

**Field of study educational effects  
for *Electronics and Telecommunications*  
second level studies – general academic**

**Faculty: Microsystem Electronics and Photonics**

**Field of study: Electronics and Telecommunications**

**Level of studies: second level, full time study**

Location of the field of study in the area of education

The field of study *Electronics and Telecommunications* (EiT) belongs to the area of education in technical sciences and is connected with such fields of study as *Informatics, Mechatronics and Automatics and Robotics*.

A person applying for the second level study at the Faculty of Microsystem Electronics and Photonics of Wrocław University of Science and Technology at the specialization of EiT should possess the first level qualifications and competences necessary for continuing education at the second level study in this specialization – the competences which encompass the following:

1. knowledge in the field of physics and mathematics enabling understanding of physical basis of electronics and telecommunication as well as formulating and solving simple project tasks from this area,
2. knowledge and skills from the field of analog and digital electronic circuits, metrology, semiconductor devices, signal processing, fundamentals of telecommunication, enabling measurements, analysis, simulation and design of simple elements and electronic and communication systems,
3. skill of using analytical, simulation and experimental methods for formulating and solving engineering tasks,
4. knowledge and skills concerning architecture and software of computer systems,
5. knowledge and skills on methodology and techniques of programming, enabling formulation of an algorithm for a simple engineering task and developing a software program in a chosen high level language with the use of suitable informatics tools,
6. skills connected with interpretation, presentation and documentation of experimental results and presentation and documentation of a project-like task.

Legend:

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

**S** – specialization 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><b>Field of study educational effects for the 2nd level studies in <i>Electronics and Telecommunications</i></b></p>	<p align="center"><b>DESCRIPTION OF FIELD OF STUDY EDUCATIONAL EFFECTS</b></p> <p align="center"><b>Upon completion of the second level study in the field of <i>Electronics and Telecommunications</i> the graduate:</b></p>	<p><b>Correlation of educational effects with universal characteristics of PQF, with second stage characteristics of PQF for qualifications on the 7<sup>th</sup> level, with second stage characteristics of PQF for engineering competences on the 7<sup>th</sup> level</b></p>
<b>KNOWLEDGE</b>		
K2eit_W01	has extended and deepened knowledge in the area of sciences and disciplines (physics, chemistry, biology, informatics, materials engineering) necessary to understand the essence of phenomena/properties being the result of size reduction, which are used in nanotechnology	P7U_W P7S_WG
K2eit_W02	has extended and deepened knowledge in the field of physics, encompassing basis of quantum physics and solid state physics and theoretical and experimental bases of specific phenomena from the area of electronics and photonics, necessary to understand the phenomena (photoelectronic, electro-acoustic, super-conductivity)	P7U_W P7S_WG
K2eit_W03	has basic knowledge concerning theory and methods of linear and nonlinear programming used in optimization procedures	P7S_WG
K2eit_W04	has theoretically grounded knowledge concerning typical techniques and numerical algorithms applied in engineering, such as: numerical differentiation and integration, experiment design, optimization applied to solving equations or equation systems, both linear and nonlinear, numerical interpolation or optimization and systems of differential equations	P7U_W P7S_WG
K2eit_W05	knows and understands the elements of mathematical statistics in terms of possibilities of its application in engineering practice and scientific research	P7U_W

K2eit_W06	has basic knowledge concerning ordinary and partial differential equations, integral equations, theory of stochastic processes (stationary, Markow, renewal, gaussian processes), Hilbert spaces, necessary to understand mathematical problems in sciences of engineering character	P7U_W
K2eit_W07	has knowledge concerning reliability theory, methods of elements and devices testing, diagnostic methods, basic characteristics in theory of reliability, typical distributions, reliability of systems, estimation of reliability parameters, experiment design, testing and diagnostics as well as failure models	P7S_WG P7S_WG_NT P7S_WG_INŽ
K2eit_W08	has knowledge concerning basis of operation of force and deflection sensors basing on piezoresistive and piezoelectric effects, methods of calculation of measurement sensitivity and resolution of piezoresistive sensors and designs of MEMS systems	P7S_WG
K2eit_W09	has ordered, theoretically grounded, general and detailed knowledge in the range of exact and technical sciences in the areas related to the field of study	P7U_W P7S_WG P7S_WG_NT P7S_WG_INŽ
K2eit_W10	has knowledge on the basic concepts of production management systems useful for managers of small or middle enterprises; knows modern production systems and production management systems as well as information about finances, market analysis, logistics, people management, which are necessary in strategic management of enterprises	P7S_WK P7S_WK_NT P7S_WK_INŽ
K2eit_W11	has knowledge necessary to understand economic, legal, social and beyond technical factors of engineering activities and their using in engineering practice	P7S_WK P7S_WK_NT P7S_WK_INŽ
K2eit_W12	has basic knowledge concerning management, quality management and running a business	P7S_WK P7S_WK_NT P7S_WK_INŽ
K2eit_W13	has knowledge concerning sensor technologies, including the knowledge necessary to understand the physical and mechanical principles of operation of sensors and actuators; knows relations between their functional parameters and structure; has basic knowledge on sensor and actuators technologies	P7U_W P7S_WG P7S_WG_NT P7S_WG_INŽ
	achieves results in KNOWLEDGE category in one of the following specializations: <ul style="list-style-type: none"> <li>• Microsystems – EMS</li> <li>• Optoelectronics and Waveguide Technology – EOT</li> <li>• Electronics, Photonics, Microsystems – EPM</li> </ul>	

<b>SKILLS</b>		
K2eit_U01	is able to assess and use devices/objects with nanometric dimensions (especially semiconductor devices and other ones, made using different technologies)	P7S_UW P7S_UW1_NT P7S_UW2_NT P7S_UW3_NT P7S_UW1_INŽ P7S_UW2_INŽ P7S_UW3_INŽ
K2eit_U02	is able to assess and use the phenomena occurring in solid state materials in quantum electronics applications	P7S_UW P7S_UW1_NT P7S_UW2_NT P7S_UW3_NT P7S_UW1_INŽ P7S_UW2_INŽ P7S_UW3_INŽ
K2eit_U03	using the methods of linear and nonlinear programming, is able to solve problems and tasks, optimizing the goal	P7U_U P7S_UW P7S_UW2_NT P7S_UW1_INŽ P7S_UW2_INŽ
K2eit_U04	is able to use the learned numerical methods for solving typical engineering tasks	P7U_U P7S_UW P7S_UW2_NT P7S_UW1_INŽ P7S_UW2_INŽ
K2eit_U05	has basic practical skills concerning presentation, analysis and interpretation of data and application of statistical methods in the analysis of various physical phenomena	P7U_U P7S_UK P7S_UW2_NT P7S_UW2_INŽ
K2eit_U06	is able to correctly and effectively use the knowledge concerning differential and integral equations, as well as stochastic processes, for qualitative and quantitative analysis of mathematical problems related to the studied engineering discipline	P7U_U P7S_UW2_NT P7S_UW2_INŽ
K2eit_U07	is able to solve problems concerning calculation of reliability characteristics, calculation of parameters using measurement data, planning of testing methods, planning of diagnostic methods	P7U_U P7S_UW2_NT P7S_UW2_INŽ

K2eit_U08	is able to explain the operating principle and basic characteristics and designs of deflection actuators using piezoelectric and electrostatic actuation	P7U_U P7S_UK
K2eit_U09	is able, using literature information and basing on the result of own work, integrating, interpreting and critically evaluating, to prepare and give an oral presentation relevant to the field of study	P7U_U P7S_UW P7S_UK P7S_UU P7S_UW1_NT P7S_UW2_NT P7S_UW3_NT
K2eit_U10	is able to use the acquired knowledge on modern production systems, processes of production management, market analysis, logistics and people management	P7U_U P7S_UO P7S_UW4_NT P7S_UW4_INŽ
K2eit_U11	is able to formulate and test the hypotheses connected with engineering problems and simple research work	P7S_UW1_NT P7S_UW1_INŽ
K2eit_U12	is able to assess the usefulness and possibilities of application of modern achievements in the fields of technique and technology connected with the current field of study	P7S_UW2_NT P7S_UW2_INŽ
K2eit_U13	is able to perform critical analysis of the way of functioning and assess novel technical solutions, especially connected with the current field of study, such as devices, objects, systems, processes, services	P7S_UW2_NT P7S_UW3_NT P7S_UW2_INŽ P7S_UW3_INŽ
K2eit_U14	is able to suggest rationalization proposal/improvements to existing technical solutions	P7S_UW3_NT P7S_UW3_INŽ
K2eit_U15	is able to assess and use semiconductor devices and other devices fabricated using various techniques/technologies	P7S_UW2_NT P7S_UW2_INŽ
K2eit_U16	is able to define the fields of further education and follow the process of self-learning	P7S_UU
	achieves results in SKILLS category in one of the following specializations: <ul style="list-style-type: none"> <li>• Microsystems – EMS</li> <li>• Optoelectronics and Waveguide Technology – EOT</li> <li>• Electronics, Photonics, Microsystems – EPM</li> </ul>	
<b>SOCIAL COMPETENCES</b>		
K2eit_K01	shows curiosity about new innovative design solutions and production processes	P7S_KK
K2eit_K02	perceives the aspects connected with collecting and presentation of measurement data in various areas of engineering practice and the need of using statistical methods for their description	P7U_K P7S_KK P7S_KR

K2eit_K03	perceives the necessity of undertaking and putting into practice optimization measures in various areas of life	P7U_K P7S_KK P7S_KO
K2eit_K04	takes into account the need of using numerical methods in design process	P7S_KK
K2eit_K05	can think and act in a creative and entrepreneurial way	P7S_K P7S_KK
K2eit_K06	properly recognizes, solves, and acting in a team, puts into practice the knowledge concerning analysis of mathematical problems	P7S_KK P7S_KO P7S_KR
K2eit_K07	is able to properly define priorities for realization of a task defined by himself/herself or other person; can safely perform measurements and work out results of measurements	P7U_K P7S_KR
K2eit_K08	is conscious of importance of the issues connected with implementation and functioning in engineering activity of modern production systems, production management systems, logistics and people management	P7U_K P7S_KK
K2eit_K09	realizes the need of formulating and sharing in society, also with the use of mass media, the information and opinions concerning achievements in the field of study, and other aspects of electronic engineer's activity, in a clear, commonly understandable way, justifying various points of view	P7U_K P7S_KO P7S_KR
K2eit_K10	is conscious of importance and realizes beyond technical aspects and consequences of engineering activity, including its impact on environment and associated with it responsibility for taken decisions	P7U_K P7S_KO P7S_KR
K2eit_K11	is able to define priorities for realization of a particular task	P7U_K
K2eit_K12	properly recognizes and settles dilemmas connected with professional activity	P7S_KR
	achieves results in COMPETENCES category in one of the following specializations: <ul style="list-style-type: none"> <li>• Microsystems – EMS</li> <li>• Optoelectronics and Waveguide Technology – EOT</li> <li>• Electronics, Photonics, Microsystems – EPM</li> </ul>	

# EDUCATIONAL EFFECTS FOR EMS SPECIALIZATION

**Faculty:** Microsystem Electronics and Photonics  
**Field of study:** Electronics and Telecommunications  
**Level of studies:** second level, full time study  
**Specialization:** Microsystems (EMS)

Specialization educational effects at the 2nd level study in <i>Microsystems</i>	DESCRIPTION OF EDUCATIONAL EFFECTS	Correlation of educational effects with universal characteristics of PQF, with second stage characteristics of PQF for qualifications on the 7 <sup>th</sup> level, with second stage characteristics of PQF for engineering competences on the 7 <sup>th</sup> level
<b>KNOWLEDGE</b>		
S2ems_W01	has extended and deepened knowledge concerning technological processes applied in widely understood thin-film microelectronics, with the use of the knowledge on phenomena occurring in plasma processes carried out at reduced pressure	P7U_W P7S_WG
S2ems_W02	has extended and deepened knowledge concerning theoretical and practical aspects of application of numerical methods for modeling and design in the field of microsystems	P7U_W P7S_WG
S2ems_W03	has ordered basic knowledge concerning structure and operation of analog integrated circuits	P7U_W P7S_WG

S2ems_W04	understands methodology of programming and implementation of <i>FPGA</i> systems	P7U_W P7S_WG
S2ems_W05	has extended and deepened knowledge in the range of sciences (physics, chemistry, biology, informatics, material engineering) necessary to understand the essence of phenomena/ properties being the result of size reduction, which are used in microsystems	P7U_W P7S_WG
S2ems_W06	has extended and deepened knowledge in the field of physics, encompassing basis of quantum physics and solid state physics and theoretical and experimental basis of specific phenomena in the field of electronics and microsystems	P7U_W P7S_WG
S2ems_W07	has basic knowledge concerning theory and methods of linear and nonlinear programming used in optimization procedures of microelectromechanical systems	P7S_WG
S2ems_W08	has theoretically grounded knowledge concerning typical techniques and numerical algorithms applied in modelling of microelectromechanical systems	P7U_W P7S_WG
S2ems_W09	knows and understands the elements of mathematical statistics in terms of possibilities of its application in engineering practice and scientific research in the field of microsystem technique	P7U_W
S2ems_W10	has basic knowledge concerning ordinary and partial differential equations, integral equations, theory of stochastic processes (stationary, Markow, renewal, gaussian processes), Hilbert spaces, necessary to understand mathematical problems in sciences of engineering character, applied in the MEMS technique	P7U_W
S2ems_W11	has extended, deepened and ordered knowledge in the range of physics and basis of chemistry, necessary to understand the principles of operation of supplying systems in microsystems (principle of operation, technological and design solutions, exploitation parameters)	P7U_W
S2ems_W12	has theoretically grounded knowledge on current achievements in commercial and industrial electronics: microelectronics, high power and high temperature electronics, microsystems, including MEMS and MOEMS; has knowledge about the newest achievements in electronics application	P7S_WG
S2ems_W13	has ordered and theoretically grounded knowledge related to structure, operation principles, properties and applications of physical and chemical sensors as well as microsystems made using thick-film and LTCC ( <i>Low Temperature Cofired Ceramics</i> ) technology; knows trends in the development of LTCC microsystems	P7S_WG
S2ems_W14	has theoretically grounded knowledge concerning physico-chemical, and technological basis, design, fabrication, operation and applications of analytical microsystems, microreactors, bio-chips and lab-on-chips	P7S_WG P7S_WG_NT P7S_WG_INŽ
S2ems_W15	has ordered knowledge concerning application of the methods of investigation and analysis of results for comprehensive diagnostics of the properties of materials for electronics and photonics	P7U_W P7S_WG

S2ems_W16	has knowledge on the basis of sensor technology relevant to the studied discipline, including the knowledge necessary to understand physical and chemical mechanisms of sensor operation, taking into account the relations between their functional parameters and the structure; moreover has knowledge on classification and technologies of sensor fabrication	P7U_W P7S_WG
S2ems_W17	has knowledge on the structure and principles of operation of contemporary operating systems, with special emphasis on Linux family and embedded systems; knows the principles of using of low-level system functions as well as programming and configuration of embedded systems intended for microcontrollers	P7U_W P7S_WG
S2ems_W18	has ordered knowledge concerning structure, operation and designing of specific electronic circuits responsible for measurement and processing of sensor signals	P7U_W P7S_WG
S2ems_W19	has knowledge concerning reliability theory, methods of testing of elements and devices and diagnostic methods; has knowledge on basic characteristics in the theory of reliability, typical distributions, reliability of systems, estimation of reliability parameters, experiment design, testing and diagnostics as well as failure models	P7S_WG_NT P7S_WG_INŽ
S2ems_W20	has knowledge concerning basis of operation of force and deflection sensors basing on piezoresistive and piezoelectric effects, methods of calculation of measurement sensitivity and resolution of piezoresistive and piezoelectric sensors and structures of MEMS systems	P7S_WG_NT P7S_WG_INŽ
S2ems_W21	has ordered, theoretically grounded general and detailed knowledge in the field of exact and technical sciences relevant to the studied specialization; knows basic principles of editing of research projects and diploma thesis	P7U_W P7S_WG P7S_WG_NT P7S_WG_INŽ
S2ems_W22	has ordered knowledge on basic technological processes, characteristic of polymer and molecular electronics and basic materials, passive elements and active devices of organic electronics	P7U_W P7S_WG
S2ems_W23	has ordered, theoretically grounded universal and detailed knowledge in the range of exact and technical sciences relevant to the studied specialization	P7U_W P7S_WG
S2ems_W24	has knowledge on the basis of production management and management systems useful for the managers of a small or middle enterprises; knows modern production systems and production management systems as well as financial information, market analysis, logistics, people management, which are necessary in strategic enterprise management	P7S_WK
<b>SKILLS</b>		
S2ems_U01	is able to design a technological process of thin-film deposition, including the processes occurring in gas discharge	P7U_U P7S_UW P7S_UW1_NT P7S_UW1_INŽ

S2ems_U02	is able - while formulating and solving the tasks associated with modeling and design of microsystems - to integrate knowledge coming from different sources	P7S_UW2_NT P7S_UW2_INŽ
S2ems_U03	is able to asses and compare, in terms of the parameters describing an integrated circuit, system solutions and perform analysis of operation of analog and digital integrated circuits in typical applications	P7S_UW2_NT P7S_UW2_INŽ
S2ems_U04	is able to program and implement <i>FPGA</i> systems	P7S_UW4_NT P7S_UW4_INŽ
S2ems_U05	is able to assess and use devices/objects with micrometric dimensions (especially sensor devices and other ones, made using different technologies)	P7S_UW P7S_UW1_NT P7S_UW2_NT P7S_UW3_NT P7S_UW1_INŽ P7S_UW2_INŽ P7S_UW3_INŽ
S2ems_U06	is able to assess and use the phenomena occurring in a solid state material in microsystems	P7S_UW P7S_UW1_NT P7S_UW2_NT P7S_UW3_NT P7S_UW1_INŽ P7S_UW2_INŽ P7S_UW3_INŽ
S2ems_U07	is able, using the methods of linear and nonlinear programming, to solve the tasks optimizing the parameters of the microsystems	P7U_U P7S_UW P7S_UW2_NT P7S_UW1_INŽ P7S_UW2_INŽ
S2ems_U08	is able to use the learned numerical methods during design of MEMS structures	P7U_U P7S_UW P7S_UW2_NT P7S_UW1_INŽ P7S_UW2_INŽ
S2ems_U09	has basic practical skills concerning presentation, analysis and interpreting data as well as application of statistical methods in the analysis of microsystems reliability	P7U_U P7S_UK P7S_UW2_NT P7S_UW2_INŽ

S2ems_U10	is able, properly and effectively to apply the knowledge on differential and integral equations, and stochastic processes relevant to the studied specialization	P7U_U P7S_UW2_NT P7S_UW2_INŽ
S2ems_U11	depending on requirements and available solutions, is able to choose and apply exploitation parameters suitable source for supplying a microsystem	P7S_UW2_NT P7S_UW2_INŽ
S2ems_U12	is able to assess the usefulness of application of novel solutions (circuits, systems of functional and industrial electronics) with innovative character	P7S_UW2_NT P7S_UW2_INŽ
S2ems_U13	is able to assess the usefulness and possibility of using physical and chemical sensors, and microsystems made in LTCC technology	P7S_UW2_NT P7S_UW2_INŽ
S2ems_U14	is able to design chosen sensors, actuators and ceramic microsystems; is able to develop prerequisites concerning the structure of selected devices and develop an algorithm of technological process for their fabrication	P7S_UW4_NT P7S_UW4_INŽ
S2ems_U15	is able to describe, assess and compare the operation of analytic gaseous and fluidic microsystems; knows the principles of design, fabrication, operation and application of microsystems in chemistry and microchemistry	P7S_UW P7S_UW2_NT P7S_UW2_INŽ
S2ems_U16	is able to use the acquired knowledge for carrying out the studies of the components of analytical microsystems (valves, metering units, mixers and detectors); knows the operation principles of advanced analytical microsystems (e.g. integrated gas chromatograph)	P7S_UW P7S_UW1_NT P7S_UW2_NT P7S_UW1_INŽ P7S_UW2_INŽ
S2ems_U17	is able to plan and safely carry out measurements and work out the measurement results	P7S_UW1_NT P7S_UW1_INŽ
S2ems_U18	is able to make distinctions between methods used in investigation of semiconductor surface structures applied in microsystem electronics and in structural characterization of modern materials for opto- and microelectronics	P7S_UW1_NT P7S_UW2_NT P7S_UW1_INŽ P7S_UW2_INŽ
S2ems_U19	is able to assess the usefulness and apply the learned methods, used in microelectronics for characterization of a solid material surface, structure, material composition and optical properties	P7S_UW1_NT P7S_UW2_NT P7S_UW1_INŽ P7S_UW2_INŽ
S2ems_U20	is able to design, make and carry out investigation of the produced and commercially available sensors, and to determine their functional parameters	P7S_UW1_NT P7S_UW4_NT P7S_UW1_INŽ P7S_UW4_INŽ
S2ems_U21	has a skill of using low-level system functions and is able to program and configure embedded systems intended for microcontrollers	P7S_UW

S2ems_U22	is able to design electronic circuits responsible for the measurement and processing of sensor signals – and depending on complexity level – make, run and measure functional properties of designed, precise analog and digital (microcontroller) systems, including the automatic control systems	P7S_UW P7S_UW1_NT P7S_UW4_NT P7S_UW1_INŽ P7S_UW4_INŽ
S2ems_U23	is able to explain the principle of operation and basic characteristics of the deflection actuators functioning on piezoelectric and electrostatic actuation principle	P7S_UK
S2ems_U24	is able, using literature information and basing on the results of own work, while integrating, interpreting and making critical evaluation, to prepare diploma thesis and give an oral presentation related to the studied specialization	P7U_U P7S_UW P7S_UK P7S_UU
S2ems_U25	is able to assess and use the knowledge about passive elements and sub-systems (sensors based on the composites: powder filler - organic resin), active devices of organic electronics (emitters of optical radiation, displays, detectors of radiation, organic transistors, integrated circuits and mass memories) as well as chemical sensors based on organic semiconductors	P7S_UW P7S_UW2_NT P7S_UW2_INŽ
S2ems_U26	is able, using the literature information and basing on own work results, while integrating and interpreting and making critical evaluation, to prepare and give an oral presentation concerning the subjects relevant to the studied specialization	P7U_U P7S_UW P7S_UK P7S_UU
S2ems_U27	is able to use the acquired knowledge about modern production systems and production management processes, market analysis, logistics and people management	P7S_UW P7S_UO
<b>SOCIAL COMPETENCES</b>		
S2ems_K01	can work individually and in a team	P7U_K
S2ems_K02	takes into account the necessity of using numerical methods in design process of microsystems	P7S_KK
S2ems_K03	can think and act in innovative and entrepreneurial way	P7U_K P7S_KK
S2ems_K04	shows curiosity about new innovative design solutions and production processes applied in the microsystems technology	P7S_KK
S2ems_K05	perceives the aspects connected with collecting and presentation of measurement data and the need of using statistical methods for description of designed MEMS sensors	P7U_K P7S_KK P7S_KR
S2ems_K06	perceives the necessity of undertaking and putting into practice optimization of structures, elements and systems, applied in various areas of life	P7U_K P7S_KK P7S_KO

S2ems_K07	properly, recognizes solves, and acting in a team, puts into practice the knowledge concerning analysis of engineering problems	P7S_KR P7S_KK P7S_KO
S2ems_K08	understands the need of permanent education; understands the operation principle of the used sensor devices; understands the necessity of sensor applications to improve people's safety, accelerate medical diagnostics and monitor the environment condition	P7U_K P7S_KO P7S_KR
S2ems_K09	is able to set clear priorities for realization of a task defined by himself/herself or other person; can safely perform and work out results of measurements	P7U_K
S2ems_K10	is conscious of importance of the issues connected with implementation and functioning in engineering activity, modern technologies and production systems, production management, logistics and people management	P7U_K P7S_KK
S2ems_K11	understands the need of formulating and sharing in society, e.g. with the use of mass media, the information and opinions concerning achievements in the studied specialization, and other aspects of electronic engineer's activity, in a clear, commonly understandable way, taking into account various points of view	P7U_K P7S_KO P7S_KR

# EDUCATIONAL EFFECTS FOR EOT SPECIALIZATION

**Faculty: Microsystem Electronics and Photonics**

**Field of study: Electronics and Telecommunications**

**Level of studies: second level, full time study**

**Specialization: Optoelectronics and Optical Waveguide Technology (EOT)**

<p><b>Specialization educational effects at the 2nd level study in <i>Optoelectronics and Optical Waveguide Technology</i></b></p>	<p><b>DESCRIPTION OF EDUCATIONAL EFFECTS</b></p> <p>Upon completion of the second level study in the field of <i>Electronics and Telecommunications</i> within the specialization the graduate:</p>	<p><b>Correlation of educational effects with universal characteristics of PQF, with second stage characteristics of PQF for qualifications on the 7<sup>th</sup> level, with second stage characteristics of PQF for engineering competences on the 7<sup>th</sup> level</b></p>
<b>KNOWLEDGE</b>		
S2eot_W01	has extended and deepened knowledge in the field of physics, encompassing basis of quantum physics and solid state physics necessary to understand the phenomena having an important impact on the properties of novel materials and operation of advanced photonic devices	P7U_W P7S_WG
S2eot_W02	has deepened and theoretically grounded knowledge in the field of photonics, including the knowledge necessary to understand the operation of optical telecommunication systems and optical recording and processing of information	P7U_W P7S_WG P7S_WG_NT P7S_WG_INŽ

S2eot_W03	has extended and deepened knowledge in the field of physics, encompassing basis of quantum physics and solid state physics, necessary to understand physical phenomena having an important impact on the properties of novel materials and operation of advanced electronic devices	P7U_W P7S_WG
S2eot_W04	has deepened and theoretically grounded knowledge in the field of photonics, including the knowledge necessary to understand the operation of optoelectronic, sensor and micro- systems	P7U_W P7S_WG
S2eot_W05	has deepened and theoretically grounded knowledge concerning basic mechanisms of amplification and generation of electromagnetic radiation, lasers and applications of laser technique	P7U_W P7S_WG P7S_WG_NT P7S_WG_INŽ
S2eot_W06	has deepened and ordered knowledge about the processes of fabrication of electronic elements, integrated circuits and microsystems as well as on the influence of process parameters on the design and functional parameters of produced objects; has basic knowledge from the field of nanotechnology	P7U_W P7S_WG P7S_WG_NT P7S_WG_INŽ
S2eot_W07	has deepened and ordered knowledge concerning applications and design of optical fiber measurement systems used in contemporary technology	P7U_W P7S_WG P7S_WG_NT P7S_WG_INŽ
S2eot_W08	has deepened and ordered knowledge on the basic optical phenomena in semiconductors, physical basis and structures of advanced optoelectronic devices and systems, and applications of optoelectronic systems	P7U_W P7S_WG P7S_WG_NT P7S_WG_INŽ
S2eot_W09	understands the design methodology of advanced analog, digital and mixed electronic circuits (also in integrated version) and electronic systems; knows the languages for equipment description and computer tools for design and simulation of circuits and systems	P7U_W P7S_WG P7S_WG_NT P7S_WG_INŽ
S2eot_W10	has deepened and theoretically grounded knowledge in the field of photonics, including the knowledge necessary for understanding the operation of optical telecommunication systems and optical recording and processing of information; has basic knowledge concerning algorithms used in the applications employed for modeling of optoelectronic devices and systems; knows and understands advanced numerical methods applied in designing of electronic and photonic devices and systems	P7U_W P7S_WG P7S_WG_NT P7S_WG_INŽ
S2eot_W11	has deepened and theoretically grounded knowledge in the field of photonics, including the knowledge necessary to understand the operation of optical telecommunication systems and optical recording and processing of information; has ordered knowledge concerning the devices being components of teleinformatic networks, including the wireless ones	P7U_W P7S_WG P7S_WG_NT P7S_WG_INŽ

S2eot_W12	has ordered and theoretically grounded knowledge in the field of photovoltaics, including the knowledge necessary to understand the physical basis of operation of photovoltaic elements and designs and to assess the quality of photovoltaic systems	P7U_W P7S_WG P7S_WG_NT P7S_WG_INŽ
<b>SKILLS</b>		
S2eot_U01	is able to acquire information from literature, databases and other sources, is able to integrate acquired information, perform its interpretation, and critical assessment, draw conclusions, and formulate and profoundly justify opinions	P7S_UW2_NT P7S_UW3_NT P7S_UW2_INŽ P7S_UW3_INŽ
S2eot_U02	is able to work individually and in a team; is able to assess time consumption for task execution; is able to manage a small team in a way ensuring completion of the task in due time	P7S_UO
S2eot_U03	is able to develop detailed documentation of the results of experiment, design task or research project; is able to prepare a report containing discussion of the results	P7S_UW1_NT P7S_UW1_INŽ
S2eot_U04	is able to prepare and give a presentation on realization of a task or research project and conduct a discussion concerning the presentation	P7S_UK
S2eot_U05	can use English at the level sufficient for communication, also in professional issues, reads with understanding the professional literature and is able to prepare and give a short oral presentation on realization of a task or research project	P7S_UW P7S_UK
S2eot_U06	can use the learned methods and mathematical models (and should the need arise, modify them) for the analysis and design of electronic and photonic components, circuits and systems	P7U_U
S2eot_U07	is able to assess and compare design solutions and fabrication methods of electronic devices and circuits in terms of presumed functional and economic criteria (power consumption, thermal budget, rate of operation, reliability, time consumption, costs etc.)	P7S_UW2_NT P7S_UW3_NT P7S_UW2_INŽ P7S_UW3_INŽ
S2eot_U08	is able to plan and carry out simulations and measurements of electrical and optical characteristics and extract the parameters characterizing materials, devices and analog and digital electronic circuits	P7S_UW2_NT P7S_UW2_INŽ
S2eot_U09	is able to plan a process of testing of a complex electronic circuit and electronic or photonic system	P7S_UW1_NT P7S_UW1_INŽ
S2eot_U10	is able to design analog, digital and mixed electronic devices, electronic (photonic) circuits and electronic systems taking into account the functional and economic criteria, and should the need arise, adapt the existing or develop new design methods or tools for computer aided design (CAD)	P7S_UW4_NT P7S_UW4_INŽ
S2eot_U11	is able to design electronic circuits and systems intended for different applications, including monolithic and hybrid electronic and photonic circuits	P7S_UW4_NT P7S_UW4_INŽ
S2eot_U12	is able to apply communication devices in local and wide area teleinformatic networks, including optical fibers networks	P7S_UW4_NT P7S_UW4_INŽ

S2eot_U13	is able, with the use of suitable analytic, simulation and experimental tools, to formulate and test the hypotheses connected with modeling and design of electronic components, circuits and systems and design the process of their manufacturing	P7S_UW1_NT P7S_UW2_NT P7S_UW1_INŽ P7S_UW2_INŽ
S2eot_U14	in formulating and solving the tasks connected with modeling and design of electronic components, circuits and systems and designing their manufacturing process, is able to integrate the knowledge from the field of electronics, photonics, informatics, automatics, telecommunications and other disciplines, using a system approach with taking into account beyond technical aspects	P7S_UW1_NT P7S_UW2_NT P7S_UW4_NT P7S_UW1_INŽ P7S_UW2_INŽ P7S_UW4_INŽ
S2eot_U15	in formulating and solving the tasks connected with modeling and design of electronic elements, circuits and systems and designing their manufacturing process, is able to integrate the knowledge from different sources	P7S_UW
S2eot_U16	is able to assess the cost of design and realization of an electronic or photonic circuit or system	P7S_UW2_NT P7S_UW4_NT P7S_UW2_INŽ P7S_UW4_INŽ
S2eot_U17	is able to propose improvements of existing design solutions and models of electronic devices, circuits and systems	P7S_UW3_NT P7S_UW3_INŽ
S2eot_U18	is able to assess the usefulness and possibility of application of modern achievements in materials, elements, design and fabrication methods (including microelectronic technologies) for the design and fabrication of electronic circuits and systems, containing solutions of innovative character	P7S_UW2_NT P7S_UW2_INŽ
S2eot_U19	is able to design a complex device, object, system or process and develop this project (even in part), relevant to the studied discipline, with the use of suitable methods and tools, both the existing ones and newly developed	P7S_UW4_NT P7S_UW4_INŽ
S2eot_U20	is able to choose and assess optical fiber and optoelectronic elements used in designing of photonic systems and optical fiber networks; knows the techniques of measurements of waveguides, waveguide couplers and possibilities of their application in waveguide systems	P7S_UW
<b>SOCIAL COMPETENCES</b>		
S2eot_K01	is able to think and act in creative and entrepreneurial way	P7S_KO
S2eot_K02	understands the need of permanent updating the lifetime learning process, is able to prepare educational aids and popular science presentations	P7S_KK
S2eot_K03	is able to think in an ecology-friendly way, is conscious of the importance and understands the beyond technical aspects and results of engineering activity, including its impact on environment; is able to design systems using alternative energy sources	P7S_KO

S2eot_K04	is able to design and develop a plan of a project realization, is able to cooperate and work in a team, undertaking different tasks	P7U_K P7S_KR
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