidate should have the competences which encompass the following:

1. knowledge and skills in the field of mathematics, physics, metrology, production management and engineering and data recording in technique,
2. knowledge and skills in the field of material engineering, mechanics, construction design, driving systems, manufacturing technologies, thermodynamics,
3. knowledge and skills in the field of electrical engineering, electronics and optoelectronics, sensors and actuators, microprocessors and microcontrollers, control automatics, robotics and technologies in electronics,
4. knowledge and skills in the field of programming, programming languages, communication networks and interfaces, signal and imaging processing and computer aided engineering design,
5. knowledge about review and applications of mechatronics and basic skills connected with designing mechatronic systems, especially aspects connected with programming and electronics,
6. skills connected with interpretation, presentation and documentation of experimental results and presentation and documentation of a project-like task,
7. the skill of using English-language documents and literature.

Legend:

K (before line/dash) – field-of-study educational effects

W – category of knowledge

U – category skills

K (after line/dash) – category of social competences

P7U_W, P7U_U, P7U_K – Universal characteristics of levels in Polish Qualification Framework

P7S_WG, P7S_WK, P7S_UW, P7S_UK, P7S_UO, P7S_UU, P7S_KK, P7S_KO, P7S_KR – Second stage characteristics of Polish Qualification Framework

For the precise definition of the reference to the definitions of the characteristics of the second stage of the Polish Qualification Framework, the following extensions were added and numbered:

P7S_WG_NT, P7S_WK_NT, P7S_UW_NT – Scope of teaching in the field of technical sciences

P7S_WG_INŻ, P7S_WK_INŻ, P7S_UW_INŻ - Qualifications covering engineering competencies

<p>Field of study educational effects for the 2nd level studies in <i>Mechatronics</i></p>	<p style="text-align: center;">DESCRIPTION OF FIELD OF STUDY EDUCATIONAL EFFECTS</p> <p style="text-align: center;">Upon completion of the second level study in the field of <i>Mechatronics</i> the graduate:</p>	<p>Correlation of educational effects with universal characteristics of PQF, with second stage characteristics of PQF for qualifications on the 7th level, with second stage characteristics of PQF for engineering competences on the 7th level</p>
KNOWLEDGE		
K2MTR_W01	knows the principle of operation of popular digital telecommunication interfaces used in mechatronics	P7U_W
K2MTR_W02	knows the methodology of design and programming of electronic embedded systems for applications used in mechatronics	P7U_W
K2MTR_W03	has actual knowledge about principles of operation and design methods of battery-less and wireless systems	P7U_W P7S_WG P7S_WG_NT P7S_WG_INŽ
K2MTR_W04	has theoretically grounded general knowledge concerning designing and construction of electronic apparatus	P7U_W
K2MTR_W05	has precise knowledge concerning construction, principles of operation and application area of microprocessors integrated circuits	P7S_WG P7S_WG_NT P7S_WG_INŽ
K2MTR_W06	has theoretically grounded knowledge concerning material's diagnostic methods applied in electronics	P7S_WG

K2MTR_W07	has general knowledge from the completed main courses during the studies, detailed knowledge on specific topics and knows development trends in mechatronics and other disciplines connected with mechatronics	P7S_W P7S_WG P7S_WG_NT P7S_WG_INŽ
K2MTR_W08	has completed the diploma thesis, basing on the acquired during the studies knowledge, specific for studied field of study in <i>Mechatronics</i>	P7U_W P7S_WG P7S_WG_NT P7S_WG_INŽ
K2MTR_W09	has knowledge concerning manufacturing processes and application of novel optoelectronic elements and devices in microsystems	P7S_WG
K2MTR_W10	knows the application principles of micromechanisms and microdrives in the technology and daily life	P7S_WG P7S_WG_NT P7S_WG_INŽ
K2MTR_W11	knows the construction, technology and application possibilities of micro-opto-electro mechanical systems (MOEMS) in modern technique	P7S_WG P7S_WG_NT P7S_WG_INŽ
K2MTR_W12	has theoretically grounded knowledge concerning optical fibre technique, including knowledge necessary to understand physical principles of operation of optical fibres and optical telecommunication systems	P7S_WG P7S_WG_NT P7S_WG_INŽ
K2MTR_W13	has theoretically grounded and practical knowledge concerning numerical methods and tools for electronic micro- and nanosystems modelling and designing	P7S_WG P7S_WG_NT P7S_WG_INŽ
K2MTR_W14	has knowledge concerning reliability theory in mechatronics including: methods of mechatronic systems testing and diagnostics, reliability characteristics and distributions, estimation of reliability parameters, failure models	P7S_WG P7S_WG_NT P7S_WG_INŽ
K2MTR_W15	has ordered, theoretically grounded knowledge concerning construction, principle of operation, properties and applications of chemical and optical fibre sensors used in electronics and knows development trends of advanced sensing systems	P7S_WG P7S_WG_NT P7S_WG_INŽ
K2MTR_W16	has ordered and extended knowledge concerning construction and principle of operation of analogue and digital electronic circuits and signal processing methods, i.e. from sensing system	P7U_W P7S_WG

K2MTR_W17	has ordered and theoretically grounded knowledge concerning advanced microelectronic technologies, manufacturing processes of thin and thick film electronic elements and integrated circuits and biochemical sensors, knows the actual state of the art and development trends in advanced microelectronic technologies	P7S_WG P7S_WG_NT P7S_WG_INŽ
K2MTR_W18	knows and understands the area of application and characteristics of optoelectronic systems and basic concepts concerning construction of electronic elements, especially the optoelectronic elements	P7S_WG
K2MTR_W19	has extended knowledge concerning metrology and application of devices for control and measurements; knows and understands methods of physical quantities measurements, characteristics of measured objects and remote control by virtual apparatus	P7U_W P7S_WG
K2MTR_W20	has knowledge concerning applications of laser technology for manufacturing i.e. cutting, welding, hardfacing and laser micromachining; understands the principle of laser's operation, optical energy transfer and its interaction with matter	P7U_W P7S_WG
K2MTR_W21	has knowledge concerning enterprise management, in particular projects and management of interdisciplinary teams, that implements mechatronic projects	P7S_WK P7S_WK_NT P7S_WK_INŽ
K2MTR_W22	has knowledge concerning the basic concepts of the theory and techniques of systems and operational processes management; also has the knowledge of innovative problem solving, conceptual design and rules of solution selection	P7U_W P7S_WG
K2MTR_W23	has knowledge concerning the construction and operation of the typical mechatronic systems in working machines and a variety of vehicles (hoists, storage devices, construction, mining, agriculture machines, etc.)	P7S_WG P7S_WG_NT P7S_WG_INŽ
K2MTR_W24	has knowledge of the dynamics modelling of mechatronic systems, taking into account the definition of the finite element of mechanical, electrical, electrohydraulic objects, etc.	P7S_WG
K2MTR_W25	has knowledge concerning probability theory, mathematical statistics and probability distributions, particularly related to mechatronics	P7U_W
SKILLS		
K2MTR_U01	is able to choose and configure digital communication interface, according to mechatronic project requirements	P7S_UW P7S_UW2_NT P7S_UW4_NT P7S_UW2_INŽ P7S_UW4_INŽ

K2MTR_U02	is able to design, program and construct an embedded system, which is an integral part of a mechatronic system	P7S_UW P7S_UW2_NT P7S_UW4_NT P7S_UW2_INŽ P7S_UW4_INŽ
K2MTR_U03	is able to design and program a wireless and battery-less electronic system	P7S_UW P7S_UW2_NT P7S_UW4_NT P7S_UW2_INŽ P7S_UW4_INŽ
K2MTR_U04	is able to assess and choose adequate diagnostic methods for materials and technologies applied in electronics	P7U_U P7S_UW1_NT P7S_UW2_NT P7S_UW3_NT P7S_UW1_INŽ P7S_UW2_INŽ P7S_UW3_INŽ
K2MTR_U05	is able to choose and program a microprocessor or microcontroller for application in a specialised mechatronic project	P7S_UO P7S_UW4_NT P7S_UW4_INŽ
K2MTR_U06	is able to present own research results, acquire and analyse information from the literature, databases and other correctly chosen sources; present own qualifications concerning knowledge, skills and social competences relevant to the field of study in <i>Mechatronics</i>	P7S_UW P7S_UK P7S_UU
K2MTR_U07	is able to create technical texts (“Diploma Thesis”) and multimedia presentations, presenting own research results, acquire and analyse data concerning problems connected with field of study in <i>Mechatronics</i> ; critically analyse and assess current technical solutions and is able to propose new ones	P7S_UW P7S_UU P7S_UW3_NT P7S_UW3_INŽ
K2MTR_U08	is able to design and use a microsystem with optoelectronic elements and assess its functional capabilities and also can propose possible upgrades	P7S_UW3_NT P7S_UW3_INŽ
K2MTR_U09	is able to correctly choose micomachines and microdrives in practical applications	P7S_UW P7S_UW2_NT P7S_UW2_INŽ

K2MTR_U10	is able to design a measurement experiment, can use correctly chosen measuring units and systems, calculate measurement uncertainty and compile the measurements results	P7S_UW1_NT P7S_UW1_INŽ
K2MTR_U11	is able to correctly choose MOEMS for practical application	P7S_UW P7S_UW2_NT P7S_UW2_INŽ
K2MTR_U12	is able to design, start-up and test electronic analogue circuits, is able to make a cost estimation model, knows the health and safety rules	P7S_UW P7S_UW2_NT P7S_UW2_INŽ
K2MTR_U13	knows and uses the workplace health and safety rules in work with lasers and optical fibres; is able to use basic measurement devices and build a measuring system for application in optical fibre technique	P7S_UW1_NT P7S_UW1_INŽ
K2MTR_U14	is able to use appropriate numerical methods and devices for computer aided design for electronic micro- and nanosystems design (i.e. Ansys, FlexPDE, Material Studio, etc.)	P7S_UW2_NT P7S_UW2_INŽ
K2MTR_U15	is able to solve problems concerning reliability theory of mechatronic systems, including: calculation of reliability characteristics and parameters on the basis of measured data, planning methods of diagnostics and tests	P7S_UW1_NT P7S_UW1_INŽ
K2MTR_U16	is able to design specific chemical and optical fibre sensor and prepare concepts of its construction and parameters; is able to use appropriate constructions in designed sensing systems	P7S_UW P7S_UW1_NT P7S_UW1_INŽ
K2MTR_U17	is able to assess and compare analogue and digital circuit on the basis of its parameters and is able to analyse its operation in different applications; is able to assess the usefulness and application possibilities of novel solutions concerning signal processing systems and methods	P7S_UW2_NT P7S_UW2_INŽ
K2MTR_U18	is able to design a technological manufacturing process of a specific semiconductor or optoelectronic devices and systems or elements manufactured in thick-film technology, is able to specify further self-study area	P7S_UU P7S_UW2_NT P7S_UW2_INŽ
K2MTR_U19	is able to choose technique and required data needed for completion of a designed project and is able to design basic optoelectronic systems projects by self	P7S_UW P7S_UW3_NT P7S_UW3_INŽ
K2MTR_U20	is able to use virtual control and measuring apparatus and is able to build and configure appropriate control and measuring systems applied in engineering practice	P7S_UW2_NT P7S_UW2_INŽ
K2MTR_U21	is able to use, parameterise and investigate the operation results of a mechatronic devices in different manufacturing technologies	P7S_UW1_NT P7S_UW1_INŽ
K2MTR_U22	is able to choose laser beam parameters for specific process, is able to use specialised equipment used in laser micromachining processes	P7S_UW1_NT P7S_UW1_INŽ

K2MTR_U23	is able to analyse the construction and operation principle of various mechatronic systems applied in the working machines and vehicles, is able to design and carry out a research experiment	P7S_UW2_NT P7S_UW2_INŽ
K2MTR_U24	is able to perform computer simulation of hydraulic system's operation, analyse dynamic processes; is able to analyse and construct a hydrotronic system	P7S_UW2_NT P7S_UW2_INŽ
K2MTR_U25	is able to model mechatronic system in professional virtual design programs (CAS, MBS, MES), perform static and dynamic calculations in linear and non-linear range	P7S_UW2_NT P7S_UW2_INŽ
K2MTR_U26	knows foreign language at the upper-intermediate level (B2+) used in the studied field of specialisation; is able to communicate in work (oral communication and writing), knows more than one foreign language	P7S_UK
K2MTR_U27	understands and is able to use the basic concepts of probability theory and mathematical statistics in mechatronic practice	P7U_U P7S_UW2_NT P7S_UW2_INŽ
SOCIAL COMPETENCES		
K2MTR_K01	is able to think and act in creative and entrepreneurial way, work in a group, understands the importance and knows possibilities of constant self-study, analyses taken decision and its influence on the environment and dilemmas related with it	P7U_K P7S_KO P7S_KR
K2MTR_K02	is able to work by self and in a group, undertaking different roles in the group	P7U_K
K2MTR_K03	is able to co-work and work in a group, undertaking different roles in the group	P7U_K
K2MTR_K04	plans his or her actions in a creative way, is able to specify priorities and the order of tasks	P7S_KK
K2MTR_K05	understands the need to learn and use new techniques and technologies and is able to define goals and predicts the effects of the undertaken experimental work and works independently and in a team	P7S_KK
K2MTR_K06	takes into account the necessity for application of numerical methods in electronic system design	P7S_KK
K2MTR_K07	is able to see the aspects connected with the reliability of mechatronic systems and statistical presentation of the measurement data in various fields of engineering practice	P7U_K
K2MTR_K08	understands the necessity for constant learning and understands the operation principle of the sensor systems and the necessity for their application in diagnostic and control systems	P7S_KK
K2MTR_K09	while working in a group, properly identifies, solves and implements knowledge concerning the design and application of electronic circuits	P7U_K P7S_KR
K2MTR_K10	understands the influence of applied technologies on the environment and is conscious of limits that are connected with it	P7S_KO P7S_KR
K2MTR_K11	development of skills connected with working in group and taking responsibility for results of own work	P7U_K
K2MTR_K12	is able to see positive aspects of virtual control and measuring apparatus application in engineering practice	P7S_KK

K2MTR_K13	is conscious of importance and understands the non-technical aspects and results of mechatronic engineer work, its influence on the environment and responsibility for own decisions	P7S_KR
K2MTR_K14	is able to specify the priorities concerning the completion of a task specified by himself or others	P7S_KK P7S_KO
K2MTR_K15	is able to search and use the literature, acquire knowledge by himself, works systematically and develops skills; is able to work in a group	P7U_K