Bialystok University of Technology									
Field of study	**Architecture**							**Degree level and programme type**	Engineer's / Master degree Erasmus + Program
Specialization / diploma path	**---**							**Study profile**	academic
Course name	Architectural Design - Housing design I							**Course code**	**IS-FA-00043W**
								Course type	electiv
Forms and number of hours of tuition	L	C	LC	P	SW	FW	S	**Semester**	**---**
				75				**No. of ECTS credits**	**12**
Entry requirements	**---**								
Course objectives	The theoretical aim is to familiarize students with the main problems related to architectural design of house including spatial, social, technical, functional and theoretical aspects. The practical objective is to exercise the execution of architectural conceptual drawings of a unique house. Skills to be acquired: * experience in the analyses and assessment of housing; * skills for preparation of an architectural program; * skills of conceptual, functional, spatial and structural design; * research abilities related to the field of human inhabitation assessment.								
Course content	This course acquaints students with different concepts of house located in a natural environment. Students may have various level of preparation and training - this is the reason course is divided for different levels. The main task in accordance with the level of knowledge declared by the student – optional : beginner students - single-family house / intermediate - multi-generational home / advanced - house for independent elderly people. (1) Single-family house - The main task is to design a house with the IDEA (something non-obvious, special, unique, unusual). For Example: house in a unique location (house on the cliff, on the coast, in the woods,…), house with unusual inhabitant and function (painter - a house with a studio and gallery, an astronomer - a house with a watchtower, swimmer - house with swimming pool 25m in length, …), house with unusual function/form (mobile house, transformable house, adaptable house, floating house, bridge house, tower house, …) (2) Multi-generational home - The main task is to design a house for big famili where different generations live together but separately . Functional plan should consiste at least two apartments for two families (family with children 2+2 and grandparents). The house can be one-storey or multi-storey (but grandparents should have an apartment on the ground floor), some functions may be shared by both families. There should be a connection between the apartments inside the house. (3) House for the elderly - house for 8 independent elderly people who live together on the basis of: mutual self-help, affordable architecture , and co-living. The functional plan should consist of individual bedrooms (single and double) with bathrooms, and a common day zone for all residents. In addition, it can have a guest room, hobbyroom, etc ... The house should be one-storey, and if located in the city, can be a multi-storey with elevator.								
Teaching methods	Design classes, self-presentation, discussion,								
Assessment method	Assessment based on the final design evaluation (60%), 3 small design tasks (20%), self-presentation (10%) and mid-term evaluation (10%).								
Symbol of learning outcome	**Methods of assessing the learning outcomes**							**Type of tuition during which the outcome is assessed**	
EU1	the student knows the most important achievements in the field of single-family housing architecture of the 20th and 21st centuries, is aware of contemporary trends in design							A1_W01, A1_W09	
EU2	knows the typology of single-family housing, the principles of shaping single-							A1_W01, A1_W06, A1_U11	

	family housing complexes and plot development, can apply the provisions contained in the technical conditions to be met by single-family buildings and their location	
EU3	is able to design a single-family house taking into account the objective and subjective needs of the user, adapting the form to the spatial and cultural context	A1_W05, A1_W06, A1_U02, A1_U05,
EU4	is able to use building materials and construction elements appropriate to the form and the intended aesthetic effect of the designed object	A1_W06, A1_U02, A1_U07, A1_U11
EU5	is able to prepare architectural and construction documentation for a single-family building and a plot development design, taking into account the multi-sector aspect of design	A1_W06, A1_W11, A1_U07, A1_U11
EU6	understand the complexity of the issues of shaping the housing environment and the designer's responsibility for its quality, is aware of non-technical aspects and effects of design activities	A1_K01
Symbol of learning outcome	**Methods of assessing the learning outcomes**	**Type of tuition during which the outcome is assessed**
EU1	evaluation of small introductory design tasks,	P
EU2	assessment of design solutions in the mid-term and final project	P
EU3	documentation and presentation of the final project	P
EU4	discussion	P
Student workload (in hours)		**No. of hours**
Calculation	participation in design classes	75
	own work on the project (homework)	35
	preparation of the final study (boards + mockup + description)	25
	participation in final presentation	5
	TOTAL:	**140**
Quantitative indicators	**HOURS**	**No. of ECTS credits**
Student workload – activities that require direct teacher participation	**80**	**6,8**
Student workload – practical activities	**140**	**12**
Basic references	1. Levitt D., Bernstein L., The Housing Design Handbook. A guide to good practice, Routledge, Taylor & Francis Group, New York 2010. 2. Schleifer S., Minimalist houses, Taschen 2006. 3. Welsch J., Modern House, Phaidon, Londyn 2004.	
Supplementary references	1. Frampton K., The Twentieth-century American house: masterworks of residential architecture, Thames and Hudson, London 1998. 2. Friedman M., Frank Gehry :The Houses, Rizzoli, New York 2009. 3. Jodido Ph., Tadao Ando, Taschen, Köln 2001. 4. Pearman H., Contemporary World Architecture, Phaidon, 2002.	
Organisational unit conducting the course	Department of Housing Architecture	**Date of issuing the programme**
Author of the programme	PhD, Eng. Arch. Monika Magdziak	**Feb. 17, 2022**

L – lecture, C – classes, LC – laboratory classes, P – project, SW –specialization workshop, FW – field work,S – seminar

COURSE DESCRIPTION CARD

<table>
<tr><td colspan="10">Faculty of Electrical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="6">Electrical and Electronic Engineering</td><td>Degree level and programme type</td><td>bachelor's degree, full time programme</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="6">-</td><td>Study profile</td><td>-</td></tr>
<tr><td rowspan="2">Course name</td><td colspan="6" rowspan="2">Basics of photonics</td><td>Course code</td><td>IS-FEE-10001W</td></tr>
<tr><td>Course type</td><td>elective</td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>winter</td></tr>
<tr><td></td><td></td><td>30</td><td></td><td></td><td></td><td></td><td>No. of ECTS credits</td><td>4</td></tr>
<tr><td>Entry requirements</td><td colspan="9">-</td></tr>
<tr><td>Course objectives</td><td colspan="9">Acquainting students with the main theme of photonics research (metrology devices and systems, sensors and photonic technologies). Identification of areas of photonics applications including respectively: optical fiber technology, laser technology, optical and fiber-optic telecommunication, semiconductor optoelectronics, integrated optoelectronics. Overview of selected problems of photonics: geometrical and wave optics, propagation of the electromagnetic wave in free space and the dispersion medium. Acquainted with the elements of nonlinear optics. Teaching the principles of operation and measurement of the elements of photonic systems: cylindrical and planar optical fibers, elements of optical fiber network, optical modulators. Acquainted with the materials and microelectronic technologies. Overview of contemporary directions in the field of photonics.</td></tr>
<tr><td>Course content</td><td colspan="9">The basics of the optical phenomena theory in semiconductors and optical waveguides. Low dimensional structures - the principle of the use of quantum wells in semiconductor emitters of radiation. Engineering of the photonic bang gap - super-network. Interfaces in photonic structures. Periodic optical structures - a construction of selected elements, methods of analysis and development perspectives. The construction and selected applications of the matrix of sources and detectors with low-dimensional structures. The phenomenon of optical bistability. Bistable photonic components. Optical logic elements. Nonlinear phenomena.</td></tr>
<tr><td>Teaching methods</td><td colspan="9">Laboratory class</td></tr>
<tr><td>Assessment method</td><td colspan="9">evaluation of reports, tests of preparation for laboratory exercise.</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="7">Learning outcomes (Student ...)</td><td colspan="2">Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="7">has detailed knowledge of photonics;</td><td colspan="2"></td></tr>
<tr><td>LO2</td><td colspan="7">explains optical phenomena occurring in semiconductors;</td><td colspan="2"></td></tr>
<tr><td>LO3</td><td colspan="7">discusses the construction of photonic structures;</td><td colspan="2"></td></tr>
<tr><td>LO4</td><td colspan="7">characterizes the construction of photonic structures;</td><td colspan="2"></td></tr>
<tr><td>LO5</td><td colspan="7">measures and analyzes the properties of semiconductor radiation emitters;</td><td colspan="2"></td></tr>
</table>

LO6	**measures and analyzes the spectroscopic properties of materials used in photonics;**	
LO7	**represents contemporary trends photonics, finding their usefulness in technic;**	
LO8	**understands the role of photonics in modern knowledge-based society.**	
Symbol of learning outcome	**Methods of assessing the learning outcomes**	**Type of tuition during which the outcome is assessed**
LO1	evaluation of the report on exercise, a discussion during the laboratory classes;	
LO2	evaluation of the report on exercise, a discussion during the laboratory classes;	
LO3	evaluation of the report on exercise, a discussion during the laboratory classes;	
LO4	evaluation of the report on exercise, a discussion during the laboratory classes;	
LO5	evaluation of the report on exercise, a discussion during the laboratory classes;	
LO6	evaluation of the report on exercise, a discussion during the laboratory classes	
LO7	discussion on the report of the exercise, observation of the work in the classroom	
LO8	discussion on the report of the exercise, observation of the work in the classroom.	
Student workload (in hours)		**No. of hours**
Calculation	**preparation for the laboratory**	**30**
	description of laboratory reports or doing homework assignments (homework)	**20**
	participation in lab sessions / student-teacher consultations	**30**
	prepare to pass the module	**20**
	TOTAL:	**100**
Quantitative indicators		**HOURS** / **No. of ECTS credits**
Student workload – activities that require direct teacher participation		**30** / **1**
Student workload – practical activities		**100** / **4**
Basic references	**1. Safa K.: Cambridge illustrated handbook of optoelectronics and photonics. Cambridge University Press, Cambridge, 2012.** **2. Jamal M. D., Basu P. K.: Silicon photonics : fundamentals and devices. John Wiley & Sons, New York, 2012.**	
Supplementary references		
Organisational unit conducting the course	**Department of Photonics, Electronics and Light Technique**	**Date of issuing the programme**
Author of the programme	**Marcin Kochanowicz, Jacek Żmojda, prof. Andrzej Zając,**	**20-02-2020**

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar

COURSE DESCRIPTION CARD

<table>
<tr><td colspan="10">Faculty of Electrical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="6">Electrical and Electronic Engineering</td><td colspan="2">Degree level and programme type</td><td>bachelor's degree, full time programme</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="6">-</td><td colspan="2">Study profile</td><td>-</td></tr>
<tr><td rowspan="2">Course name</td><td colspan="6" rowspan="2">Basics of lighting technology</td><td colspan="2">Course code</td><td>IS-FEE-10002W</td></tr>
<tr><td colspan="2">Course type</td><td>elective</td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>winter</td></tr>
<tr><td>30</td><td></td><td>15</td><td></td><td></td><td></td><td></td><td>No. of ECTS credits</td><td>5</td></tr>
<tr><td>Entry requirements</td><td colspan="9">-</td></tr>
<tr><td>Course objectives</td><td colspan="9">Familiarizing students with basic light quantities, units and electric light sources. Using luxmeter and luminance meter. Teaching the methodology of main photometric measurements. Familiarizing with current problems in illuminating engineering. .</td></tr>
<tr><td>Course content</td><td colspan="9">Vision and light. Basic light quantities and units (luminous flux, luminous intensity, illuminance, luminance). Spectral distribution of light quantities. Lambert law. Correlation between illuminance and distance from the source. Types and parameters of light sources. Spatial distribution of light intensity. Basic measurements in light technology. Procedures of chosen light measurements. Using chosen light meters (luxmeter, luminance meter). Standarization in lighting technology - introduction to lighting design. Light - human interaction. Energy efficiency in lighting.</td></tr>
<tr><td>Teaching methods</td><td colspan="9">laboratory experiments, lecture/consultations, self-work, discussion.</td></tr>
<tr><td>Assessment method</td><td colspan="9">lecture: written exam; laboratory class: verification of preparation for classes, evaluation of the reports.</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="8">Learning outcomes</td><td>Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="8">lists and explains light quantities;</td><td></td></tr>
<tr><td>LO2</td><td colspan="8">shortly characterizes electrical and optoelectronic light sources;</td><td></td></tr>
<tr><td>LO3</td><td colspan="8">can use the lightmeter and luminance meter;</td><td></td></tr>
<tr><td>LO4</td><td colspan="8">performs measurements of chosen light quantities;</td><td></td></tr>
<tr><td>LO5</td><td colspan="8">can provide simple calculations connected with lighting.</td><td></td></tr>
<tr><td>Symbol of learning</td><td colspan="8">Methods of assessing the learning outcomes</td><td>Type of tuition during which the outcome is</td></tr>
</table>

outcome		assessed	
LO1	exam, evaluation of the report on exercise, a discussion during the laboratory classes	L,LC	
LO2	exam, evaluation of the report on exercise, a discussion during the laboratory classes	L,LC	
LO3	observation during the laboratory classes, reports	LC	
LO4	observation during the laboratory classes, reports	LC	
LO5	observation during the laboratory classes, reports, evaluation of case studies	L,LC	
Student workload (in hours)		No. of hours	
Calculation	participation in the laboratory	15	
	preparation for the laboratory	15	
	description of laboratory reports	10	
	participation in lecture / student - teacher consultations	30	
	preparing to pass the exam	20	
	case studies/homeworks	40	
	TOTAL:	130	
Quantitative indicators		HOURS	No. of ECTS credits
Student workload – activities that require direct teacher participation		45	2
Student workload – practical activities		85	4
Basic references	1. Standard CIE S 017/E:2011: International Lighting Vocabulary, 2011. 2. IESNA Lighting Handbook, New York, 2000. 3. Winchip S.: Fundamentals of lighting. Fairchild Books, 2011. 4. Lighting fundamentals handbook (technical report). Electric Power Research Institute, 1992. 5. Ryer A.: Light measurement handbook. International Light, 1998. 6. Ganslandt R., Hoffmann H.: Handbook of lighting design. 1992. 7. Khan T.Q. LED Lighting - Technology and Perception, Wiley 2015		
Supplementary references	1. Taylor A.: Illumination fundamentals. Lighting Research Center, 2000. 2. Csele M.: Fundamentals of light sources and lasers. Wiley Interscience, 2004.		
Organisational unit conducting the course	Department of Photonics, Electronics and Light Technique	Date of issuing the programme	
Author of the programme	Urszula Błaszczak, Ph.D. Eng.	30.01.2020	

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar

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<tr><td>Field of study</td><td colspan="6">Electrical Engineering</td><td>Degree level and programme type</td><td>bachelor's degree</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="6">-</td><td>Study profile</td><td>-</td></tr>
<tr><td rowspan="2">Course name</td><td colspan="6" rowspan="2">Electrical Machines 1</td><td>Course code</td><td>IS-FEE-10005W</td></tr>
<tr><td>Course type</td><td>elective</td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>winter</td></tr>
<tr><td>30</td><td></td><td></td><td></td><td>15</td><td></td><td></td><td>No. of ECTS credits</td><td>5</td></tr>
<tr><td>Entry requirements</td><td colspan="9">-</td></tr>
<tr><td>Course objectives</td><td colspan="9">Achievement of skills of analysis of asynchronous machines and transformers.</td></tr>
<tr><td>Course content</td><td colspan="9">Transformers: construction, principles of working, mathematical models. One-phase and three-phase transformers. Asynchronous motors: construction, principles of working, mathematical models. Transformations of co-ordinate systems, substitute scheme. Symmetrical steady state.</td></tr>
<tr><td>Teaching methods</td><td colspan="9">lecture, specialization workshop.</td></tr>
<tr><td>Assessment method</td><td colspan="9">lecture: written exam; specialization workshop: verification of preparation for classes.</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="7">Learning outcomes</td><td colspan="2">Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="7">describes construction and explains the principle of operation of transformers and induction machines;</td><td colspan="2"></td></tr>
<tr><td>LO2</td><td colspan="7">identifies and suggests groups of connections of three-phase transformer, calculates voltages and currents in transformer windings;</td><td colspan="2"></td></tr>
<tr><td>LO3</td><td colspan="7">interprets the behaviour of induction machines and transformers in various conditions (various voltage, frequency, load);</td><td colspan="2"></td></tr>
<tr><td>LO4</td><td colspan="7">illustrates different ways of startup and speed control of induction motors, calculates speed and current of induction</td><td colspan="2"></td></tr>
</table>

	motor in various work conditions (various voltage, frequency, load torque);	
LO5	describes the actual status and construction development trends in electrical machines;	
LO6	associates the connection of electrical machines with other areas of knowledge in the discipline of electrical engineering.	
Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	exam	L
LO2	evaluating the student's preparation for the classes, exam	L,SW
LO3	evaluating the student's preparation for the classes, exam	L,SW
LO4	evaluating the student's preparation for the classes, exam	L,SW
LO5	exam	L
LO6	exam	L

Student workload (in hours)		No. of hours	
Calculation	participation in the laboratory	15	
	preparation for the laboratory	15	
	description of laboratory reports	15	
	participation in lectures	30	
	preparing to pass the exam	30	
	case studies/homeworks	40	
	TOTAL:	145	
Quantitative indicators		HOURS	No. of ECTS credits
Student workload – activities that require direct teacher participation		45	3
Student workload – practical activities		45	3
Basic references	1. Morris N.: Electrical & electronic engineering principles. Longman, 1994. 2. Ryff P. F.L: Electric machinery. Prentice Hall, 1988. 3. Wildi T.: Electrical machines, drives and power systems. Pearson Education, 2006.		
Supplementary references	1. Sen P. G.: Principles of electric machines and power electronics. J. Wiley & Sons, 1997. 2. Chapman S. J.: Electric machinery fundamentals. Mc Graw Hill, 2005. 3. Morris N. M.: Electrical and electronic engineering principles. Longman, 1994.		
Organisational unit conducting the course	Department of Electrotechnics, Power Electronics and Power Engineering	Date of issuing the programme	
Author of the programme	Adam Sołbut, Ph.D. Eng.	07.02.2020	

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar

COURSE DESCRIPTION CARD

<table>
<tr><td colspan="10">Faculty of Electrical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="5">Electrical and Electronics Engineering</td><td colspan="2">Degree level and programme type</td><td>bachelor’s degree</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="5">-</td><td colspan="2">Study profile</td><td>-</td></tr>
<tr><td rowspan="2">Course name</td><td colspan="5" rowspan="2">Electronics 1</td><td colspan="2">Course code</td><td>IS-FEE-10006S</td></tr>
<tr><td colspan="2">Course type</td><td>elective</td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>summer</td></tr>
<tr><td>15</td><td>15</td><td>30</td><td></td><td></td><td></td><td></td><td>No. of ECTS credits</td><td>6</td></tr>
<tr><td>Entry requirements</td><td colspan="9">Electrical Circuits 1</td></tr>
<tr><td>Course objectives</td><td colspan="9">To provide students with basic knowledge of electronic devices. To develop skills in analysis, design and testing of electronic circuits containing diodes, transistors and operational amplifiers.</td></tr>
<tr><td>Course content</td><td colspan="9">Diodes – parameters, I-V characteristics, DC and AC models. Simple circuits containing diodes. Transistors (BJT, FET and MOSFET) – principles of operation, I-V characteristics, equivalent circuits. Transistor biasing. Single stage transistor amplifiers. Small signal analysis of amplifiers. Transistor as a switch. Parameters of operational amplifiers. Ideal OpAmp. Basic applications of operational amplifiers. Analysis and design of electronic devices and circuits using PSPICE.</td></tr>
<tr><td>Teaching methods</td><td colspan="9">lecture, class, laboratory class, computer simulations</td></tr>
<tr><td>Assessment method</td><td colspan="9">lecture: written exam; class: two tests; laboratory class: evaluation of reports, verification of preparation for classes</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="7">Learning outcomes</td><td colspan="2">Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="7">describes the basic operation, characteristics and applications of diodes, transistors and operational amplifiers</td><td colspan="2"></td></tr>
<tr><td>LO2</td><td colspan="7">can apply knowledge of mathematics and engineering to analyze and design circuits containing diodes, transistors and operational amplifiers</td><td colspan="2"></td></tr>
<tr><td>LO3</td><td colspan="7">analyzes an electronic circuit using PSpice</td><td colspan="2"></td></tr>
<tr><td>LO4</td><td colspan="7">uses laboratory instruments for the measurement of circuit parameters and the data acquisition</td><td colspan="2"></td></tr>
<tr><td>LO5</td><td colspan="7">analyzes and interprets measurement data and prepares reports</td><td colspan="2"></td></tr>
<tr><td>LO6</td><td colspan="7">uses datasheets and application notes</td><td colspan="2"></td></tr>
</table>

Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	written exam, tests	L, LC
LO2	written exam, tests	L, C, LC
LO3	verification of preparation for classes	LC
LO4	tests, evaluation of class work	LC
LO5	evaluation of reports	LC
LO6	evaluation of class work	LC

Student workload (in hours)		No. of hours
Calculation	lecture attendance	15
	participation in classes	15
	preparation for classes	15
	participation in laboratory classes	30
	preparation for laboratory classes	20
	working on projects, reports	25
	participation in student-teacher sessions related to the classes/laboratory classes	5
	preparation for and participation in exams/tests	25
	TOTAL:	150

Quantitative indicators	HOURS	No. of ECTS credits
Student workload – activities that require direct teacher participation	65	2,6
Student workload – practical activities	110	4,4

Basic references	1. Sedra A.S., Smith K. C.: Microelectronic Circuits. Oxford University Press, 2004. 2. Muret P.: Fundamentals of Electronics 1 : Electronic Components and Elementary Functions, John Wiley & Sons, Inc., 2017 (Available from: ProQuest Ebook Central)
Supplementary references	1. Boysen E., Kybett H.: Complete Electronics Self-Teaching Guide with Projects, John Wiley & Sons, Inc., 2012 (Available from: ProQuest Ebook Central) 2. Singh S.: Electronics Engineering, Alpha Science International, New Delhi, 2014 (Available from: ProQuest Ebook Central) 3. Westcott S., Westcott J.R.: Basic Electronics: Theory and Practice, Mercury Learning & Information, 2015 (Available from: ProQuest Ebook Central) 4. Saggio G.: Principless of analog electronic. CRC Press, 2014.

Organisational unit conducting the course	Department of Automatic Control and Robotics	**Date of issuing the programme**
Author of the programme	Andrzej Karpiuk, Ph.D.	23.02.2021

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar

COURSE DESCRIPTION CARD

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<tr><td>Specialization/ diploma path</td><td colspan="5">-</td><td colspan="2">Study profile</td><td>-</td></tr>
<tr><td rowspan="2">Course name</td><td colspan="5" rowspan="2">Electronics 1</td><td colspan="2">Course code</td><td>IS-FEE-10006W</td></tr>
<tr><td colspan="2">Course type</td><td>elective</td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>winter</td></tr>
<tr><td>15</td><td>15</td><td>30</td><td></td><td></td><td></td><td></td><td>No. of ECTS credits</td><td>6</td></tr>
<tr><td>Entry requirements</td><td colspan="9">Electrical Circuits 1</td></tr>
<tr><td>Course objectives</td><td colspan="9">To provide students with basic knowledge of electronic devices. To develop skills in analysis, design and testing of electronic circuits containing diodes, transistors and operational amplifiers.</td></tr>
<tr><td>Course content</td><td colspan="9">Diodes – parameters, I-V characteristics, DC and AC models. Simple circuits containing diodes. Transistors (BJT, FET and MOSFET) – principles of operation, I-V characteristics, equivalent circuits. Transistor biasing. Single stage transistor amplifiers. Small signal analysis of amplifiers. Transistor as a switch. Parameters of operational amplifiers. Ideal OpAmp. Basic applications of operational amplifiers. Analysis and design of electronic devices and circuits using PSPICE.</td></tr>
<tr><td>Teaching methods</td><td colspan="9">lecture, class, laboratory class, computer simulations</td></tr>
<tr><td>Assessment method</td><td colspan="9">lecture: written exam; class: two tests, laboratory class: evaluation of reports, verification of preparation for classes</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="7">Learning outcomes</td><td colspan="2">Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="7">describes the basic operation, characteristics and applications of diodes, transistors and operational amplifiers</td><td colspan="2"></td></tr>
<tr><td>LO2</td><td colspan="7">can apply knowledge of mathematics and engineering to analyze and design circuits containing diodes, transistors and operational amplifiers</td><td colspan="2"></td></tr>
<tr><td>LO3</td><td colspan="7">analyzes an electronic circuit using PSpice</td><td colspan="2"></td></tr>
<tr><td>LO4</td><td colspan="7">uses laboratory instruments for the measurement of circuit parameters and the data acquisition</td><td colspan="2"></td></tr>
<tr><td>LO5</td><td colspan="7">analyzes and interprets measurement data and prepares reports</td><td colspan="2"></td></tr>
<tr><td>LO6</td><td colspan="7">uses datasheets and application notes</td><td colspan="2"></td></tr>
</table>

Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	written exam, tests	L, LC
LO2	written exam, tests	L, C, LC
LO3	verification of preparation for classes	LC
LO4	tests, evaluation of class work	LC
LO5	evaluation of reports	LC
LO6	evaluation of class work	LC

Student workload (in hours)		No. of hours
Calculation	lecture attendance	15
	participation in classes	15
	preparation for classes	15
	participation in laboratory classes	30
	preparation for laboratory classes	20
	working on projects, reports	25
	participation in student-teacher sessions related to the classes/laboratory classes	5
	preparation for and participation in exams/tests	25
	TOTAL:	150

Quantitative indicators	HOURS	No. of ECTS credits
Student workload – activities that require direct teacher participation	65	2,6
Student workload – practical activities	110	4,4

Basic references	1. Sedra A.S., Smith K. C.: Microelectronic Circuits. Oxford University Press, 2004. 2. Muret P.: Fundamentals of Electronics 1 : Electronic Components and Elementary Functions, John Wiley & Sons, Inc., 2017 (Available from: ProQuest Ebook Central)
Supplementary references	1. Boysen E., Kybett H.: Complete Electronics Self-Teaching Guide with Projects, John Wiley & Sons, Inc., 2012 (Available from: ProQuest Ebook Central) 2. Singh S.: Electronics Engineering, Alpha Science International, New Delhi, 2014 (Available from: ProQuest Ebook Central) 3. Westcott S., Westcott J.R.: Basic Electronics: Theory and Practice, Mercury Learning & Information, 2015 (Available from: ProQuest Ebook Central) 4. Saggio G.: Principless of analog electronic. CRC Press, 2014.

Organisational unit conducting the course	Department of Automatic Control and Robotics	**Date of issuing the programme**
Author of the programme	Andrzej Karpiuk, Ph.D.	23.02.2021

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar

COURSE DESCRIPTION CARD

<table>
<tr><td colspan="10">Faculty of Electrical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="6">Electrical and Electronics Engineering</td><td colspan="2">Degree level and programme type</td><td>bachelor's degree, full time programme</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="6">-</td><td colspan="2">Study profile</td><td>-</td></tr>
<tr><td rowspan="2">Course name</td><td colspan="6" rowspan="2">Fundamentals of Control Engineering</td><td colspan="2">Course code</td><td>IS-FEE-10008W</td></tr>
<tr><td colspan="2">Course type</td><td>elective</td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>winter</td></tr>
<tr><td>30</td><td></td><td>30</td><td></td><td></td><td></td><td></td><td>No. of ECTS credits</td><td>6</td></tr>
<tr><td>Entry requirements</td><td colspan="9">mathematics, physics.</td></tr>
<tr><td>Course objectives</td><td colspan="9">Introducing students to structures, tasks and methods of analysis and synthesis of simple control systems. Application of different methods of controllers design for control of simple processes</td></tr>
<tr><td>Course content</td><td colspan="9">Lecture: Laplace transforms of commonly encountered time function and basic Laplace transforms. Mathematical modelling of dynamic systems. Transient-response analysis of first and second-order systems. The correlation between transient and frequency-response and s-plane diagram. Stability of linear time-invariant systems. Hurwitz and Nyquist asymptotic stability criteria. Quality parameters of control on the basis of time and frequency domain performance specifications. Process control and the tuning of three-term controllers (analytical and experimental methods). Discrete time and computer control systems. Analytical techniques required for discrete time system analysis. Design methods for discrete time controllers. Nonlinear systems - practical aspects including relaycontrolled systems (PD and PID compensation). Laboratory class: Basic methods of identification, modelling and control of simple plants. Industry PID controllers, configuration and tuning methods. Control of nonlinear systems (with relay).</td></tr>
<tr><td>Teaching methods</td><td colspan="9">lecture, laboratory class</td></tr>
<tr><td>Assessment method</td><td colspan="9">written exam (lecture), evaluation of homework reports (laboratory class)</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="8">Learning outcomes</td><td>Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="8">has an elementary knowledge of analysis and synthesis methods of simple automatic control system and its</td><td></td></tr>
</table>

	constituent parts;	
LO2	is capable of evaluating the quality specifications of control system and has an elementary knowledge of basic compensation methods of control system;	
LO3	can describe procedures necessary for setting the parameters of three term controllers	
LO4	has some skills of identification and control of simple plants	
Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	written exam, evaluation of reports	L,LC
LO2	written exam, evaluation of reports	L,LC
LO3	written exam, evaluation of reports	L,LC
LO4	evaluation of reports	LC
Student workload (in hours)		No. of hours
Calculation	lecture attendance	30
	individual work on lecture topics	30
	preparation for and participation in exams/tests	15
	laboratory class attendance	30
	preparation for laboratory class	15
	work on reports	30
	TOTAL:	150

Quantitative indicators	HOURS	No. of ECTS credits
Student workload – activities that require direct teacher participation	60	2
Student workload – practical activities	120	4

Basic references	1. Ogata K.: Modern control engineering. Prentice-Hall International, 2004. 2. Nise N.S.: Control Systems Engineering, 5th edition, Wiley, 2008. 3. Åström K.J, Murray R.M.: Feedback Systems: An Introduction for Scientists and Engineers, Princeton University Press, 2008. 4. Norman N. S.: Control systems engineering, 5th ed., John Wiley a. Sons, Hoboken 2008.
Supplementary references	1. Kaczorek T.: Linear Control Systems, vol. 1 and 2, Research Studies Press, 1993. 2. Presentations for lecture (on-line available).

Organisational unit conducting the course	Department of Automatic Control and Electronics	Date of issuing the programme
Author of the programme	prof. Tadeusz KACZOREK, PhD Eng, Łukasz Sajewski, PhD Eng. Krzysztof Rogowski, PhD Eng.	08.02.2020

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar

COURSE DESCRIPTION CARD – SPECIMEN

<table>
<tr><td colspan="10">Faculty of Electrical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="6">Electrical and Electronic Engineering</td><td>Degree level and programme type</td><td>Bachelor's degree</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="6">-</td><td>Study profile</td><td>-</td></tr>
<tr><td rowspan="2">Course name</td><td colspan="6" rowspan="2">Microprocessor Technique and Microcontrollers</td><td>Course code</td><td>IS-FEE10009S</td></tr>
<tr><td>Course type</td><td>elective</td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>summer</td></tr>
<tr><td>30</td><td></td><td>30</td><td></td><td></td><td></td><td></td><td>No. of ECTS credits</td><td>6</td></tr>
<tr><td>Entry requirements</td><td colspan="9">-</td></tr>
<tr><td>Course objectives</td><td colspan="9">Knowledge about the basic problems of the microprocessor technique and microcontrollers.
Skills on programming of microprocessor systems in low-level and high-level languages.</td></tr>
<tr><td>Course content</td><td colspan="9">Lecture:
Binary arithmetic. Basic topics of the microprocessor engineering. Microprocessor system structures and main components: processors, memories, basic peripheral devices, standard buses, additional circuits. Interrupt systems. Methods of input/output device service. Input/output binary and analogue devices. Exemplary microcontroller family: standard structure, instruction list, peripherals, interrupts, extensions.
Laboratory classes:
Practical exercises in programming of basic algorithms and I/O device service in machine- and high-level language.</td></tr>
<tr><td>Teaching methods</td><td colspan="9">Lecture: presentations
Laboratory classes: set of exercises</td></tr>
<tr><td>Assessment method</td><td colspan="9">Written exam and reports</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="7">Learning outcomes</td><td colspan="2">Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="7">describes the activity of microprocessor, microcontrollers and whole microprocessor system</td><td colspan="2"></td></tr>
<tr><td>LO2</td><td colspan="7">distinguishes: types of processors, interrupt systems, semiconductor memories, peripheral device service techniques</td><td colspan="2"></td></tr>
<tr><td>LO3</td><td colspan="7">uses suitable programming tools</td><td colspan="2"></td></tr>
<tr><td>LO4</td><td colspan="7">writes software servicing the microcontroller I/O devices</td><td colspan="2"></td></tr>
<tr><td>LO5</td><td colspan="7">writes software implementation of designed algorithm</td><td colspan="2"></td></tr>
<tr><td>LO6</td><td colspan="7"></td><td colspan="2"></td></tr>
</table>

Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	written exam test on lecture content	L
LO2	written exam test on lecture content	L
LO3	evaluating the student's reports	LC
LO4	evaluating the student's reports and written tests	LC
LO5	evaluating the student's reports and written tests	LC
LO6		

Student workload (in hours)		No. of hours
Calculation	lecture attendance	**30**
	individual work on lecture topics	**15**
	preparation for exam	**10**
	participation in laboratory classes	**30**
	preparation for laboratory classes and drawing up reports	**40**
	participation in student-teacher sessions related to the classes	**10**
	preparation for laboratory classes tests	**10**
	exam and lab-classes tests attendance	**5**
	TOTAL:	**150**

Quantitative indicators	HOURS	No. of ECTS credits
Student workload – activities that require direct teacher participation	**75**	**3**
Student workload – practical activities	**82**	**3**

Basic references	*1. William Stallings: Computer Organization and Architecture, ISBN: 9780135160930; 896 p, 2019, Pearson.* *2. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi: The AVR Microcontroller and Embedded Systems, ISBN: 0138003319; 781 p, 2011, Pearson/Prentice Hall.* *3. Stuart Ball: Embedded Microprocessor Systems, ISBN: 0750675349; 432 p, 2002, Elsevier Newnes.*
Supplementary references	*1. Lech Grodzki: Presentations for lecture. Updated each semester.* *2. Lech Grodzki: Manuals for laboratory classes. Updated each semester.*

Organisational unit conducting the course	Department of Control Engineering and Robotics	Date of issuing the programme
Author of the programme	Lech Grodzki, PhD Eng	15.02.2021

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work,
S – seminar

COURSE DESCRIPTION CARD – SPECIMEN

<table>
<tr><td colspan="10">Faculty of Electrical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="6">Electrical and Electronic Engineering</td><td>Degree level and programme type</td><td>Bachelor's degree</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="6">-</td><td>Study profile</td><td>-</td></tr>
<tr><td rowspan="2">Course name</td><td colspan="6" rowspan="2">Microprocessor Technique and Microcontrollers</td><td>Course code</td><td>IS-FEE-10009W</td></tr>
<tr><td>Course type</td><td>elective</td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>winter</td></tr>
<tr><td>30</td><td></td><td>30</td><td></td><td></td><td></td><td></td><td>No. of ECTS credits</td><td>6</td></tr>
<tr><td>Entry requirements</td><td colspan="9">-</td></tr>
<tr><td>Course objectives</td><td colspan="9">Knowledge about the basic problems of the microprocessor technique and microcontrollers.
Skills on programming of microprocessor systems in low-level and high-level languages.</td></tr>
<tr><td>Course content</td><td colspan="9">Lecture:
Binary arithmetic. Basic topics of the microprocessor engineering. Microprocessor system structures and main components: processors, memories, basic peripheral devices, standard buses, additional circuits. Interrupt systems. Methods of input/output device service. Input/output binary and analogue devices. Exemplary microcontroller family: standard structure, instruction list, peripherals, interrupts, extensions.
Laboratory classes:
Practical exercises in programming of basic algorithms and I/O device service in machine- and high-level language.</td></tr>
<tr><td>Teaching methods</td><td colspan="9">Lecture: presentations
Laboratory classes: set of exercises</td></tr>
<tr><td>Assessment method</td><td colspan="9">Written exam and reports</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="7">Learning outcomes</td><td colspan="2">Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="7">describes the activity of microprocessor, microcontrollers and whole microprocessor system</td><td colspan="2"></td></tr>
<tr><td>LO2</td><td colspan="7">distinguishes: types of processors, interrupt systems, semiconductor memories, peripheral device service techniques</td><td colspan="2"></td></tr>
<tr><td>LO3</td><td colspan="7">uses suitable programming tools</td><td colspan="2"></td></tr>
<tr><td>LO4</td><td colspan="7">writes software servicing the microcontroller I/O devices</td><td colspan="2"></td></tr>
<tr><td>LO5</td><td colspan="7">writes software implementation of designed algorithm</td><td colspan="2"></td></tr>
<tr><td>LO6</td><td colspan="7"></td><td colspan="2"></td></tr>
</table>

Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	written exam test on lecture content	L
LO2	written exam test on lecture content	L
LO3	evaluating the student's reports	LC
LO4	evaluating the student's reports and written tests	LC
LO5	evaluating the student's reports and written tests	LC
LO6		

Student workload (in hours)		No. of hours
Calculation	lecture attendance	30
	individual work on lecture topics	15
	preparation for exam	10
	participation in laboratory classes	30
	preparation for laboratory classes and drawing up reports	40
	participation in student-teacher sessions related to the classes	10
	preparation for laboratory classes tests	10
	exam and lab-classes tests attendance	5
	TOTAL:	**150**

Quantitative indicators	HOURS	No. of ECTS credits
Student workload – activities that require direct teacher participation	**75**	**3**
Student workload – practical activities	**82**	**3**

Basic references	*1. William Stallings: Computer Organization and Architecture, ISBN: 9780135160930; 896 p, 2019, Pearson.* *2. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi: The AVR Microcontroller and Embedded Systems, ISBN: 0138003319; 781 p, 2011, Pearson/Prentice Hall.* *3. Stuart Ball: Embedded Microprocessor Systems, ISBN: 0750675349; 432 p, 2002, Elsevier Newnes.*
Supplementary references	*1. Lech Grodzki: Presentations for lecture. Updated each semester.* *2. Lech Grodzki: Manuals for laboratory classes. Updated each semester.*

Organisational unit conducting the course	Department of Control Engineering and Robotics	Date of issuing the programme
Author of the programme	Lech Grodzki, PhD Eng	15.02.2021

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work,
S – seminar

COURSE DESCRIPTION CARD

<table>
<tr><td colspan="10">Faculty of Electrical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="6">Electrical and Electronic Engineering</td><td>Degree level and programme type</td><td>bachelor's degree, full time programme</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="6"></td><td>Study profile</td><td></td></tr>
<tr><td rowspan="2">Course name</td><td colspan="6" rowspan="2">Modern Wireless Networks Technologies</td><td>Course code</td><td>IS-FEE-10010W</td></tr>
<tr><td>Course type</td><td>elective</td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>winter</td></tr>
<tr><td>30</td><td></td><td></td><td></td><td></td><td></td><td></td><td>No. of ECTS credits</td><td>3</td></tr>
<tr><td>Entry requirements</td><td colspan="9"></td></tr>
<tr><td>Course objectives</td><td colspan="9">Student is familiar with the main wireless network standards and distinguishing architectures.</td></tr>
<tr><td>Course content</td><td colspan="9">Classification of the wireless networks. Wireless Internet protocol. Physical layer. Radiowave propagation. Antennas for wireless networks. Multipath propagation and transmission channel model. Noise and pulse interferences, ISI, radio receiver structure, equalizes. RAKE receivers. Coding and modulation. Space-time Block and trellis coding. Architecture of the GSM, GPRS, EDGE and UMTS. The spread-spectrum technology. Main standards. The OFDM and MIMO Technologies. Hybrid wireless systems.</td></tr>
<tr><td>Teaching methods</td><td colspan="9">Lecture, presentation, disscusion</td></tr>
<tr><td>Assessment method</td><td colspan="9">exam.</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="8">Learning outcomes</td><td>Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="8">is familiar with the main wireless network standards;</td><td></td></tr>
<tr><td>LO2</td><td colspan="8">is familiar with distinguishing architectures and performance of wireless networks;</td><td></td></tr>
<tr><td>LO3</td><td colspan="8">is familiar with the basics of radiowave propagation and transmission channel issues;</td><td></td></tr>
<tr><td>LO4</td><td colspan="8">can asses implementation problems related to wireless networks.</td><td></td></tr>
<tr><td>LO5</td><td colspan="8"></td><td></td></tr>
</table>

LO6		
LO7		
Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	exam;	
LO2	exam;	
LO3	exam;	
LO4	exam;	
LO5		
LO6		
LO7		
Student workload (in hours)		No. of hours
Calculation	lecture attendance	30
	homework	20
	participation in student-teacher sessions related to the class	5
	preparation for and participation in exam	25
	TOTAL:	80

Quantitative indicators	HOURS	No. of ECTS credits
Student workload – activities that require direct teacher participation	38	1,5
Student workload – practical activities	20	1

Basic references	1. Harte L., Bowler D.: Introduction to mobile telephone systems. Althos Publishing, 2003. 2. Proakis J. G., Salehi M.: Communication systems engineering. Prentice-Hall, 2002. 3. Haykin S.: Communications systems. J. Wiley & Sons, 2000.	
Supplementary references	1. Bellamy J.: Digital telephony. J. Wiley & Sons, 1982.	
Organisational unit conducting the course	Department of Photonics, Electronics and Light Technique	Date of issuing the programme
Author of the programme	Adam Nikolajew, PhD.	08.02.2020

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar

COURSE DESCRIPTION CARD

<table>
<tr><td colspan="10">Faculty of Electrical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="6">Electrical and Electronic Engineering</td><td colspan="2">Degree level and programme type</td><td>bachelor's degree, full time programme</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="6">-</td><td colspan="2">Study profile</td><td>-</td></tr>
<tr><td rowspan="2">Course name</td><td colspan="6" rowspan="2">Optical Fibers</td><td colspan="2">Course code</td><td>IS-FEE-10012W</td></tr>
<tr><td colspan="2">Course type</td><td>elective</td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>winter</td></tr>
<tr><td>30</td><td></td><td>30</td><td></td><td></td><td></td><td></td><td>No. of ECTS credits</td><td>5</td></tr>
<tr><td>Entry requirements</td><td colspan="9">-</td></tr>
<tr><td>Course objectives</td><td colspan="9">Introduction to telecommunication systems. Learning the principles and methods for measuring properties of optical fiber components and systems. Learning determination the parameters of the optical fiber telecommunication link. Education application rules and service of specialized measurement equipment.</td></tr>
<tr><td>Course content</td><td colspan="9">Telecommunications systems. Measurements of physical parameters of optical fibers. Measurements of optical fiber components. Measurements of attenuation of optical fibers. Reflectometric measurements of optical fiber telecommunication link. Power distribution in optical fibers (transverse modes). Spectral attenuation. Optical fibers connectors.</td></tr>
<tr><td>Teaching methods</td><td colspan="9">Lecture, presentation, discussion, laboratory experiments.</td></tr>
<tr><td>Assessment method</td><td colspan="9">evaluation of reports, tests of preparation for laboratory exercise.</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="7">Learning outcomes
(Student ...)</td><td colspan="2">Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="7">measures the physical parameters of optical fibers</td><td colspan="2"></td></tr>
<tr><td>LO2</td><td colspan="7">measures the spectral characteristics of optical fiber</td><td colspan="2"></td></tr>
<tr><td>LO3</td><td colspan="7">uses and configures specialized measurement equipment (optical fiber technology)</td><td colspan="2"></td></tr>
<tr><td>LO4</td><td colspan="7">analyzes the parameters of optical fiber systems</td><td colspan="2"></td></tr>
<tr><td>LO5</td><td colspan="7">classifies and summarizes the elements of the optical fiber, specifying their functionality in telecommunication systems;</td><td colspan="2"></td></tr>
<tr><td>LO6</td><td colspan="7">measures the parameters of optical fiber</td><td colspan="2"></td></tr>
<tr><td>LO7</td><td colspan="7">applies the principles of health and safety required for working with radiation in the range of NIR;</td><td colspan="2"></td></tr>
<tr><td>LO8</td><td colspan="7">understands the need and knows the possibilities of continuous training in the field of photonics</td><td colspan="2"></td></tr>
</table>

Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	evaluation of the report on exercise, a discussion during the laboratory classes	LC
LO2	evaluation of the report on exercise, a discussion during the laboratory classes	LC
LO3	evaluation of the report on exercise, a discussion during the laboratory classes	LC
LO4	evaluation of the report on exercise, a discussion during the laboratory classes, exam	L, LC
LO5	evaluation of the report on exercise, a discussion during the laboratory classes, exam	L, LC
LO6	evaluation of the report on exercise, a discussion during the laboratory classes	LC
LO7	evaluation of the report on exercise, a discussion during the laboratory classes	LC
LO8	evaluation of the report on exercise, a discussion during the laboratory classes, exam	L, LC

Student workload (in hours)		No. of hours
Calculation	participation in the labolatory sessions	30
	participation in the labolatory sessions	30
	development of laboratory reports and/or completion of homework assignments	45
	participation in consultations related to the exercise	5
	attending lecture, student - teacher sessions	30
	TOTAL:	140

Quantitative indicators	HOURS	No. of ECTS credits
Student workload – activities that require direct teacher participation	65	2
Student workload – practical activities	75	3

Basic references	1. Ghatak A. K., Thyagarajan K.: Introduction to fiber optics. Cambridge University Press, 2000. 2. Hecht J.: Understanding fiber optics. Pearson Prentice Hall, 2002. 3. Digonnet M.: Rare earth doped fiber lasers and amplifiers. Marcel Decker, 2001.	
Supplementary references		
Organisational unit conducting the course	Department of Photonics, Electronics and Light Technique	Date of issuing the programme
Author of the programme	Jacek Żmojda, PhD. DSc.	30.01.2020

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar

COURSE DESCRIPTION CARD

Faculty of Electrical Engineering									
Field of study	**Electrical and Electronics Engineering**							**Degree level and programme type**	**bachelor's degree, full time programme**
Specialization/ diploma path	**-**							**Study profile**	**-**
Course name	**Power Electronics**							**Course code**	**IS-FEE-10013W**
								Course type	**elective**
Forms and number of hours of tuition	**L**	**C**	**LC**	**P**	**SW**	**FW**	**S**	**Semester**	**winter**
	30							**No. of ECTS credits**	**3**
Entry requirements	**-**								
Course objectives	**The acquaint with basic power electronics devices and different types of converters (DC/DC, AC/DC, DC/AC, AC/AC 1- and 3-phases) and its control. The acquire of skills to different types converter operation analyze.**								
Course content	**Power semiconductor devices (SCR, BJT, MOSFET, IGBT). Single and three phases controlled rectifiers with different type of load. The rectifier influence on the net, active, reactive and distortion powers. The DC/AC and AC/DC converters - structures and control. The transistors matrix converter controlled by PWM methods. 2- and 4-quadrant DC-DC converters. Vectorial model of 3-phases converter**								
Teaching methods	**lecture, specialization workshop.**								
Assessment method	**lecture: written exam; specialization workshop: evaluation of reports.**								
Symbol of learning outcome	**Learning outcomes**								**Reference to the learning outcomes for the field of study**
LO1	**lists, clasiffies and discusses operation of basic power electronic converters**								
LO2	**discusses properties of the power electronic devices**								
LO3	**describes present state and developmental trends of the power electronics**								
LO4	**analyses and evaluates operation of selected types converter on the base of test results**								
Symbol of learning outcome	**Methods of assessing the learning outcomes**								**Type of tuition during which the outcome is assessed**
LO1	**written and oral exam**								**L**

LO2	written and oral exam	L
LO3	written and oral exam	L
LO4	written and oral exam	L
Student workload (in hours)		No. of hours
Calculation	lecture attendance	30
	participation in student-teacher sessions related to the lecture	10
	preparation for and participation in exams	35
	TOTAL:	75

Quantitative indicators	HOURS	No. of ECTS credits
Student workload – activities that require direct teacher participation	42	1,5
Student workload – practical activities	0	0

Basic references	1. Rashid H. M.: Power electronics handbook : devices, circuits, and applications. Academic Press, 2007. 2. Mazda F.: Power electronics handbook. Elsevier, 2003. 3. Erickson R. W., Maksimowic D.: Fundamentals of power electronics. Kulwer Academic, 2001. 4. Rarnes M.: Practical variable speed drives and power electronics. Elsevier, 2003.
Supplementary references	1. Bin Wo: Power conversion and control of wind energy system. J. Wiley & Sons, 2011. 2. Benysek G.: Improvement in the quality of delivery of electrical energy using power electronics systems. Springer, 2007. 3. Wilamowski B. M., Irwin J. D.: Power electronics and motor drives – the industrial electronics handbook. Taylor and Francis, 2005. 4. Strzelecki R., Benysek G.: Power electronics in smart electrical energy networks. Springer, 2008

Organisational unit conducting the course	Department of Electrotechnics, Power Electronics and Power Engineering	Date of issuing the programme
Author of the programme	Agata Godlewska	20.01.2020

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar

COURSE DESCRIPTION CARD

<table>
<tr><td colspan="10">Faculty of Electrical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="6">Electrical and Electronics Engineering</td><td>Degree level and programme type</td><td>bachelor's degree, full time programme</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="6">-</td><td>Study profile</td><td>-</td></tr>
<tr><td rowspan="2">Course name</td><td colspan="6" rowspan="2">Programmable Logic Controllers</td><td>Course code</td><td>IS-FEE-10015W</td></tr>
<tr><td>Course type</td><td>elective</td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>winter</td></tr>
<tr><td>15</td><td></td><td>30</td><td></td><td></td><td></td><td></td><td>No. of ECTS credits</td><td>5</td></tr>
<tr><td>Entry requirements</td><td colspan="9">-</td></tr>
<tr><td>Course objectives</td><td colspan="9">This course will provide the basic technical skills and knowledge necessary to work with programmable logic controllers typically found in an industrial environment.</td></tr>
<tr><td>Course content</td><td colspan="9">Industrial control systems. Programmable Logic Controllers (PLC): classification, structure, selection, configuration. PLC programming languages. Input/Output devices (switches, sensors, relays, solenoids etc.). PLC communication with I/O devices. Sequential Control Structure. Industrial networks - Profibus and Profinet. Visualization of industrial processes - Supervisory Control and Data Acquisition (SCADA) Systems. Human–machine interface (HMI). PLC programming software. HMI software.</td></tr>
<tr><td>Teaching methods</td><td colspan="9">presentation and lecture, practical work, reports</td></tr>
<tr><td>Assessment method</td><td colspan="9">lecture – tests; laboratory classes – evaluation of reports</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="7">Learning outcomes</td><td colspan="2">Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="7">explains the purpose of various components of industrial control systems</td><td colspan="2"></td></tr>
<tr><td>LO2</td><td colspan="7">creates the control algorithm based on machine and process description</td><td colspan="2"></td></tr>
<tr><td>LO3</td><td colspan="7">describes the basic structure and operation of the PLC</td><td colspan="2"></td></tr>
<tr><td>LO4</td><td colspan="7">applies appropriate engineering tools for control application, visualization, configuration and parameterization selected PLC</td><td colspan="2"></td></tr>
<tr><td>LO5</td><td colspan="7">writes PLC program and HMI program</td><td colspan="2"></td></tr>
<tr><td>LO6</td><td colspan="7">executes and test the application on a set composed of PLC,</td><td colspan="2"></td></tr>
</table>

	HMI and the process model	
LO7	prepares the technical documentation and present the results	
Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	tests	L,LC
LO2	tests	L,LC
LO3	tests	L,LC
LO4	evaluation of reports	LC
LO5	evaluation of reports	LC
LO6	evaluation of reports	LC
LO7	evaluation of reports	LC
Student workload (in hours)		No. of hours
Calculation	lecture attendance	15
	individual work on lecture topics	20
	preparation for and participation in exams/tests	20
	laboratory class attendance	30
	preparation for laboratory class	20
	work on reports	30
	TOTAL:	130

Quantitative indicators	HOURS	No. of ECTS credits
Student workload – activities that require direct teacher participation	45	1,5
Student workload – practical activities	95	3,5

Basic references	1. Kręglewska U., Ławryńczuk M., Marusak P.: Control laboratory exercises, Oficyna Wydawnicza PW, Warszawa 2007. 2.Erickson K. T.: Programmable Logic Controllers: An Emphasis on Design and Application, 2nd Ed, Dogwood Valley Press 2011. 3. Roebuck K.: SCADA: High-impact Strategies - What You Need to Know: Definitions, Adoptions, Impact, Benefits, Mat, 2011.
Supplementary references	1. Clements-Jewery K., Jeffcoat W. : The PLC Workbook: programmable logic controllers made easy. London, Prentice-Hall, 1996. 2. Bolton W.: Programmable Logic Controllers (Fourth Edition). London, Elsevier, 2006.

Organisational unit conducting the course	Department of Automatic Control and Electronics	Date of issuing the programme
Author of the programme	Andrzej Ruszewski,, PhD Eng. DSc.	08.02.2020

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar

COURSE DESCRIPTION CARD

<table>
<tr><td colspan="10">Faculty of Electrical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="6">Electrical and Electronics engineering</td><td colspan="2">Degree level and programme type</td><td>bachelor's degree, full time programme</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="6">-</td><td colspan="2">Study profile</td><td>-</td></tr>
<tr><td rowspan="2">Course name</td><td colspan="6" rowspan="2">Radioelectronic Devices</td><td colspan="2">Course code</td><td>IS-FEE-10017W</td></tr>
<tr><td colspan="2">Course type</td><td>elective</td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>winter</td></tr>
<tr><td>30</td><td></td><td>30</td><td></td><td></td><td></td><td></td><td>No. of ECTS credits</td><td>6</td></tr>
<tr><td>Entry requirements</td><td colspan="9">-</td></tr>
<tr><td>Course objectives</td><td colspan="9">The principal objective of lectures is to cover the fundamentals of main radioelectronics circuits (amplifiers, oscillators, frequency multipliers, mixers) and analogue modulation (AM,FM,PM modulations, modulators and demodulators structures). The basis of superheterodyne receivers are presented.</td></tr>
<tr><td>Course content</td><td colspan="9">Static and dynamic characteristics. Approximation characteristics of active elements. Classes and regimes of work. Analysis of work of resonance power amplifier. Frequency multipliers. LC and crystal oscillators. Amplitude modulation. AM modulators and demodulators. Angle modulations - FM and PM. FM modulators and demodulators. Frequency mixers. Superheterodyne receiver idea.</td></tr>
<tr><td>Teaching methods</td><td colspan="9">lecture, laboratory class</td></tr>
<tr><td>Assessment method</td><td colspan="9">lecture: oral exam, two small tests during lecture, evaluation of homeworks; laboratory class: evaluation of reports, verification of preparation for classes.</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="8">Learning outcomes</td><td>Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="8">has a knowledge of work principles of basis radioelectronic devices;</td><td></td></tr>
<tr><td>LO2</td><td colspan="8">has a knowledge of principles of modulation and demodulations;</td><td></td></tr>
<tr><td>LO3</td><td colspan="8">has a skill of frequency spectrum measurements;</td><td></td></tr>
<tr><td>LO4</td><td colspan="8">has a skill of measurements of radioelectronic devices characteristics.</td><td></td></tr>
<tr><td>LO5</td><td colspan="8"></td><td></td></tr>
<tr><td>LO6</td><td colspan="8"></td><td></td></tr>
<tr><td>LO7</td><td colspan="8"></td><td></td></tr>
</table>

LO8		
Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	evaluating the student's reports and preparation for the classes	L
LO2	evaluating the student's reports and preparation for the classes , tests on lecture content	L,LC
LO3	evaluating the student's reports, tests on lecture content	L,LC
LO4	evaluating the student's reports, tests on lecture content	L,LC
LO5		
LO6		
LO7		
LO8		

Student workload (in hours)		No. of hours
Calculation	lecture attendance	30
	participation in laboratory classes	30
	participation in laboratory classes	15
	preparation for laboratory reports	30
	preparation reports from homeworks	30
	preparation for and participation in exams/tests	20
	TOTAL:	155

Quantitative indicators	HOURS	No. of ECTS credits
Student workload – activities that require direct teacher participation	60	2
Student workload – practical activities	75	3

Basic references	1. Li R., Chi-Hsi: RF circuit design. Wiley, 2008. 2. Grebennikov A.: RF and microwave power amplifier design. McGraw-Hill, 2005. 3. Hagen J. B.: Radio-frequency electronics. Circuits and applications. Cambridge University, 2009.	
Supplementary references	1. Sorrentino R., Bianchi G.: Microwave and RF engineering. Wiley, 2010. 2. Whitaker J.C.: The RF transmission systems handbook. CRC Press, 2002.	
Organisational unit conducting the course	Department of Photonics, Electronics and Light Technique	Date of issuing the programme
Author of the programme	Maciej Sadowski, Ph. D. Eng.	13.02.2020

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar

COURSE DESCRIPTION CARD

<table>
<tr><td colspan="10">Faculty of Electrical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="6">Electrical and Electronics Engineering</td><td colspan="2">Degree level and programme type</td><td>bachelor's degree, full time programme</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="6">-</td><td colspan="2">Study profile</td><td>-</td></tr>
<tr><td rowspan="2">Course name</td><td colspan="6" rowspan="2">Wireless Transmission Systems</td><td colspan="2">Course code</td><td>IS-FEE-10019W</td></tr>
<tr><td colspan="2">Course type</td><td>elective</td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>winter</td></tr>
<tr><td>30</td><td></td><td></td><td></td><td></td><td></td><td></td><td>No. of ECTS credits</td><td>2</td></tr>
<tr><td>Entry requirements</td><td colspan="9">-</td></tr>
<tr><td>Course objectives</td><td colspan="9">To acquaint students with the techniques used to transmit information in wireless systems. To acquaint students with the architecture, principles of operation and application of modern wireless systems.</td></tr>
<tr><td>Course content</td><td colspan="9">Decibel calculation in radiocommunication. Ranges and properties of radio waves used in wireless communication. Basics of radio wave propagation. Radio wave propagation in free space. The structure and characteristics of the radio link. Radiocommunication equation. Bases of antenna array operation. Mathematical description of multiport radio devices. Impedance, admittance and dissipation matrices in the description of the properties of wireless devices. The matching of radio devices. Rayleigh ratio. Basics of operation of various types of commonly used wireless systems - architecture, principle of operation, radio channels, application. Satellite systems, trunking systems, cellular systems.</td></tr>
<tr><td>Teaching methods</td><td colspan="9">lecture</td></tr>
<tr><td>Assessment method</td><td colspan="9">exam and evaluation of reports</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="8">Learning outcomes</td><td>Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="8">has knowledge about radio wave propagation</td><td></td></tr>
<tr><td>LO2</td><td colspan="8">has knowledge about techniques used for transmission information in wireless systems</td><td></td></tr>
<tr><td>LO3</td><td colspan="8">has knowledge about structure, operation, mathematical description of multiport radio devices</td><td></td></tr>
<tr><td>LO4</td><td colspan="8">has knowledge about operation of antenna arrays</td><td></td></tr>
</table>

LO5	**has knowledge about operation of commonly used wireless systems**	
LO6		
Symbol of learning outcome	**Methods of assessing the learning outcomes**	**Type of tuition during which the outcome is assessed**
LO1	**exam on lecture content**	**L**
LO2	**exam on lecture content**	**L**
LO3	**exam on lecture content**	**L**
LO4	**exam on lecture content**	**L**
LO5	**evaluation of reports and presentation of selected topic**	**L**
LO6		

Student workload (in hours)		**No. of hours**
Calculation	**lecture attendance**	**30**
	preparation reports from homeworks	**15**
	preparation for and participation in exams/tests	**15**
	TOTAL:	**60**

Quantitative indicators	**HOURS**	**No. of ECTS credits**
Student workload – activities that require direct teacher participation	**30**	**1**
Student workload – practical activities	**15**	**0,5**

Basic references	Siwiak K.: Radiowave propagation and antennas for personal communications. Artech House, 2007. Saunders S.: Antennas and propagation for wireless communications systems. Wiley & Sons, 2007. Rohde U.: RF/microwave circuit design for wireless applications. Wiley & Sons, 2013.
Supplementary references	Fujimoto K., James J. R.: Mobile antenna system handbook. Artech House, 1994. Sorrentino R., Bianchi G.: Microwave and RF engineering. Wiley & Sons, 2010. Randy L.: Antenna arrays : a computational approach. Wiley & Sons, 2010. Rhee M.Y., Mobile communication systems and security. Wiley & Sons, 2009. Maral G., M. Bousquet M., Satellite communications systems. Wiley & Sons, 2002.

Organisational unit conducting the course	Department of Photonics, Electronics and Lighting Technology	**Date of issuing the programme**
Author of the programme	**Marek Garbaruk, Ph.D. Eng.**	**20.02.2021**

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar

COURSE DESCRIPTION CARD – SPECIMEN

<table>
<tr><td colspan="10">Faculty of Electrical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="6">Electrical and Electronics Engineering</td><td>Degree level and programme type</td><td>bachelor's degree, full time programme</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="6">-</td><td>Study profile</td><td>-</td></tr>
<tr><td rowspan="2">Course name</td><td colspan="6" rowspan="2">Microcontrollers in Applications</td><td>Course code</td><td>IS-FEE-10020W</td></tr>
<tr><td>Course type</td><td>elective</td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>winter</td></tr>
<tr><td></td><td></td><td>30</td><td></td><td></td><td></td><td></td><td>No. of ECTS credits</td><td>4</td></tr>
<tr><td>Entry requirements</td><td colspan="9">-</td></tr>
<tr><td>Course objectives</td><td colspan="9">Teaching the development and testing of practical and advanced applications using microcontrollers and electronic components.</td></tr>
<tr><td>Course content</td><td colspan="9">Fundamentals programming of microcontrollers with ARM core. Practical I/O port operations. Alphanumeric and graphical display applications. Determination of the tilt using a MEMS sensor. Generating a multi-channel PWM signal to control the robot arm (model AL5A). Communication with GPS receiver. Using Bluetooth technology for remote voltage measurements. DC motor control. Implementation of color recognition system. DAC converter application to audio playback.</td></tr>
<tr><td>Teaching methods</td><td colspan="9">laboratory classes, presentation, disscusion, specialization workshop</td></tr>
<tr><td>Assessment method</td><td colspan="9">evaluation of partial reports from the set of exercises</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="8">Learning outcomes</td><td>Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="8">describes the operation of modern microcontrollers</td><td></td></tr>
<tr><td>LO2</td><td colspan="8">uses appropriate integrated development tools</td><td></td></tr>
<tr><td>LO3</td><td colspan="8">creates and verifies software supporting peripherals of the selected microcontroller</td><td></td></tr>
<tr><td>LO4</td><td colspan="8">implements the prepared algorithm of program operation</td><td></td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="8">Methods of assessing the learning outcomes</td><td>Type of tuition during which the outcome is assessed</td></tr>
<tr><td>LO1</td><td colspan="8">evaluation of the report on exercise, a discussion during the</td><td></td></tr>
</table>

	laboratory classes		
LO2	evaluation of the report on exercise, a discussion during the laboratory classes		
LO3	evaluation of the report on exercise, a discussion during the laboratory classes		
LO4	evaluation of the report on exercise, a discussion during the laboratory classes		
Student workload (in hours)		No. of hours	
Calculation	preparation for the laboratory	30	
	description of laboratory reports	20	
	participation in lab sessions or student-teacher consultations	30	
	prepare to pass the module	20	
	TOTAL:	100	
Quantitative indicators		HOURS	No. of ECTS credits
Student workload – activities that require direct teacher participation		30	1
Student workload – practical activities		100	4
Basic references	1. Bansod T., Tawde P.: Microcontroller Programming (8051, PIC, ARM7 ARM Cortex), Shroff Publisher, 2017. 2. Martin T.: The insider's guide to the Philips ARM7-based microcontrollers. Hitex 2005. 3. Predko M.: Programming and Customizing the ARM7 Microcontroller, McGraw-Hill, 2011. 4. Touluson R., Wilmshurst T.: Fast and Effective Embedded Systems Design : Applying the ARM mbed, Newness, 2016. 5. Warwick A.S.: C Programming for Embedded Microcontrollers, Elektor Publishing, 2009. 6. Warwick A.S.: ARM Microcontroller Interfacing: Hardware and Software, Elektor Publishing, 2010		
Supplementary references	1. Kociszewski R.: Laboratory Guide. Course website. 2. LPC 214x – User manual. Philips Semiconductors 2004. 3. Hohl W.: ARM Assembly Language. Fundamentals and Techniques. CRC Press, 2014.		
Organisational unit conducting the course	Department of Automatic Control and Robotics	Date of issuing the programme	
Author of the programme	Rafał Kociszewski, PhD Eng.	24.02.2021	

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work,

S – seminar

COURSE DESCRIPTION CARD

<table>
<tr><td colspan="10">Faculty of Electrical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="6">Electrical and Electronics Engineering</td><td>Degree level and programme type</td><td>bachelor's degree, full time programme</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="6">-</td><td>Study profile</td><td>-</td></tr>
<tr><td rowspan="2">Course name</td><td colspan="6" rowspan="2">Final Project</td><td>Course code</td><td>IS-FEE-10021W</td></tr>
<tr><td>Course type</td><td>elective</td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>winter</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>No. of ECTS credits</td><td>12</td></tr>
<tr><td>Entry requirements</td><td colspan="9">5/6 semesters of engineer level in appropriate area</td></tr>
<tr><td>Course objectives</td><td colspan="9">Familiriazing student with the methodology of solving engineer problems. Deepening skills of appropriate choice and use of literature references and the skill of use of scientific and technical data bases. Training the ability of analyzing the literature to identify the possible solutions of the problem stated in the engineer project. Obtaining the skill of formulating the engineer problem and the choice of the methodology and tools to solve it (including calculation tools and computer programmes). Achieving the skill of preparing plan and schedule of the process of the engineer task realization. Improving skill of preparing the report of the engineer task realization. Creating the skill of the design assumptions' verification, concluding and evaluation of achieved results.</td></tr>
<tr><td>Course content</td><td colspan="9">Knowledge and skills connected with the subject of the project - acquisition of information from the literature. Characterization of the possible solutions of the problem stated in the engineer project derived from the current state of knowledge. Knowledge of the development trends within the chosen area allowing to choose the solution of the problem. Planning the realization of the engineer problem. Using computer tools and techniques in order to realize or support the solution of the task. Verification of the solution by means of the methods and tools of theoretical and experimental analysis. Methodology of characterization and analyzing the engineer task and forming the conclusions. Development of the results and the documentation of executed tasks.</td></tr>
<tr><td>Teaching methods</td><td colspan="9">Discussion, consultations</td></tr>
<tr><td>Assessment method</td><td colspan="9">evaluation of the final project by the tutor and evaluator, evaluation of the defence of the final project.</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="7">Learning outcomes</td><td colspan="2">Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="7">collects knowledge from the literature and evaluates the applicability to solve chosen technical problem;</td><td colspan="2"></td></tr>
<tr><td>LO2</td><td colspan="7">indyvidually plans the solution of the engineer problem, specifying</td><td colspan="2"></td></tr>
</table>

	the method and the execution time;	
LO3	implements engineering task and prepares the development containing documentation and verification of the results;	
LO4	formulates objectives for the various stages of solving engineering tasks, suggesting methods of implementation and verification of a solution;	
LO5	can design a measurement system implementing engineering design or research task;	
LO6	can evaluate relevance and use appropriate methods and tools used to achieve engineering tasks;	
LO7	has the ability and understands the need to improve his/hers qualifications in order to enhance and update expertise technical knowledge.	
Symbol of learning outcome	**Methods of assessing the learning outcomes**	**Type of tuition during which the outcome is assessed**
LO1	positive evaluation of engineering work and the result of defense;	
LO2	positive evaluation of engineering work and the result of defense;	
LO3	positive evaluation of engineering work and the result of defense;	
LO4	positive evaluation of engineering work and the result of defense;	
LO5	positive evaluation of engineering work and the result of defense;	
LO6	positive evaluation of engineering work and the result of defense;	
LO7	positive evaluation of engineering work and the result of defense;	
Student workload (in hours)		**No. of hours**
Calculation	**self work on the subject, consultations, discussions with the supervisor**	**300**
	TOTAL:	**300**

Quantitative indicators	**HOURS**	**No. of ECTS credits**
Student workload – activities that require direct teacher participation	**15**	**0,5**
Student workload – practical activities	**300**	**12**

Basic references	**specialized literature - adequate to the subject of the project.**	
Supplementary references		
Organisational unit conducting the course	**Faculty of Electrical Engineering**	**Date of issuing the programme**
Author of the programme	**teachers of the Faculty of Electrical Engineering**	**15.02.2020**

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar

COURSE DESCRIPTION CARD

<table>
<tr><td colspan="10">Faculty of Electrical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="6">Electrical and Electronics Engineering</td><td>Degree level and programme type</td><td>bachelor's degree, full time programme</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="6">-</td><td>Study profile</td><td>-</td></tr>
<tr><td rowspan="2">Course name</td><td colspan="6" rowspan="2">Final Project</td><td>Course code</td><td>IS-FEE-10022S</td></tr>
<tr><td>Course type</td><td>elective</td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>summer</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>No. of ECTS credits</td><td>12</td></tr>
<tr><td>Entry requirements</td><td colspan="9">5/6 semesters of engineer level in appropriate area</td></tr>
<tr><td>Course objectives</td><td colspan="9">Familiriazing student with the methodology of solving engineer problems. Deepening skills of appropriate choice and use of literature references and the skill of use of scientific and technical data bases. Training the ability of analyzing the literature to identify the possible solutions of the problem stated in the engineer project. Obtaining the skill of formulating the engineer problem and the choice of the methodology and tools to solve it (including calculation tools and computer programmes). Achieving the skill of preparing plan and schedule of the process of the engineer task realization. Improving skill of preparing the report of the engineer task realization. Creating the skill of the design assumptions' verification, concluding and evaluation of achieved results.</td></tr>
<tr><td>Course content</td><td colspan="9">Knowledge and skills connected with the subject of the project - acquisition of information from the literature. Characterization of the possible solutions of the problem stated in the engineer project derived from the current state of knowledge. Knowledge of the development trends within the chosen area allowing to choose the solution of the problem. Planning the realization of the engineer problem. Using computer tools and techniques in order to realize or support the solution of the task. Verification of the solution by means of the methods and tools of theoretical and experimental analysis. Methodology of characterization and analyzing the engineer task and forming the conclusions. Development of the results and the documentation of executed tasks.</td></tr>
<tr><td>Teaching methods</td><td colspan="9">Discussion, consultations</td></tr>
<tr><td>Assessment method</td><td colspan="9">evaluation of the final project by the tutor and evaluator, evaluation of the defence of the final project.</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="7">Learning outcomes</td><td colspan="2">Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="7">collects knowledge from the literature and evaluates the applicability to solve chosen technical problem;</td><td colspan="2"></td></tr>
<tr><td>LO2</td><td colspan="7">indyvidually plans the solution of the engineer problem, specifying</td><td colspan="2"></td></tr>
</table>

	the method and the execution time;	
LO3	implements engineering task and prepares the development containing documentation and verification of the results;	
LO4	formulates objectives for the various stages of solving engineering tasks, suggesting methods of implementation and verification of a solution;	
LO5	can design a measurement system implementing engineering design or research task;	
LO6	can evaluate relevance and use appropriate methods and tools used to achieve engineering tasks;	
LO7	has the ability and understands the need to improve his/hers qualifications in order to enhance and update expertise technical knowledge.	
Symbol of learning outcome	**Methods of assessing the learning outcomes**	**Type of tuition during which the outcome is assessed**
LO1	positive evaluation of engineering work and the result of defense;	
LO2	positive evaluation of engineering work and the result of defense;	
LO3	positive evaluation of engineering work and the result of defense;	
LO4	positive evaluation of engineering work and the result of defense;	
LO5	positive evaluation of engineering work and the result of defense;	
LO6	positive evaluation of engineering work and the result of defense;	
LO7	positive evaluation of engineering work and the result of defense;	
Student workload (in hours)		**No. of hours**
Calculation	**self work on the subject, consultations, discussions with the supervisor**	**300**
	TOTAL:	**300**

Quantitative indicators	**HOURS**	**No. of ECTS credits**
Student workload – activities that require direct teacher participation	**15**	**0,5**
Student workload – practical activities	**300**	**12**

Basic references	**specialized literature - adequate to the subject of the project.**	
Supplementary references		
Organisational unit conducting the course	**Faculty of Electrical Engineering**	**Date of issuing the programme**
Author of the programme	**Teachers of the Faculty of Electrical Engineering**	**15.02.2020**

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar

COURSE DESCRIPTION CARD

<table>
<tr><td colspan="10">Faculty of Electrical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="6">Electrical and Electronic Engineering</td><td colspan="2">Degree level and programme type</td><td>bachelor's degree, full time programme</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="6">-</td><td colspan="2">Study profile</td><td></td></tr>
<tr><td rowspan="2">Course name</td><td colspan="6" rowspan="2">Image Processing and Recognition</td><td colspan="2">Course code</td><td>IS-FEE-10022W</td></tr>
<tr><td colspan="2">Course type</td><td>elective</td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>winter</td></tr>
<tr><td>15</td><td></td><td></td><td></td><td>30</td><td></td><td></td><td>No. of ECTS credits</td><td>4</td></tr>
<tr><td>Entry requirements</td><td colspan="9">-</td></tr>
<tr><td>Course objectives</td><td colspan="9">To familiarize students with the knowledge of digital images, methods of their processing and recognition.</td></tr>
<tr><td>Course content</td><td colspan="9"><u>Lecture</u>: Introduction to basic information about image and image processing methods: mathematical model of the image, the creation of digital images, disturbance models, image histogram alignment, context filters, morphological transformations, contouring and segmentation algorithms. Image compression and decompression methods. Image recognition tasks, application of image analysis systems. Classification of recognition methods: minimum distance methods, pattern methods, approximation methods, special methods, probabilistic methods, tree methods, graph methods. Cluster analysis and classification in the feature space.
Examples of image recognition systems: face recognition systems, vision systems.
<u>Specialization workshop</u>: Testing and evaluation of selected image processing procedures on given digital images. Application of selected image processing methods. Selection of image features and recognition methods for selected classes of objects. Testing and evaluation of selected recognition methods on given images. Presentation of individual tasks of selecting image processing procedures and methods of recognizing and assessing their quality for selected classes of objects.</td></tr>
<tr><td>Teaching methods</td><td colspan="9">Informative and problem lecture, discussions, implementation of projects</td></tr>
<tr><td>Assessment method</td><td colspan="9">Lecture - written test; Specialization workshop - evaluation of projects, verification of preparation for classes</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="7">Learning outcomes</td><td colspan="2">Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="7">The student knows the basic concepts of the description of digital images, lists and classifies them.</td><td colspan="2"></td></tr>
</table>

LO2	The student can identifies methods and techniques for processing and recognizing digital images.	
LO3	The student can cites and uses the basic procedures for processing digital images.	
LO4	The student can interprets the results of digital image processing.	
LO5	The student can assess the quality of image analysis methods used.	
LO6	The student is ready to work in a team, think and act creatively.	
Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	written test on lecture content	L
LO2	written test on lecture content	L
LO3	written test on lecture content; evaluating the student's reports	L, SW
LO4	evaluating the student's reports	SW
LO5	evaluating the student's reports	SW
LO6	discussion on the project, observation of students 'work in classes	SW
Student workload (in hours)		No. of hours
Calculation	Lecture attendance	15
	Participation in seminar workshop	30
	Preparation for seminar workshop	15
	Completion of project tasks (including work on reports)	20
	Participation in student-teacher sessions related to the classes	5
	Preparation for and participation in the final test	20
	TOTAL:	105

Quantitative indicators	HOURS	No. of ECTS credits
Student workload – activities that require direct teacher participation	50	2
Student workload – practical activities	85	3

Basic references	1. Russ J., Neal B.: The image processing handbook. CRC Press, Boca Raton, 2017 2. McAndrew A.: A computational introduction to digital image processing, Boca Raton, CRC/Taylor & Francis, 2016 3. Shih F.: Image processing and pattern recognition : fundamentals and techniques, IEEE Press, John Wiley a. Sons, 2010
Supplementary references	

Organisational unit conducting the course	**Department of Photonics, Electronics and Lighting Technology**	**Date of issuing the programme**
Author of the programme	**Grażyna Gilewska, Ph. D.**	**28.02.2021**

COURSE DESCRIPTION CARD

<table>
<tr><td colspan="10">Faculty of Electrical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="6">Electrical and Electronics Engineering</td><td colspan="2">Degree level and programme type</td><td>bachelor's degree, full time programme</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="6">-</td><td colspan="2">Study profile</td><td>-</td></tr>
<tr><td rowspan="2">Course name</td><td colspan="6" rowspan="2">Automotive lighting</td><td colspan="2">Course code</td><td>IS-FEE-10023S</td></tr>
<tr><td colspan="2">Course type</td><td>elective</td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>summer</td></tr>
<tr><td>15</td><td></td><td>15</td><td></td><td></td><td></td><td></td><td>No. of ECTS credits</td><td>4</td></tr>
<tr><td>Entry requirements</td><td colspan="9">-</td></tr>
<tr><td>Course objectives</td><td colspan="9">To familiarize students withautomotive lighting. Presentation of design methods of lightingequipment inautomotive lighting. Classification and investigation of light fittings used in automotive lighting. Presentation of methods of luminous flux emmision verification in automotive lighting. Examination of the characteristics of road lighting and horizontal and vertical marking.</td></tr>
<tr><td>Course content</td><td colspan="9">Automotive lighting. Light sources for automotive lighting equipment. Automotive lighting control systems. Headlamps and signal lamps design methods. Photometric measurements of automobile fittings. Construction of daytime running lamps, road lamps, signal lamps and others. Adaptive systems in automotive lighting.</td></tr>
<tr><td>Teaching methods</td><td colspan="9">laboratory experiments, consultations, lecture, self-work, discussion</td></tr>
<tr><td>Assessment method</td><td colspan="9">lecture: written exam; laboratory class - verification of preparation for classes, evaluation of the reports.</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="7">Learning outcomes</td><td colspan="2">Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="7">lists and distinguishes appropriate lighting equipment used in automotive engineering</td><td colspan="2"></td></tr>
<tr><td>LO2</td><td colspan="7">describes the design principles of automobile lamps;</td><td colspan="2"></td></tr>
<tr><td>LO3</td><td colspan="7">measures required illumination distributions caused by automobile lamps;</td><td colspan="2"></td></tr>
<tr><td>LO4</td><td colspan="7">selects components and light sources for automobile lamps properly;</td><td colspan="2"></td></tr>
<tr><td>LO5</td><td colspan="7">classifies and explains control methods in automotive lighting.</td><td colspan="2"></td></tr>
<tr><td>LO6</td><td colspan="7"></td><td colspan="2"></td></tr>
</table>

Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	exam, duscussion during laboratory classes	L, LC
LO2	exam	L
LO3	evaluation of the report on exercise, discussion during the laboratory classes	LC
LO4	exam, duscussion during laboratory classes	L, LC
LO5	exam, duscussion during laboratory classes	L, LC
LO6		

Student workload (in hours)		No. of hours
Calculation	attending the lecture	15
	participation in the laboratory classes	15
	preparation for the laboratory classes	20
	preparation of laboratory reports or doing homework assignments (homework)	20
	participation in consultations	10
	preparation to the exam	30
	TOTAL:	110

Quantitative indicators	HOURS	No. of ECTS credits
Student workload – activities that require direct teacher participation	35	1,5
Student workload – practical activities	35	1,5

Basic references	1. Wordenweber B., Wallaschek J., Boyce P., Hoffman D.: Automotive lighting and human vision, Springer, 2007. 2. Bauer H.: Automotive handbook, Bosch, 2000.
Supplementary references	1. E/ECE/TRANS/505, addendum 36, regulation no. 37, rev. 5: Uniform provisions concerning the approval of filament lamps for use in approved lamp units on power; Driven vehicles and of their trailers. 2. E/ECE/TRANS/505, addendum 3, regulation no. 4, rev. 2: Uniform provisions for the approval of devices for the illumination of rear registration plates of motor vehicles (except motor cycles) and their trailers. 3. E/ECE/TRANS/505, addendum 48, regulation no. 48, rev. 6: Uniform provisions concerning the approval of vehicles with regard to the installation of lighting and light; Signalling devices.

Organisational unit conducting the course	Department of Photonics, Electronics and Lighting Technology	Date of issuing the programme
Author of the programme	Maciej Zajkowski, Ph.D. Eng. Urszula Blaszczak, Lukasz Budzynski	30.01.2020

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar

COURSE DESCRIPTION CARD – SPECIMEN

Faculty of Mechanical Engineering									
Field of study	**Engineering**							**Degree level and programme type**	**Bachelor's degree**
Specialization/ diploma path	**-**							**Study profile**	**-**
Course name	**SQL Based Data Analysis and Reporting**							**Course code**	**IS-FEE-10023W**
								Course type	**elective**
Forms and number of hours of tuition	**L**	**C**	**LC**	**P**	**SW**	**FW**	**S**	**Semester**	**winter**
	15			**15**				**No. of ECTS credits**	**2**
Entry requirements	**programming - basic engineering level**								
Course objectives	**Knowledge and understanding of the basics of SQL databases. Creation of reporting systems using MSSQL functions and procedures.**								
Course content	**Introduction to SQL and T-SQL. Introduction to Tables. Introduction to Data Selection. Sorting Records. Introduction to Data Filters. Introduction to Relational Databases. Introduction to Data Joins. Introduction to Views. Topics on Views. Aggregate Queries. Selecting Records Over Partitions. Ranking Records Over Partitions. Triggers. Sub-Queries. Stored Procedures.**								
Teaching methods	**Lecture and discussion, project**								
Assessment method	**Lecture – exam;** **Project - Creation of a reporting system using MSSQL T-SQL extension**								
Symbol of learning outcome	**Learning outcomes**								**Reference to the learning outcomes for the field of study**
LO1	**knowledge of the basics of SQL databases**								
LO2	**knowledge of the basics of MSSQL T-SQL extension**								
LO3	**knowledge of the principles of proper preparation of reports and is able to analyze them**								
LO4	**preparing, testing and running own scripts for data acquisition, processing and analysis**								
LO5									
LO6									
Symbol of learning outcome	**Methods of assessing the learning outcomes**								**Type of tuition during which the outcome is assessed**

LO1	exam, partial evaluation of project	L,P
LO2	exam, partial evaluation of project	L,P
LO3	exam, partial evaluation of project	L,P
LO4	exam, partial evaluation of project	L,P
LO5		
LO6		

Student workload (in hours)		No. of hours
Calculation	lecture	15
	classes	15
	preparation for project	6
	creation of data analysis and reporting system	20
	TOTAL:	56

Quantitative indicators	HOURS	No. of ECTS credits
Student workload – activities that require direct teacher participation	30	
Student workload – practical activities	0	

Basic references	1. A. Molinaro, SQL Cookbook, O'Reilly and Associates; 1. Edition 2. W. Shields, SQL QuickStart Guide: The Simplified Beginner's Guide to Managing, Analyzing, and Manipulating Data With SQL, ClydeBank Media LLC; Illustrated Edition 3. Itzik Ben-Gan, T-SQL Fundamentals, Microsoft Press; 3rd edition	
Supplementary references	1. G.S. Linoff, Data Analysis Using SQL and Excel, Wiley; 2. Edition	
Organisational unit conducting the course	Department of Automatic Control and Robotics	Date of issuing the programme
Author of the programme	Maciej Ciężkowski, Ph. D.	12.02.2021

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar

COURSE DESCRIPTION CARD

<table>
<tr><td colspan="10">Faculty of Electrical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="6">Electrical and Electronics Engineering</td><td colspan="2">Degree level and programme type</td><td>bachelor's degree</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="6">-</td><td colspan="2">Study profile</td><td>-</td></tr>
<tr><td rowspan="2">Course name</td><td colspan="6" rowspan="2">Control Engineering and Systems</td><td colspan="2">Course code</td><td>IS-FEE-10024S</td></tr>
<tr><td colspan="2">Course type</td><td>elective</td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>summer</td></tr>
<tr><td>30</td><td></td><td></td><td></td><td>30</td><td></td><td></td><td>No. of ECTS credits</td><td>6</td></tr>
<tr><td>Entry requirements</td><td colspan="9">Fundamentals of Control Engineering</td></tr>
<tr><td>Course objectives</td><td colspan="9">This course extends the students' knowledge of state space approach to analyze and synthesis of control systems. Workshops will learn how to design and simulate considered systems in specialized software.</td></tr>
<tr><td>Course content</td><td colspan="9">Description of multivariable dynamical systems in state space and by the use of transfer matrix. Controlability and observability of linear systems, Kalman decomposition. Modal control, observer synthesis, use of observer to modal control. Linear matrix inequalities. Computer aided design and simulations of control systems.</td></tr>
<tr><td>Teaching methods</td><td colspan="9">lecture, specialized workshops</td></tr>
<tr><td>Assessment method</td><td colspan="9">written exam (lecture), evaluation of reports (workshops)</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="7">Learning outcomes</td><td colspan="2">Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="7">express a dynamical system in state-space form</td><td colspan="2"></td></tr>
<tr><td>LO2</td><td colspan="7">classify models of multivariable dynamical systems</td><td colspan="2"></td></tr>
<tr><td>LO3</td><td colspan="7">desribe procedure of synthesis of modal control and state observer</td><td colspan="2"></td></tr>
<tr><td>LO4</td><td colspan="7">use an observer to estimate a state of dynamical system</td><td colspan="2"></td></tr>
<tr><td>LO5</td><td colspan="7">use specialized software to design and analyze of control systems</td><td colspan="2"></td></tr>
<tr><td>LO6</td><td colspan="7"></td><td colspan="2"></td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="7">Methods of assessing the learning outcomes</td><td colspan="2">Type of tuition during which the outcome is assessed</td></tr>
</table>

LO1	exam, evaluation of reports	L, SW
LO2	tests on lecture content	L
LO3	tests on lecture content	L
LO4	exam, evaluation of reports	L, SW
LO5	evaluation of reports	SW
LO6		

Student workload (in hours)		No. of hours
Calculation	lecture attendance	30
	individual work on lecture topics	30
	preparation for and participation in exam	45
	participation in workshops	30
	work on reports	30
	TOTAL:	165

Quantitative indicators	HOURS	No. of ECTS credits
Student workload – activities that require direct teacher participation	60	2
Student workload – practical activities	105	4

Basic references	1. Norman N. S.: Control systems engineering 5th ed., John Wiley a. Sons, Hoboken 2008. 2. Friedland B.: Control System Design: An Introduction to State-Space Methods, Dover Publ. Inc. 2005. 3. Williams II R. L., Lawrence D. A.: Linear State-Space Control Systems, John Wiley a. Sons, New Jersey 2007. 4. Kaczorek T.: Linear Control Systems, vol. 1 and 2, Research Studies Press, 1993. 5. Doyle J.C., Francis B.A., Tannenbaum A.R.: Feedback Control Theory, Macmillan, 1992.
Supplementary references	1. Kaczorek T.: Polynomial and Rational Matrices: Applications in Dynamical Systems Theory , Springer-Verlag, 2006. 2. Rogowski K.: Presentations for lecture (on-line available).

Organisational unit conducting the course	Control Engineering and Electronics	Date of issuing the programme
Author of the programme	Krzysztof Rogowski	31.03.2016

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar

COURSE DESCRIPTION CARD – SPECIMEN

<table>
<tr><td colspan="10">Faculty of Electrical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="6">Engineering</td><td colspan="2">Degree level and programme type</td><td>Bachelor's degree</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="6">-</td><td colspan="2">Study profile</td><td>-</td></tr>
<tr><td rowspan="2">Course name</td><td colspan="6" rowspan="2">Physics</td><td colspan="2">Course code</td><td>IS-FEE-10024W</td></tr>
<tr><td colspan="2">Course type</td><td>elective</td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>winter</td></tr>
<tr><td>30</td><td>30</td><td></td><td></td><td></td><td></td><td></td><td>No. of ECTS credits</td><td>4</td></tr>
<tr><td>Entry requirements</td><td colspan="9">Mathematics - basic engineering level</td></tr>
<tr><td>Course objectives</td><td colspan="9">Knowledge and understanding of the basic laws of the classical physics and selected elements of the modern physics. Acquiring the skills to solve the physics problems.</td></tr>
<tr><td>Course content</td><td colspan="9">Lecture: 1. Basic laws of classical mechanics. Inertial and non-inertial frames. Galilean transformation. The law of universal gravitation. 2. Harmonic vibrations. Damped vibrations. Forced vibrations. 3. Mechanical waves, acoustic waves. Wave interference. Doppler effect. 4. Geometric and wave optics. 5. Electricity and magnetism. Maxwell's equations. Electromagnetic waves. 6. Basics of modern physics. Perfect black body, external photoelectric effect, Compton effect. Bohr Atomic Model. Classes: Solving problems in the field of classical mechanics, geometric and wave optics, wave and vibrating motion, electricity and magnetism.</td></tr>
<tr><td>Teaching methods</td><td colspan="9">Lecture and discussion, classes</td></tr>
<tr><td>Assessment method</td><td colspan="9">Lecture – exam;
Classes - evaluation of solutions of selected physics problems and presentation of these solutions</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="8">Learning outcomes
After completing this course student</td><td>Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="8">Describes the meaning of the basic principles of physics</td><td></td></tr>
<tr><td>LO2</td><td colspan="8">Assigns the relevant principles and rules for existing problems</td><td></td></tr>
<tr><td>LO3</td><td colspan="8">Uses the learned physical laws to solve
typical physics problems</td><td></td></tr>
<tr><td>LO4</td><td colspan="8">Analyzes and solves the engineering problems with the use of physical approach</td><td></td></tr>
</table>

LO5		
LO6		
Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	exam	L
LO2	partial evaluation of problems solutions	L, C
LO3	partial evaluation of problems solutions	L, C
LO4	partial evaluation of problems solutions	L, C
LO5		
LO6		

Student workload (in hours)		No. of hours
Calculation	lecture	30
	classes	30
	preparation for classes	15
	work on solutions of selected physics problems	25
	TOTAL:	100

Quantitative indicators	HOURS	No. of ECTS credits
Student workload – activities that require direct teacher participation	60	2
Student workload – practical activities	70	2,5

Basic references	1. D. Halliday, R. Resnick, Physics 1 and Physics 2, Wiley; 3rd edition 2. Feynman R. P., Leighton R. B., Sands M, The Feynman Lectures on Physics, Basic Books; New Millennium ed. Edition 3. https://openstax.org/details/books/university-physics
Supplementary references	1. D. Halliday, R. Resnick, J. Walker, Fundamentals of Physics, John Wiley and Sons; 7th edition

Organisational unit conducting the course	Department of Automatic Control and Robotics	Date of issuing the programme
Author of the programme	Maciej Ciężkowski, Ph. D.	12.02.2021

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar

COURSE DESCRIPTION CARD

<table>
<tr><td colspan="10">Bialystok University of Technology
Faculty of Electrical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="6">Erasmus</td><td>Degree level and programme type</td><td>bachelor's degree, full time programme</td></tr>
<tr><td>Specialisation/ diploma path</td><td colspan="6"></td><td>Study profile</td><td></td></tr>
<tr><td rowspan="2">Course name</td><td colspan="6" rowspan="2">Digital signal processing</td><td>Course code</td><td>IS-FEE-10026W</td></tr>
<tr><td>Course type</td><td>elective</td></tr>
<tr><td rowspan="2">Forms and number of hours of educational activities</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>winter</td></tr>
<tr><td>30</td><td></td><td>30</td><td></td><td></td><td></td><td></td><td>No. of ECTS credits</td><td>6</td></tr>
<tr><td>Entry requirements</td><td colspan="9"></td></tr>
<tr><td>Course objectives</td><td colspan="9">The aim of the course is to acquaint the students with the basics of the digital signal processing. Student is familiar and can apply methods of signal analysis in time and frequency domains. Student is able to use methods of digital filter design and is familiar with issues of digital filter analysis and implementation.</td></tr>
<tr><td>Course content</td><td colspan="9">Lecture: Areas of application of digital signal processing methods. Signal classification. Sampling of continuous time signals: the sampling theorem, anti-aliasing filter, quantization, practical aspects of A/D and D/A conversion, digital resampling. Properties and application of the Discrete Fourier Transform; Fast Fourier Transform algorithms; analysis of nonstationary signals. Z-transform: properties and application. Description methods of discrete time signals and systems: difference equation, impulse response, Z-transform, transfer function, frequency response, state space representation. Overview of digital filter analysis, synthesis and application: infinite impulse response filters, finite impulse response filters, commonly used filters, time and frequency domain parameters, windowing, linear phase filters. Stability. Linear and circular convolution. DSP implementation issues.
Laboratory classes: Sampling and quantization of continuous signals, anti-aliasing filter; properties and application of the Fast Fourier Transform; impulse response, frequency response, digital filter analysis, filter synthesis, IIR and FIR filters, linear phase filters.</td></tr>
<tr><td>Teaching methods</td><td colspan="9">lecture, problem solving, laboratory experiments</td></tr>
<tr><td>Assessment method</td><td colspan="9">lecture: written exam;
laboratory class: evaluation the student's reports and performance in classes.</td></tr>
</table>

Symbol of learning outcome	Learning outcomes	Reference to the learning outcomes for the field of study
LO1	Student is familiar with issues of sampling of continuous time signals and analysis of discrete-time signals	
LO2	Student knows description methods of digital systems and can describe methods of digital filters synthesis and analysis;	
LO3	Student performs sampling of continuous time signals and performs spectral analysis;	
LO4	Student performs design process of the basic digital filters and performs properties verification of their implementation.	

Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	exam	L
LO2	exam	L
LO3	evaluation of student's reports and performance in classes	LC
LO4	evaluation of student's reports and performance in classes	LC
LO5		
LO6		

Student workload (in hours)		No. of hours
Calculation	lecture attendance	30
	preparation for and participation in exams	35
	participation in laboratory classes	30
	preparation for laboratory classes	20
	work on reports	30
	participation in student-teacher sessions (L+LC)	5
	TOTAL:	150

Quantitative indicators	HOURS	No. of ECTS credits
Student workload – activities that require direct teacher participation	65	2.5
Student workload – practical activities	83	3

Basic references	1. Rao K., Swamy M., Digital Signal Processing. Theory and Practice, Springer, 2018. 2. Rawat T. K., Digital Signal Processing. Oxford University Press, 2015. 3. Gazi O., Understanding Digital Signal Processing. Springer, 2018. 4. Oppenheim A. V., Schafer R., Discrete-time Signal Processing. Prentice

	Hall, 2010. 5. Hussain Z. M., Sadik A. Z., Digital Signal Processing. Springer, 2011.	
Supplementary references	1. Manolakis D. G., Ingle V. K., Applied Digital Signal Processing: Theory and Practice. Cambridge University Press, 2011. 2. Thyagarajan K.S., Introduction to Digital Signal Processing Using MATLAB with Application to Digital Communications, Springer, 2019. 3. Smith S. K., Digital Signal Processing; A Practical Guide for Engineers and Scientists. Elsevier Science, 2003. 4. Parker, Michael. Digital Signal Processing 101: Everything You Need to Know to Get Started, Elsevier Science & Technology, 2017. 5. Downey A. B., Think DSP: Digital Signal Processing in Python, O'Reilly, 2016.	
Organisational unit conducting the course	Department of Photonics, Electronics and Lighting Technology	Date of issuing the programme
Author of the programme	Dariusz Jańczak, PhD, DSc	03.02.2023

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar

COURSE DESCRIPTION CARD

<table>
<tr><td colspan="10">Faculty of Electrical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="6">Electrical Engineering</td><td>Degree level and programme type</td><td>Bachelor's degree</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="6">-</td><td>Study profile</td><td>-</td></tr>
<tr><td rowspan="2">Course name</td><td colspan="6" rowspan="2">Electrical Equipment and Installations</td><td>Course code</td><td>IS-FEE 100028</td></tr>
<tr><td>Course type</td><td>elective</td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>winter</td></tr>
<tr><td>15</td><td></td><td>15</td><td>30</td><td></td><td></td><td></td><td>No. of ECTS credits</td><td>6</td></tr>
<tr><td>Entry requirements</td><td colspan="9">Electrical Circuits, 1,2 or relevant</td></tr>
<tr><td>Course objectives</td><td colspan="9">To familiarize students with the construction equipment and low voltage electrical installations. Learning the basic principles of the selection of electrical equipment in normal operating conditions and fault conditions. To know the principles and criteria of the dimension of electric shock protections in low and high voltage installations. Education rules for the use of diagnostic equipment and conduct testing of electrical equipment with the basic physical phenomena occurring in them. To familiarize students with rules preparation of technical documentation for the electrical installation.</td></tr>
<tr><td>Course content</td><td colspan="9">Complete with module content:Environment of electrical equipment. Standardization and typification. Insulation of electrical equipment. Work and short currents. Impedance of electric power system elements. Thermal effect of work and short currents. Electromagnetic effect of short currents. Electrical arc and arc interruption. Switches. Short currents suppresion. Measuring transformers. Low-voltage power networks. Voltage range of an electrical installations. Selection of electrical devices. Live potection conductors against overcurrent. Supply of buildings. Electrical installations of buildings. Requirements for special installations, locations (construction and demolation site of buildings, caravan parks, swimming pools). Design principles of electrical installations. Switch in low voltage installation. Cables and conductors of electric power system. Selection of conductors.</td></tr>
<tr><td>Teaching methods</td><td colspan="9">lecture, discussion, experiment, presentation</td></tr>
<tr><td>Assessment method</td><td colspan="9">lecture - written exam; project - completion, presentation and discussion of the project, laboratory - written test, raports from laboratory</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="7">Learning outcomes</td><td colspan="2">Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="7">The student knows the basic requirements of the applicable regulations for the construction and selection of equipment in electrical installations</td><td colspan="2"></td></tr>
<tr><td>LO2</td><td colspan="7">The student knows and understands the electrical design methodology</td><td colspan="2"></td></tr>
<tr><td>LO3</td><td colspan="7">The student knows the basic rules of dimensioning of electric shock protections and safety rules for the use of equipment and electrical installations</td><td colspan="2"></td></tr>
<tr><td>LO4</td><td colspan="7">The student executes basic operations research of installations and electrical equipment</td><td colspan="2"></td></tr>
</table>

LO5	The student applies the principles of safety rules when testing electrical equipment and installations	
LO6	Students can work in a team, able to develop and implement a schedule of work required to achieve the objective	
LO7	Students can design and compare the basic systems of electrical installations, including the selected utility and economic criteria, using appropriate methods, techniques and tools.	
Symbol of learning outcome	**Methods of assessing the learning outcomes**	**Type of tuition during which the outcome is assessed**
LO1	lecture exam, project,	**L, P**
LO2	project and performance in project's classes	**P**
LO3	lecture exam, project, raport from laboratory	**L, P, LC**
LO4	evaluating the student's reports,working on the project, working on the laboratory class	**P, LC**
LO5	evaluating the student's project	**P**
LO6	evaluating the student's project, discussion of the student's project, raport from laboratory, working on the laboratory class	**P, LC**
LO7	project and performance in project's classes	**P**
Student workload (in hours)		**No. of hours**
Calculation	lecture attendance	**15**
	participation in classes, laboratory classes, etc.	**45**
	preparation for classes, laboratory classes, projects, seminars, etc.	**15**
	working on projects, reports, etc.	**25**
	participation in student-teacher sessions related to the classes/seminar/project	**5**
	implementation of project tasks	**30**
	preparation for and participation in exams/tests	**21**
	TOTAL:	**156**

Quantitative indicators	**HOURS**	**No. of ECTS credits**
Student workload – activities that require direct teacher participation	**66**	**2,5**
Student workload – practical activities	**100**	**4**

Basic references	1. Seip G.G.: Electrical Installations Handbook. John Wiley and Sons. Third Edition, 2000. 2. Atkinson Bill: Electrical installation design. John Wiley and Sons, Fourth Edition, 2013. 3. Standards IEC 60364:Low voltage installations 4. Electrical installation guide. According to IEC international standards. Schneider Electric. Edition 2016
Supplementary references	1. Electrical installation handbook. Protection, control and electrical devices. Technical guide-6-th edition 2010. ABB Sace

Organisational unit conducting the course	**Department of Electrotechnics, Power Electronics and Power Engineering**	**Date of issuing the programme**
Author of the programme	**Marcin Andrzej Sulkowski Ph.D. Eng.**	**20.02.2018**

COURSE DESCRIPTION CARD

<table>
<tr><td colspan="10">Faculty of Electrical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="6">Electrical and Electronics Engineering</td><td colspan="2">Degree level and programme type</td><td>bachelor's degree, full time programme</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="6">-</td><td colspan="2">Study profile</td><td>-</td></tr>
<tr><td rowspan="2">Course name</td><td colspan="6" rowspan="2">Electrical Machines 2</td><td colspan="2">Course code</td><td>IS-FEE-10029S</td></tr>
<tr><td colspan="2">Course type</td><td>elective</td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>summer</td></tr>
<tr><td>30</td><td></td><td>30</td><td></td><td></td><td></td><td></td><td>No. of ECTS credits</td><td>6</td></tr>
<tr><td>Entry requirements</td><td colspan="9">Electrical Machines 1</td></tr>
<tr><td>Course objectives</td><td colspan="9">Achievement of skills of analysis of DC and synchronous machines.</td></tr>
<tr><td>Course content</td><td colspan="9">DC machines: construction, principles of operation, mathematical model. Direct current machine systems. Steady state with different conditions of power supply and load. Synchronous machines: construction, principles of operation and mathematical models. Torque of synchronous machines. Generators and motors.</td></tr>
<tr><td>Teaching methods</td><td colspan="9">lecture, laboratory class</td></tr>
<tr><td>Assessment method</td><td colspan="9">lecture: written exam; laboratory class: evaluation of reports, verification of preparation for classes.</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="7">Learning outcomes</td><td colspan="2">Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="7">selects the measurement methods for basic research of electrical machines, analyzes test results, assesses the state of saturation of the magnetic circuit;</td><td colspan="2"></td></tr>
<tr><td>LO2</td><td colspan="7">selects speed control methods for DC machines, interprets the behavior of the DC machines for various values of supplying voltages and load torque;</td><td colspan="2"></td></tr>
<tr><td>LO3</td><td colspan="7">interprets influence of changes in the excitation current and load torque for synchronous generators and DC machines;</td><td colspan="2"></td></tr>
<tr><td>LO4</td><td colspan="7">describes the actual status and construction development trends in electrical machines;</td><td colspan="2"></td></tr>
<tr><td>LO5</td><td colspan="7">associates the connection of electrical machines with other areas of knowledge in the discipline of electrical engineering;</td><td colspan="2"></td></tr>
</table>

LO6	can work in an organized laboratory group.	
LO7		
Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	evaluating student's preparation for laboratory tests, exam	L, LC
LO2	evaluating student's preparation for laboratory tests, exam	L, LC
LO3	evaluating student's preparation for laboratory tests, exam	L, LC
LO4	exam	L
LO5	exam	L
LO6	discussion on the report of the laboratory tests, observation of work in the laboratory	LC
LO7		

Student workload (in hours)		No. of hours	
Calculation	lecture attendance	30	
	participation in workshop activities	30	
	preparation for classes	30	
	preparation for and participation in exams/tests	30	
	elaboration of workshop's reports	30	
	TOTAL:	150	
Quantitative indicators		HOURS	No. of ECTS credits
Student workload – activities that require direct teacher participation		60	2
Student workload – practical activities		90	3

Basic references	1. Morris N.: Electrical & electronic engineering principles. Longman Group, 1994. 2. Ryff P. F.: Electric machinery. Prentice Hall, New Jersey, 1988. 3. Theodore W.: Electrical machines, drives and power systems. Pearson Education, New Jersey, 2006.
Supplementary references	1. Sen P. G.: Principles of electric machines and power electronics. J. Wiley & Sons, 1997. 2. Chapman S. J.: Electric machinery fundamentals. Mc Graw Hil, 2005. 3. Morris N. M.: Electrical and electronic engineering principles. Longman Group, 1994.

Organisational unit conducting the course	Department of Electrotechnics, Power Electronics and Power Engineering	Date of issuing the programme
Author of the programme	Adam Sołbut, Ph.D. Eng.	05.02.2020

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar

COURSE DESCRIPTION CARD

<table>
<tr><td colspan="10">Faculty of Electrical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="5">Electrical and Electronics Engineering</td><td colspan="2">Degree level and programme type</td><td>bachelor’s degree, full time programme</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="5">-</td><td colspan="2">Study profile</td><td>-</td></tr>
<tr><td rowspan="2">Course name</td><td colspan="5" rowspan="2">Electronics 2</td><td colspan="2">Course code</td><td>IS-FEE-10030S</td></tr>
<tr><td colspan="2">Course type</td><td>elective</td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>summer</td></tr>
<tr><td>15</td><td>15</td><td>30</td><td></td><td></td><td></td><td></td><td>No. of ECTS credits</td><td>6</td></tr>
<tr><td>Entry requirements</td><td colspan="9">Electronics 1</td></tr>
<tr><td>Course objectives</td><td colspan="9">The objective of this course is to provide students with deep understanding of advanced analogue circuits. The laboratory component of the course provides students with an opportunity to design, simulate and test various circuits discussed in class.</td></tr>
<tr><td>Course content</td><td colspan="9">Frequency response of single transistor amplifiers. Linear applications of operational amplifiers. Nonlinear applications of operational amplifiers. Voltage comparators. Current sources. Active filters. Output stages and power amplifiers. Voltage regulators. RC oscillators. Optoelectronic devices and circuits. Several lab and homework assignments in this class will require the use of PSpice software</td></tr>
<tr><td>Teaching methods</td><td colspan="9">lecture, class, laboratory class, computer simulations</td></tr>
<tr><td>Assessment method</td><td colspan="9">lecture: written exam; class: two tests; laboratory class: verification of preparation for classes, evaluation of reports</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="7">Learning outcomes</td><td colspan="2">Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="7">describes the basic principles of operation of the electronic circuits;</td><td colspan="2"></td></tr>
<tr><td>LO2</td><td colspan="7">applies knowledge of mathematics and engineering to analysis and design of analog circuits;</td><td colspan="2"></td></tr>
<tr><td>LO3</td><td colspan="7">uses PSPICE to analysis and design of electronic circuits;</td><td colspan="2"></td></tr>
<tr><td>LO4</td><td colspan="7">can prepare and conduct experiments using datasheets and application notes;</td><td colspan="2"></td></tr>
<tr><td>LO5</td><td colspan="7">analyzes and interprets measurement data and prepares reports</td><td colspan="2"></td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="7">Methods of assessing the learning outcomes</td><td colspan="2">Type of tuition during which the outcome is assessed</td></tr>
<tr><td>LO1</td><td colspan="7">written exam, tests</td><td colspan="2">L, LC</td></tr>
</table>

LO2	written exam, tests	L, C, LC
LO3	verification of preparation for classes, evaluation of reports	LC
LO4	tests, evaluation of class work, evaluation of reports	LC
LO5	evaluation of reports	LC
Student workload (in hours)		**No. of hours**
Calculation	lecture attendance	15
	participation in classes	15
	preparation for classes	15
	participation in laboratory classes	30
	preparation for laboratory classes	20
	working on projects, reports	25
	participation in student-teacher sessions related to the classes/laboratory classes	5
	preparation for and participation in exams/tests	25
	TOTAL:	150

Quantitative indicators	**HOURS**	**No. of ECTS credits**
Student workload – activities that require direct teacher participation	65	2,6
Student workload – practical activities	110	4,4

Basic references	1. Sedra A.S., Smith K. C.: Microelectronic Circuits. Oxford University Press, 2004. 2. Sinclair I., Dunton J.: Practical Electronics Handbook, Elsevier Science & Technology, 2006 (Available from: ProQuest Ebook Central)
Supplementary references	1. Boysen E., Kybett H.: Complete Electronics Self-Teaching Guide with Projects, John Wiley & Sons, Inc., 2012 (Available from: ProQuest Ebook Central) 2. Singh S.: Electronics Engineering, Alpha Science International, New Delhi, 2014 (Available from: ProQuest Ebook Central) 3. Westcott S., Westcott J.R.: Basic Electronics: Theory and Practice, Mercury Learning & Information, 2015 (Available from: ProQuest Ebook Central) 4. Saggio G.: Principless of analog electronic. CRC Press, 2014.

Organisational unit conducting the course	Department of Automatic Control and Robotics	**Date of issuing the programme**
Author of the programme	Andrzej Karpiuk, Ph.D.	24.02.2021

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar

Załącznik nr 2 do Zarządzenia Nr 915 z 2019 r. Rektora PB

COURSE DESCRIPTION CARD

<table>
<tr><td colspan="10">Faculty of Electrical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="6">Electrical and Electronic Engineering</td><td colspan="2">Degree level and programme type</td><td>Bachelor's degree</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="6">-</td><td>Study profile</td><td>-</td></tr>
<tr><td rowspan="2">Course name</td><td colspan="6" rowspan="2">Field Programmable Gate Arrays</td><td>Course code</td><td>IS-FEE-10031S</td></tr>
<tr><td>Course type</td><td>elective</td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>summer</td></tr>
<tr><td>15</td><td></td><td>30</td><td></td><td></td><td></td><td></td><td>No. of ECTS credits</td><td>5</td></tr>
<tr><td>Entry requirements</td><td colspan="9"></td></tr>
<tr><td>Course objectives</td><td colspan="9">The target of this course is to introduce the students to the structural design of FPGAs in the way, which is appropriate for both programmers and hardware engineers.</td></tr>
<tr><td>Course content</td><td colspan="9">Internal FPGAs architecture, clock signal frequency synthesis, signal I/O standards. CAD software for designing FPGAs - Intel Quartus II software. Design flow of FPGAs. VHDL: fundamentalunits, librarydeclarations, entity, architecture. Concurrent code. Sequential code.State machines. Packages and components. Functions and procedures. IEEE standard packages. Techniques description of the project, simulation, implementation and programming of FPGAs. Constructing a digital circuit using FPGAs. Synthesis of complex hierarchical designs. Synthesis of digital systems using standard prototype modules. Support for external devices via FPGA: PWM signal modulation, I2C and SPI bus control.</td></tr>
<tr><td>Teaching methods</td><td colspan="9">describes the basic features and properties of FPGAs,</td></tr>
<tr><td>Assessment method</td><td colspan="9">lecture – test, laboratory classes – evaluation of reports</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="8">Learning outcomes</td><td>Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="8">describes the basic features and properties of FPGAs,</td><td></td></tr>
<tr><td>LO2</td><td colspan="8">recognizes the syntax of the VHDL statements,</td><td></td></tr>
<tr><td>LO3</td><td colspan="8">uses the features of the CAD FPGA platform,</td><td></td></tr>
<tr><td>LO4</td><td colspan="8">designs simple digital systems in programmable structures,</td><td></td></tr>
<tr><td>LO5</td><td colspan="8">uses VHDL to describe the system and designs new components,</td><td></td></tr>
<tr><td>LO6</td><td colspan="8">combines various description techniques to design complex systems,</td><td></td></tr>
<tr><td>LO7</td><td colspan="8">can run a simple digital system using conventional prototype modules.</td><td></td></tr>
<tr><td>LO8</td><td colspan="8"></td><td></td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="8">Methods of assessing the learning outcomes</td><td>Type of tuition during which the outcome is assessed</td></tr>
<tr><td>LO1</td><td colspan="8">evaluating the student's test</td><td>L</td></tr>
</table>

LO2	evaluating the student's test	**L**
LO3	evaluating the student's reports	**LC**
LO4	evaluating the student's reports	**LC**
LO5	evaluating the student's reports	**LC**
LO6	evaluating the student's reports	**LC**
LO7	evaluating the student's reports	**LC**
LO8		

Student workload (in hours)		**No. of hours**
Calculation	**lecture attendance**	**15**
	participation in laboratory classes	**30**
	preparation for laboratory classes	**30**
	working on reports	**25**
	participation in student-teacher sessions related to the classes and laboratory classes	**5**
	preparation for and participation in test	**20**
	TOTAL:	**125**

Quantitative indicators	**HOURS**	**No. of ECTS credits**
Student workload – activities that require direct teacher participation	**47**	**1,5**
Student workload – practical activities	**102**	**4**

Basic references	1. Floyd L. T.: Digital Fundamentals with PLD Programming, Prentice Hall, 2005 2. Volnei A. Pedroni: Circuit Design with VHDL, MIT, Cambridge, London, 2004 3. Jha N.K., Gupta S.: Testing of Digital Systems, Cambridge University Press, 2003 4. IEEE Standard 1076-2008 VHDL-200X 5. Hamblen J., Hall T., Furman M.: Rapid Prototyping of Digital Systems, Springer, 2008
Supplementary references	1. Terasic Inc.: DE2-115 User Manual, www.terasic.com, 2010 2. My First FPGA for Altera DE2-115 Board, www.terasic.com, 2010 3. My First Nios II for Altera DE2-115 Board, www.terasic.com, 2010 4. Pedroni V.: Circuit Design with VHDL, MIT Press, 2004 5. Hwang E. - ELECTRONiX: Digital Logic and Microprocessor Design with VHDL, La Sierra University, 2005

Organisational unit conducting the course	**Department of Automatic Control and Robotics**	**Date of issuing the programme**
Author of the programme	**Marian Gilewski, Ph.D. Eng.**	**31.01.2020**

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar

COURSE DESCRIPTION CARD

<table>
<tr><td colspan="10">Faculty of Electrical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="6">Electrical and Electronics Engineering</td><td colspan="2">Degree level and programme type</td><td>bachelor's degree, full time programme</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="6">-</td><td colspan="2">Study profile</td><td>-</td></tr>
<tr><td rowspan="2">Course name</td><td colspan="6" rowspan="2">Fundamental of Telecommunication</td><td colspan="2">Course code</td><td>IS-FEE-10032S</td></tr>
<tr><td colspan="2">Course type</td><td>elective</td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>summer</td></tr>
<tr><td>30</td><td></td><td>15</td><td></td><td></td><td></td><td></td><td>No. of ECTS credits</td><td>5</td></tr>
<tr><td>Entry requirements</td><td colspan="9"></td></tr>
<tr><td>Course objectives</td><td colspan="9">The aim of the course is to learn basic knowledge in the field of telecommunications, allowing for more effective studying and understanding the specific items they place in all the studies on the direction. The result of the course is to learn the main areas of the discipline, their interrelationships, and the fundamental rights and restrictions associated with the analyzed issues.</td></tr>
<tr><td>Course content</td><td colspan="9">Elements of communication system, source of information, communication channels, fundamentals of information theory; analog modulation systems (DSB-AM, DSB-SC-AM, SSB-SC-AM, FM) and frequency division multiplexing; noise in analog communication systems especially: physical sources ofnoise, noise properties ofsystems, noise in analog modulation systems; discrete signals: sampling theory, pulse code modulation, PCM transmission, line coding, time division multiplexing, digital modulation (ASK, FSK, PSK, DPSK, QAM); noise in digital communication systems: statistical decision theory, distortion in PCM systems, digital modulation in noisy conditions, matched filtering and correlation detection; properties of selected telecommunication systems and technologies</td></tr>
<tr><td>Teaching methods</td><td colspan="9">lecture and laboratory class.</td></tr>
<tr><td>Assessment method</td><td colspan="9">lecture: tests; laboratory class: evaluation of reports.</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="8">Learning outcomes</td><td>Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="8">has an elementary knowledge of modern wired and wireless communication systems and networks, makes their classification and defines the services provided therein;</td><td></td></tr>
<tr><td>LO2</td><td colspan="8">has a theoretical basis for analysis of signals and systems and is able to compare properties of analog</td><td></td></tr>
</table>

	and digital modulation systems;	
LO3	has a theoretical basis on the sources of disturbances and how they impact on the transmitted signals, he can compare the characteristics of wired and wireless transmission media;	
LO4	has hands-on skills in maintenance and operation of digital switching system;	
LO5	measures the basic properties of the transmission mediums;	
LO6	can work in a group and distributes tasks to each person	
LO7		
Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	tests on lecture content, evaluating the student's reports	L, LC
LO2	tests on lecture content	L
LO3	tests on lecture content	L
LO4	evaluating the student's reports	LC
LO5	evaluating the student's reports	LC
LO6	evaluation of the student's performance in classes	LC
LO7		
Student workload (in hours)		No. of hours
Calculation	lecture attendance	30
	participation in laboratory classes	15
	preparation for laboratory classes	15
	work on reports	30
	participation in student-teacher sessions related to the lecture and laboratory classes	10
	preparation for and participation in exams/tests	30
	TOTAL:	130

Quantitative indicators	HOURS	No. of ECTS credits
Student workload – activities that require direct teacher participation	55	2
Student workload – practical activities	70	2

Basic references	1. Couch L. W.: Digital and analog communication systems. Prentice-Hall, 2001.	
Supplementary references	1. Freeman Roger L.: Fundamentals of Telecommunication, Willey-IEEE Press, May 2005;	
Organisational unit conducting the course	Department of Photonics, Electronics and Lighting Technology	Date of issuing the programme
Author of the programme	Krzysztof Konopko, Ph.D. Eng.	07.02.2020

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar

Załącznik nr 2 do Zarządzenia Nr 915 z 2019 r. Rektora PB

COURSE DESCRIPTION CARD

<table>
<tr><td colspan="10">Faculty of Electrical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="7">Electrical and Electronics Engineering</td><td>Degree level and programme type</td><td>Master's degree</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="7">-</td><td>Study profile</td><td>-</td></tr>
<tr><td rowspan="2">Course name</td><td colspan="7" rowspan="2">Control Theory</td><td>Course code</td><td>IS-FEE-20013W</td></tr>
<tr><td>Course type</td><td>elective</td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>winter</td></tr>
<tr><td>30</td><td>30</td><td></td><td>15</td><td></td><td></td><td></td><td>No. of ECTS credits</td><td>6</td></tr>
<tr><td>Entry requirements</td><td colspan="9">-</td></tr>
<tr><td>Course objectives</td><td colspan="9">Acquainting with control plants models (continuous and discrete-time) in the state space, design of regulators and state observers. Developing the ability to use simulation software for the analysis and synthesis of control systems in the state space.</td></tr>
<tr><td>Course content</td><td colspan="9">Lecture: Model of the control plant in the state space: transfer function and state space models, continuous models and discrete models, solution of the state equation, canonical forms, transformation of state space model to its canonical forms, controllability and observability, stability. Pole placement method. State controller, state observer. Optimal control methods: LQR linear-quadratic regulator, Kalman filter (observer), LQG control system.
Classes: State space and transfer function models - transformations; canonical forms; controllability and observability; calculation of the state regulator; calculation of the state observer.
Project: Simulation study of selected automation plants, design and testing of the PID control system, design of the state controller, design of the state observer, simulation tests of the LQG control system.</td></tr>
<tr><td>Teaching methods</td><td colspan="9">Informative-problem lecture; Classes; Project classes;</td></tr>
<tr><td>Assessment method</td><td colspan="9">Exam, tests, evaluation of project completion, current progress in project completion, discussion and activity during the classes</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="8">Learning outcomes
After completing this course student</td><td>Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="8">knows and understands the concept of the state space model</td><td></td></tr>
<tr><td>LO2</td><td colspan="8">knows and understands the method of poles placement in the design of the state controller and state observer</td><td></td></tr>
<tr><td>LO3</td><td colspan="8">knows selected methods of optimal control</td><td></td></tr>
<tr><td>LO4</td><td colspan="8">can use the method of poles placement to determine the controller and the state observer</td><td></td></tr>
<tr><td>LO5</td><td colspan="8">can design the optimal LQG control system</td><td></td></tr>
<tr><td>LO6</td><td colspan="8">can use the MATLAB / Simulink software to determine canonical forms, PID controller gains, the state controller and the llinear-gaussian controller, the state observer and Kalman filter</td><td></td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="8">Methods of assessing the learning outcomes</td><td>Type of tuition during which the outcome is assessed</td></tr>
</table>

LO1	Lecture: exam;	
LO2	Lecture: exam;	
LO3	Lecture: exam;	
LO4	Classes: two tests; Project: evaluation of project completion, current progress in project completion, discussion and activity during the classes;	
LO5	Classes: two tests; Project: evaluation of project completion, current progress in project completion, discussion and activity during the classes;	
LO6	Classes: two tests; Project: evaluation of project completion, current progress in project completion, discussion and activity during the classes;	
Student workload (in hours)		**No. of hours**
Calculation	Lecture attendance	30
	Classes attendance	30
	Project attendance	15
	Preparation for the lecture exam; participation in the exam	19
	Preparation for classes	11
	Preparation for classes completion	6
	Preparation for project classes	21
	Working on projects (including preparation of presentations)	6
	Preparation for projects completion	7
	Participation in teacher-student sessions related to the module subject	5
	TOTAL:	**150**

Quantitative indicators	**HOURS**	**No. of ECTS credits**
Student workload – activities that require direct teacher participation	**82**	**3**
Student workload – practical activities	**101**	**4**

Basic references	1. Dorf R. C., Bishop R. H., Modern control systems. 10th Edition. Prentice Hall 2005. 2. Tewari A., Modern control design: with MATLAB and Simulink. Wiley-IEEE Press 2001 3. Ogata K., Modern control engineering. 4th Edition. Pearson Education International 2002.	
Supplementary references	1. Bequette B. W., Process control, modeling, design and simulation. Prentice Hall 2003. 2. The MathWorks. Control system toolbox user's guide.	
Organisational unit conducting the course	**Department of Automatic Control and Electronics**	**Date of issuing the programme**
Author of the programme	**Zbigniew Kulesza, PhD., DSc.**	**2020-02-20**

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar