Zał. Nr 1 do ZW 16/2020

PROGRAM OF STUDIES

FACULTY: Electronics, Photonics and Microsystems.

MAIN FIELD OF STUDY: Electronics.

DISCIPLINES: D1 - Control Engineering, Electronics, Electrotechnics

EDUCATION LEVEL: second-level studies

FORM OF STUDIES: full-time studies

PROFILE: general academic

LANGUAGE OF STUDY: ENGLISH

IN EFFECT SINCE: 2021/2022..

Content:

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

*delete as applicable

zał. Nr 2 do ZW 16/2020

ASSUMED LEARNING OUTCOMES

FACULTY: . Electronics, Photonics and Microsystems

MAIN FIELD OF STUDY: Electronics

EDUCATION LEVEL: second-level studies

PROFILE: general academic

Location of the main-field-of study:

Branch of science: Engineering and Technical Sciences.

Discipline: Control Engineering, Electronics, Electrotechnics

Explanation of the markings:

P7U – universal first degree characteristics corresponding to education at the second-level studies - 7 PRK level

P7S – second degree characteristics corresponding to education at the second-level studies - 7 PRK level

W - category "knowledge"
U - category "skills"
K - category "social competences"
K (*faculty symbol*) _W1, K (*faculty symbol*) _W2, K (*faculty symbol*) _W3, … - main-field-of study learning outcomes related to the category "knowledge"
K (*faculty symbol*) _U1, K (*faculty symbol*) _U2, K (*faculty symbol*) _U3, … - main-field-of study learning outcomes related to the category "skills"
K (*faculty symbol*) _K1, K (*faculty symbol*) _K2, K (*faculty symbol*) _K3, … - main-field-of study learning outcomes related to the category "social competences"
S (*faculty symbol*) _W.., S (*faculty symbol*) _W.., S (*faculty symbol*) _W.., … - specialization learning outcomes related to the category "knowledge"
S (*faculty symbol*) _U.., S (*faculty symbol*) _U.., S (*faculty symbol*) _U.., … - specialization learning outcomes related to the category "skills"
S (*faculty symbol*) _K.., S (*faculty symbol*) _K.., S (*faculty symbol*) _K.., … - specialization learning outcomes related to the category "social competences"
… _inż. – learning outcomes related to the engineer competences

* delete as applicable

Main field of study learning outcomes	Description of learning outcomes for the main-field-of study Electronics After completion of studies, the graduate:	Reference to PRK characteristics		
		Universal first degree characteristics (U)	Second degree characteristics typical for qualifications obtained in higher education (S)	
			Characteristics for qualifications on 7 levels of PRK	Characteristics for qualifications on 7 levels of PRK, enabling acquiring engineering competences
KNOWLEDGE (W)				
K2EKA_W01	Has extended and in-depth knowledge of selected mathematics branches necessary to understand issues in the field of electronics	P7U_W	P7S_WG	P7S_WG_INŻ
K2EKA_W02	Has extended and in-depth knowledge of selected branches of physics necessary to understand physical phenomena in the field of the scientific discipline being studied	P7U_W	P7S_WG	P7S_WG_INŻ
K2EKA_W03	Has knowledge in the field of creating or developing forms of individual entrepreneurship in the area appropriate for the studied field of study, has knowledge in the field of industrial property protection and copyright	P7U_W	P7S_WK	P7S_WK_INŻ
K2EKA_W04	Explains the principles of operation of lasers and lists their basic properties; explains the principles of light propagation in optical fibers.	P7U_W	P7S_WG	P7S_WG_INŻ
K2EKA_W05	Explains the principles of operation of optimization algorithms used to solve problems in the field of electronics	P7U_W	P7S_WG	P7S_WG_INŻ
K2EKA_W06	Lists and describes advanced numerical methods and algorithms as well as techniques for their implementation allowing for effective solving of problems encountered in electronics	P7U_W	P7S_WG	P7S_WG_INŻ
K2EKA_W07	Recognizes and characterizes new approaches in technologies used in electronics	P7U_W	P7S_WG	P7S_WG_INŻ
K2EKA_W08	Describes the structure, principles of operation and application of advanced systems and technologies used in modern electronic and telecommunications equipment as well as in control and measurement systems	P7U_W	P7S_WG	P7S_WG_INŻ

K2EKA_W09	Lists and characterizes the methods of acquisition, transmission and processing of measurement data in selected areas of technology	P7U_W	P7S_WG	P7S_WG_INŻ
K2EKA_W10	Lists and describes the architectures of microprocessor and programmable systems, their applications in selected fields of science and technology, and characterizes the methods and tools necessary for their effective implementation and testing	P7U_W	P7S_WG	P7S_WG_INŻ
SKILLS (U)				
K2EKA_ U01	Uses a foreign language in accordance with the requirements for the B2 + CEFR level in terms of scientific and technical language. Levels of linguistic proficiency in interpersonal contacts and communication in an international academic and communication environment.	P7U_U	P7S_UK	
K2EKA_ U02	Uses a selected foreign language in accordance with the requirements specified for the A1 CEFR level in terms of basic language skills; uses basic vocabulary and grammatical structures in everyday life and basic intercultural behavior	P7U_U	P7S_UK	
K2EKA_U03	Searches for specialist texts and assesses the possibilities of using new achievements in the field of techniques and technologies used in electronics; based on literature reports and on the basis of the results of his own work, he integrates, interprets and critically evaluates the presented content as part of the author's presentation	P7U_U	P7S_UK	
K2EKA_U04	Uses advanced mathematical methods to solve complex problems in the field of electronics	P7U_U	P7S_UW	
K2EKA_U05	Uses optimization algorithms to solve problems in the field of electronics	P7U_U	P7S_UW	P7S_UW_ INŻ
K2EKA_U06	Uses selected numerical algorithms to solve complex problems in the field of electronics; creates computer models of dynamic objects, verifies and analyzes implemented models	P7U_U	P7S_UW	P7S_UW_ INŻ
K2EKA_U07	Selects tools and means and proposes technical and algorithmic solutions that allow to effectively design and run a complex electronic system using available conditioning, processing and signal acquisition techniques	P7U_U	P7S_UW	P7S_UW_ INŻ

K2EKA_U08	Plans, conducts and interprets the results of experiments with the use of advanced electronic equipment in selected areas of application	P7U_U	P7S_UW	P7S_UW_ INŻ
K2EKA_U09	Reports on the individual phases of the implementation of a complex project (e.g. A diploma thesis), prepares presentations containing the results of the experiments carried out, derives and justifies the resulting conclusions; uses the rules of creative discussion and assumes the role of a moderator in the group	P7U_U	P7S_UW P7S_UK P7S_UO P7S_UU	P7S_UW_ INŻ
K2EKA_U10	Is able to plan and implement the process of self-education, determine possible directions of further learning throughout life, as well as direct others in this area	P7U_U	P7S_UU	
K2EKA_U11	Is able to manage the work of the team and cooperate with other people in the implementation of tasks and team projects. Is able to responsibly and respect the rules of professional ethics to perform the roles entrusted to the team	P7U_U	P7S_UO	
K2EKA_U12	Can evaluate various solutions emerging as part of the design or research process and make an economic and time-consuming estimate of planned activities in the field of data acquisition, processing and analysis	P7U_U	P7S_UW	P7S_UW_ INŻ
K2EKA_U13	Prepares a master's thesis containing research aspects, including: - obtains information from literature, databases and other sources, integrates it, interprets and critically evaluates it, - plans and conducts experiments, including measurements and computer simulations, interprets the obtained results and draws conclusions, - uses analytical, simulation and experimental methods to formulate and solve problems, - formulates and tests hypotheses related to research problems, - integrates knowledge from various fields and disciplines and applies a systemic approach, also taking into account non-technical aspects, - assesses the usefulness and the possibility of using new achievements (techniques and technologies) in the represented discipline, - proposes improvements / rationalization of existing technical solutions,	P7U_U	P7S_UK P7S_UW P7S_UU	P7S_UW_ INŻ.

	- interprets the obtained research results, draws appropriate conclusions and formulates recommendations, - edits the master's thesis in accordance with formal requirements.			
SOCIAL COMPETENCES (K)				
K2EKA_K01	Is aware of the social consequences of engineering activities and the related responsibility for the decisions made. Understands the need to provide the society with information and opinions on the achievements of technology and other aspects of the activities of a technical university graduate. Understands the role of the mass media. He is ready to create models of proper conduct in the social and professional environment	P7U_K	P7S_KO P7S_KR	
K2EKA_K02	Is able to think and act in a critical, creative and entrepreneurial manner, and to properly define priorities for the implementation of a complex task	P7U_K	P7S_KK P7S_KO	
K2EKA_K03	Is aware of the impact of technical activity on the environment and understands the related social responsibility of science and technology	P7U_K	P7S_KK P7S_KO P7S_KR	
K2EKA_K04	Critically evaluate own knowledge and received information; understands the need for self-education and improving competencies in the field of engineering and technical sciences	P7U_K	P7S_KK P7S_KR	

*delete as applicable

Zał. nr 3 do ZW 16/2020

Attachment no. 2. to the Program of Studies

DESCRIPTION OF THE PROGRAM OF STUDIES

Main field of study: ELECTRONICS **Profile GENERAL ACADEMIC**

Level of studies SECOND **Form of studies FULL TIME**

1. General description

1.1 Number of semesters: 3	*1.2 Total number of ECTS points necessary to complete studies at a given level:90*
1.3 Total number of hours:1080	*1.4 Prerequisites (particularly for second-level studies):* *Candidates for Master's studies in the field of Electronics may enroll after obtaining at least the title of a professional engineer in admitted fields of study. The detailed conditions and procedure of recruitment applicable for a given academic year are approved annually by the Senate of Wrocław University of Science and Technology and announced by an appropriate internal regulation..*
1.5 Upon completion of studies graduate obtains *professional degree of: Master of Science (MSc)*	*1.6 Graduate profile, employability:* *This course will give students multidisciplinary knowledge of electronics, optoelectronics, microwaves and telecommunication. It will enable them to obtain theoretical and practical knowledge in designing applied electronic systems based on analogue and digital techniques, laser, fibre and microwave electronics as well as gaining expertise in microprocessors, programmable logic applications and*

	signal processing. Additionally students will gain laboratory experience and become familiar with work practices of research laboratories. *Students who complete this three-semester course will acquire the experience necessary for a professional career in research units, universities and industry*
1.7 Possibility of continuing studies: *After completing the second-cycle studies, it is possible to continue education at a Doctoral School or at postgraduate studies.*	*1.8 Indicate connection with University's mission and its development strategy:* *Wrocław University of Science and Technology is a technical university which, as an autonomous technical university and university research institution, recognizes as its mission shaping creative, critical and tolerant personalities of students and doctoral students and setting directions for the development of science and technology. The university, in the service of society, carries out its mission through: inventiveness and innovation, the highest standards in research, transfer of knowledge, high quality of education and freedom of criticism with respect for the truth (Statute of Wroclaw University of Science and Technology and Development Strategy of Wroclaw University of Science and Technology 2016-2020). The study program is fully correlated with the mission of the university and its development strategy adopted by the Senate of Wrocław University of Science and Technology on March 21, 2013 (Resolution No. 127/7 / 2012-2016) with subsequent amendments (Resolution No. 227/11 / 2012-2016 and the Resolution No. 759/34 / 2012-2016).* *The concept of education at the Faculty takes into account the perspective of the development of higher education in 2015-*

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

	2030, as defined by the Ministry of Science and Higher Education. When educating at general-academic studies, the Faculty directs its offer to people interested in the development and improvement of qualifications. Ultimately, studies with this profile should prepare professional staff for the economy and science. Education in the field of Electronics is concurrent with the strategic framework for smart specializations of Lower Silesia in the field of electronics and related areas, and National Smart Specializations in the field of intelligent technologies and industrial processes.

2. Detailed description

2.1 Total number of learning outcomes in the program of study: W (knowledge) =. ...13, U (skills) = ..10., K (competences) = ...4..., W + U + K = ...27.....

2.2 For the main field of study assigned to more than one discipline - the number of learning outcomes assigned to the discipline: D1 – 100%

D1 (major) ..100%. (this number must be greater than half the total number of learning outcomes)

2.3 For the main field of study assigned to more than one discipline - percentage share of the number of ECTS points for each discipline: D1 ....n/a.....% ECTS points

2.4a. For the general academic profile of the main field of study – the number of ECTS points assigned to the classes related to the University's academic activity in the discipline or disciplines to which the main field of study is assigned – DN (must be greater than 50% of the total number of ECTS points from 1.2) ..82.....

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

2.4b. For the practical profile of the main field of study - the number of ECTS points assigned to the classes shaping practical skills (must be greater than 50% of the total number of ECTS points from 1.2)-n/a

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

Before the launch of the AAE specialization several representatives of companies active in electronics and similar industries had been consulted. Moreover, the syllabuses were analysed of various educational institutions, both in Poland and abroad. The curriculum makes an effort to meet the market needs for competences common for electrical engineering, automation and telecommunications. The teaching result is an expanded theoretical and practical expertise in the design of advanced electronic circuits using analogue and digital circuits, lasers, optical fibers and microwave techniques, as well as a thorough ability to use the microprocessor and programmable logic systems and signal processors. Education provided through this specialization ensures familiarity with specialist English terminology and gives the graduate the ability to combine the various aspects of analogue and digital electronics and optoelectronics. AAE graduates gain a competitive advantage in the labour market particularly in the case of multinationals dealing with digital and analogue electronics and optoelectronics in their broadest sense as well as those, in which exchange of information in English is the basis for efficient communication. By making the research labs available to students, the AAE curriculum allows them to learn about independent and team research & scientific work, thus meeting the needs of scientific and research & scientific institutions in terms of providing able and creative candidates for PhD studies or employment as research and teaching assistants.

2.6. The total number of ECTS points that a student must obtain in classes requiring direct participation of academic teachers or other persons conducting classes and students (enter the sum of ECTS points for courses / groups of courses marked with the BU[1] code) ..**49,5..** ECTS

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

Number of ECTS points for obligatory subjects	6

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

Number of ECTS points for optional subjects	0
Total number of ECTS points	6

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

Number of ECTS points for obligatory subjects	10
Number of ECTS points for optional subjects	43
Total number of ECTS points	53

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

…8…. ECTS points

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

…68. ECTS points

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

Following the curriculum, students attend organized classes. According to the regulations of higher education at Wrocław University of Science and Technology, the student is required to participate in classes. Classes are conducted in the forms specified in the regulations of studies, with the use of both traditional methods and didactic tools as well as the possibilities offered by the university e-learning platform. Outside of class hours, the tutors are available to students during the consultation hours designated and announced on the Faculty's website. An important element of the learning process is the student's own work, consisting in preparing for classes (on the basis of materials provided by the lecturers and recommended literature), studying literature, preparing reports and reports, preparing for tests and exams.
Each learning outcome is assigned the codes of the courses defined in the study program. Successful completion of these courses (this course) means obtaining the given effect. Courses are credited on the basis of the forms of control of acquired knowledge, skills and social competences, defined in the course cards. Failure to achieve the learning outcomes assigned to the course by the student results in the failure to complete the course and the necessity to do it again.

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

Completion of each semester of studies is conditional upon obtaining the number of ECTS points in a specific study program, which is tantamount to achieving most of the learning outcomes envisaged in a given semester. The remaining results are achieved by the student re-completing the failed courses in subsequent semesters of study.
Successful completion of studies is possible after the student achieves all learning outcomes specified in the study program.
The quality of the classes and the achievement of learning outcomes are controlled by the Department's Education Quality Assurance System, including, inter alia, procedures for creating and modifying education programs, individualizing study programs, implementing the teaching process and diplomas. Quality control of the education process includes the evaluation of the learning outcomes achieved by students. Quality control of the classes is supported by hospitals and surveys, carried out according to strictly defined departmental procedures.

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

4. List of education blocks:

4.1. List of obligatory blocks:

4.1.1 List of general education blocks

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

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses cl	Way[3] of crediting lab	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5]	BU			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	FLEA00002S	Social Communication					1	K2EKA_K01 K2EKA_K03	15	60	2		1	T/Z*	Z	O		1	KO
2	ZMZ000387W	Entrepreneurship	1					K2EKA_ W03	15	30	1		1	T/Z*	Z	O		0	KO
2a	ZMZ000387S	Entrepreneurship					1	K2EKA_K02	15	60	2		1	T/Z*	Z	O		0	KO
		Total	**1**	**0**	**0**	**0**	**2**	–	**45**	**150**	**5**	**0**	**3**	–	–	–	**-**	**1**	

Altogether for general education blocks

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
1	**0**	**0**	**0**	**2**	**45**	**150**	**5**	**0**	**3**

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

4.1.2 List of basic sciences blocks

4.1.2.1 *Mathematics* block

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	MAEA00100W	Numerical methods in differential equations	2					K2EKA_W01	30	60	2	2	1	T/Z*	Z		DN	0	PD
1A	MAEA00100L	Numerical methods in differential equations			2			K2EKA_U04	30	90	3	3	1.4	T	Z		DN	3	PD
		Total	2		2				60	150	5		2.4					3	

4.1.2.2 *Physics* block

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	ETEA00004W	Optical Fibers and Optocommunications	1					K2EKA_W02	15	30	1	1	0,9	T/Z*	E(w)		DN		K
		Total	**1**	**0**	**0**	**0**	**0**	–	**15**	**30**	**1**	1	0,9					0	

Altogether for basic sciences blocks:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
3	0	2	0	0	75	180	6	6	3,3

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

4.1.3 List of the main field of study blocks

4.1.3.1 *Obligatory main field of study* blocks

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	ETEA00004W	Optical Fibers and Optocommunication	1					K2EKA_W02 K2EKA_W04	15	30	1	1	0,9	T/Z*	E		DN	0	K
1A	ETEA00004L	Optical Fibers and Optocommunication			1			K2EKA_U06	15	60	2	2	1,4	T	E		DN	2	K
1B	ETEA00004S	Optical Fibers and Optocommunication					1	K2EKA_U08	15	60	2	2	0,5	T/Z*	E		DN	1	K
2	EKEU00010W	Numerical methods and optimization	2					K2EKA_W05	30	60	2	2	1	T/Z*	E(W)		DN	0	K
2A	EKEU00010L	Numerical methods and optimization			2			K2EKA_U05	30	90	3	3	2,1	T	Z		DN	3	K
3	ETEA00206	New Approaches to Electronics and Telecommunications	2					K2EKA_W07 K2EKA_K02	30	30	1	1	1	T/Z*	Z		DN	0	K
		Total	**5**		**3**		**1**		**135**	**330**	**11**	**11**	**6,9**					**6**	

Altogether (for main field of study blocks):

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
7		**5**		**1**	**135**	**330**	**17**	**11**	**6,9**

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

4.2 List of optional blocks

4.2.1 List of general education blocks

4.2.1.2 *Foreign languages* block *(min. ...3..... ECTS points):*

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1		Foreign Language I		1				K2EKA_U01	15	30	1		0.5	T	Z	O		1	KO
2		Foreign Language II		3				K2EKA_U02	45	60	2		1.5	T	Z	O		2	KO
		Total		4					60	90	3	0	2					3	

Altogether for general education blocks:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
0	**0**	**4**	**0**	**0**	**60**	**90**	**3**	**0**	**2**

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

4.2.4 List of specialization blocks

4.2.4.1 *Specialization subjects (AAE)* blocks *(min. .65.. ECTS points):*

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	lec	lec	lec	lec		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	ETEA00208W	DSP Architectures	2	0	0	0	0	K2EKA_W10	30	90	3	3	1,2	T/Z*	E(W)		DN	0	S
1A	ETEA00208L	DSP Architectures	0	0	2	0	0	K2EKA_U07	30	90	3	3	2,1	T	Z		DN	3	S
2	ETEA00210W	Computer Operating Systems	1	0	0	0	0	K2EKA_W08	15	30	1	1	0,5	T/Z*	Z		DN	0	S
2A	ETEA00210L	Computer Operating Systems	0	0	2	0	0	K2EKA_U07	30	60	2	2	1,2	T	Z		DN	2	S
3	ETEA00202W	Analog Peripherals of Digital Sys	1	0	0	0	0	K2EKA_W09	15	30	1	1	0,5	T/Z*	E(W)		DN	0	S
3A	ETEA00202L	Analog Peripherals of Digital Sys	0	0	2	0	0	K2EKA_U08	30	90	3	3	1,4	T	Z		DN	3	S
3B	ETEA00202P	Analog Peripherals of Digital Sys	0	0	0	1	0	K2EKA_U07	15	30	1	1	0,5	T	Z		DN	1	S
4	ETEA00009W	Microcontrollers Programming	2	0	0	0	0	K2EKA_W10	30	90	3	3	1,2	T/Z*	E(W)		DN	0	S
4A	ETEA00009P	Microcontrollers Programming	0	0	0	2	0	K2EKA_U07 K2EKA_U11	30	90	3	3	2,1	T	Z		DN	3	S
5	ETEA00106W	Lasers and Applications	2	0	0	0	0	K2EKA_W04	30	60	2	2	1	T/Z*	Z		DN	0	S
5A	ETEA00106L	Lasers and Applications	0	0	1	0	0	K2EKA_u08	15	30	1	1	0,7	T	Z		DN	1	S
6	ETEA00203W	Machine Learning Methods	1	0	0	0	0	K2EKA_W06	15	30	1	1	0,5	T/Z*	Z		DN	0	S
6A	ETEA00203l	Machine Learning Methods	0	0	1	0	0	K2EKA_U06	15	30	1	1	0,7	T	Z		DN	1	S
6B	ETEA00203s	Machine Learning Methods	0	0	0	0	1	K2EKA_U06	15	30	1	1	0,5	T/Z*	Z		DN	1	S
7	ETEA00205S	Specialization seminar	0	0	0	0	2	K2EKA_U03 K2EKA_U09 K2EKA_K02 K2EKA_K04	30	60	2	2	1	T/Z*	Z		DN	2	S
8	ETEA00204W	RF Circuits Design	1	0	0	0	0	K2EKA_W08	15	30	1	1	0,5	T/Z*	Z		DN	0	S
8A	ETEA00204l	RF Circuits Design	0	0	2	0	0	K2EKA_U08	30	60	2	2	1,4	T	Z		DN	2	S
8B	ETEA00204p	RF Circuits Design	0	0	0	1	0	K2EKA_U07	15	60	2	2	1,4	T	Z		DN	2	S
9	ETEA00209W	Hardware Programming	2	0	0	0	0	K2EKA_W10	30	90	3	3	1,8	T/Z*	E(W)		DN	0	S
9A	ETEA00209L	Hardware Programming	0	0	2	0	0	K2EKA_U06 K2EKA_U11	30	90	3	3	2,1	T	Z		DN	3	S
10	ETEA17109S	Diploma Seminar					2	K2EKA_U09 K2EKA_U10 K2EKA_K02 K2EKA_K04	30	90	3	3	2	T/Z*	Z		DN	3	S
11	ETEA00220	Master thesis						K2EKA_U12 K2EKA_U13K 2EKA_K02	180	510	17	17	7	T	E		DN	10	S
		Optional courses from table 4.2.4.1a (minimum 6 ECTS)	3	3					90	180	6	6	3	T	Z		DN	3	S
		Total	**15**	**24**					**765**	**1950**	**65**	**65**	34,3					40	

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

Altogether for specialization blocks:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
15	**24**				**765**	**1950**	**65**	**65**	37,3

4.2.4.1a Elected courses – (6 pkt ECTS) (minimum 6 ECTS with 3 BU and P(3))

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
A	ETEA00113W	Real-time operating systems	2	0	0	0	0	K2EKA_W02	30	60	2	2	1	T/Z*	Z		DN	0	S
A	ETEA00113L	Real-time operating systems	0	0	2	0	0	K2EKA_U06	30	60	2	2	1	T	Z		DN	2	S
B	ETEA00116W	Optics and Nonlinear Optics	1	0	0	0	0	K2EKA_W04	15	30	1	1	0.5	T/Z*	Z		DN	0	S
B	ETEA00116C	Optics and Nonlinear Optics	0	1	0	0	0	K2EKA_U08	15	30	1	1	0.5	T	Z		DN	1	S
C	ETEA00123W	IoT modules	1	0	0	0	0	K2EKA_W08	15	30	1	1	0.5	T/Z*	Z		DN	0	S
C	ETEA00123P	IoT modules	0	0	0	1	0	K2EKA_U06	15	30	1	1	0.5	T	Z		DN	1	S
D	ETEA00122W	Electrotechnics	2	0	0	0	0	K2EKA_W08	30	60	2	2	1	T/Z*	Z		DN	0	S
D	ETEA00122L	Electrotechnics	0	0	1	0	0	K2EKA_U08	15	30	1	1	0.5	T	Z		DN	1	S
E	ETEA00124W	Advanced Obective Programming	2	0	0	0	0	K2EKA_W10	30	60	2	2	1	T/Z*	Z		DN	0	S
E	ETEA00124L	Advanced Obective Programming	0	0	2	0	0	K2EKA_U06	30	60	2	2	1	T	Z		DN	2	S
		Total (MINIMUM to choose)	**3**	**3**					**90**	**180**	6	**6**	3					**3**	

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

4.3 Training block - concerning principles of training crediting – not applicable. …

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

Type of diploma dissertation	MSc	
Number of diploma dissertation semesters	**Number of ECTS points**	**Code**
1	17, P(10)	ETEA00220
Character of diploma dissertation		
RESEARCH		
Number of BU[1] ECTS points	7	
Number of dn[1] ECTS points	17	

5. Ways of verifying assumed learning outcomes

Type of classes	**Ways of verifying assumed learning outcomes**
lecture	written exam, oral exam, e-exam, written work prepared on the basis of lectures and recommended literature, oral or written test, lecture discussion, final test, active participation in lectures, oral answer, quiz, test in the form of e-test
class	oral answers, quizzes, tests, e-tests, discussions, evaluation of solutions to exemplary exercises, final test, written reports on exercises, results of partial tests, reports, active participation in classes
laboratory	preparation for laboratory classes (quizzes); homework; evaluation of performed laboratory tasks; presentation of the results of the performed exercises along with their discussion and conclusions; final exercise reports
project	evaluation of the final project documentation, implementation report, results of project tasks, evaluation of performed tests, evaluation of the prepared report, evaluation of the project presentation, evaluation of formal project implementation, attendance, analysis of the progress, work, consultation, evaluation of the team leader, evaluation of teamwork skills , adherence to the schedule, team activity, the ability to apply the principles of project management, project defense, participation in problem discussions

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

seminar	evaluation of the preparation of the presentation and the delivery of a seminar on a selected topic, active participation in seminar classes, evaluation of the quality of seminar presentations, participation in problem discussions
diploma dissertation	prepared thesis - the formal and substantive aspects

6. Range of diploma examination

Main Field:

1. Static optimization task types and methods of its solution.
2. Local and global optimization algorithms
3. Methods of numerical solving of differential equations.
4. Principle of laser operation, types of lasers and their basic parameters.
5. Architectures and implementations of data acquisition and processing algorithms.
6. Light propagation in optical fibers, types of optical fibers, optical elements and their basic parameters.

Specialization:

1. Basic features of 8-bit microcontrollers. Memories in microcontrollers and microcontrollers' peripherals.
2. ARM architecture. Cortex-M, Cortex-R and Cortex-A – features and similarities.
3. Please name key low level mechanisms implemented in DSP processor for supporting signal processing and describe the work of the selected one by the chairmen of examination board
4. Specify the role of lasers in application areas: technology, telecommunications, medicine, metrology, military etc.
5. Name and describe shortly operation principles and cardinal properties of basic analog-digital converters.
6. What are differences between operational and instrumentation amplifier?
7. Name the basic methods of eliminate interferences in electronic systems, describe briefly power decoupling techniques for PCB and features of a decupling capacitors.
8. Compare Nonnegative Matrix Factorization with Principal Component Analysis. Specify their areas of applications, give examples..
9. Blind source separation problem – assumptions, algorithms, applications.
10. What is Voltage Standing Wave Ratio (VSWR)? Please specify what values take the VSWR for the transmission line terminated with: a- short circuit, b- open circuit, c- matched load impedance?
11. Please provide definitions of the following quantities: Return, Insertion and Mismatch Losses. Specify what values in dB take the Return Loss for measured Reflection Coefficient of ½ .
12. What are the steps performed by Unix operating system to create a new process? List three (or more) possible states of created process.
13. Describe fundamental inter-process communication techniques in Unix operating systems.
14. Explain ifferences between programming languages (like C/C++), HVLs and HDLs. MWhat are the main elements of a VHDL code ?

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

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

No.	*Course / group of courses code*	*Name of course / group of courses*	*Crediting by deadline of... (number of semester)*
1		*Foreign Language I*	*2*
2		*Foreign Language II*	*2*

8. Plan of studies (attachment no. …4…)

Approved by faculty student government legislative body:

....
Date name and surname, signature of student representative

....
Date Dean's signature

*delete as appropriate

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

Zał. nr 4 do ZW 16/2020
Attachment no. 4 to Program of Studies

PLAN OF STUDIES

FACULTY: ELECTRONICS, PHOTONICS AND MICROSYSTEMS

MAIN FIELD OF STUDY: Electronisc

EDUCATION LEVEL: second-level studies

FORM OF STUDIES: full-time studies

PROFILE: general academic

SPECIALIZATION: Advanced Applied Electronics (AAE).

LANGUAGE OF STUDY: ENGLISH

IN EFFECT SINCE: 2021/2022

Plan of studies structure (optionally)
1) in ECTS point layout

not applicable

2) in hourly layout

not applicable

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

Semester 1

Obligatory courses / groups of courses

Number of ECTS points **18**

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	FLEU00001	Social communication					1	K2EKA_K03 K2EKA_K01	15	60	2		1	T/Z*	Z	O		P (1)	KO
2	ETEA00004W	Optical Fibers and Optocommunications	2					K2EKA_W02 K2EKA_W04	30	90	3	3	1.8	T/Z*	E(W)		DN		PD/K
3	ETEA00004L	Optical Fibers and Optocommunications			1			K2EKA_U06	15	60	2	2	1.4	T	Z		DN	P(2)	K
4	ETEA00004S	Optical Fibers and Optocommunications					1	K2EKA_U08	15	30	1	1	0.5	T/Z*	Z		DN	P(1)	K
9	MAEA00100W	Numerical methods in differential equations	2					K2EKA_W01	30	60	2	2	1	T/Z*	Z		DN		PD
10	MAEA00100L	Numerical methods in differential equations			2			K2EKA_U04	30	90	3	3	1.4	T	Z		DN	P(3)	PD
11	EKEU00010W	Numerical methods and optimization	2					K2EKA_W05	30	60	2	2	1	T/Z*	E(W)		DN		K
12	EKEU00010L	Numerical methods and optimization			2			K2EKA_U05	30	90	3	3	2.1	T	Z		DN	P(3)	K
		Total	**6**	**0**	**5**	**0**	**2**		**195**	**540**	**18**	**16**	**10.2**	**-**	**-**	**-**	**16**	**10**	**-**

Optional courses / groups of courses (minimum 165hours)

Number of ECTS points **12**

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1		Foreign language I		1				K2EKA_U01	15	30	1		0.5	T	Z	O		P(1)	KO
2		Foreign language II		3				K2EKA_U02	45	60	2		1.5	T	Z	O		P(2)	KO
3	ETEA00009W	Microcontrollers Programming	2					K2EKA_W10	30	90	3	3	1.2	T/Z*	E(W)		DN		S
4	ETEA00009P	Microcontrollers Programming				2		K2EKA_U07 K2EKA_U11	30	90	3	3	2.1	T	Z		DN	P(3)	S
5	ETEA00210W	Computer Operating Systems	1					K2EKA_W08	15	30	1	1	0.5	T/Z*	Z		DN		S
6	ETEA00210L	Computer Operating Systems			2			K2EKA_U07	30	60	2	2	1.2	T	Z		DN	P(2)	S
		Total	**3**	**4**	**2**	**2**	**0**		**165**	**360**	**12**	**9**	**7**	**-**	**-**	**-**	**9**	**8**	**0**

Razem w semestrze 1

Łączna liczba godzin					Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Liczba punktów ECTS zajęć DN[1]	Liczba punktów ECTS zajęć BU[1]
w	ć	l	p	s					
9	4	7	2	2	360	900	30	25	17.2

Semestr 2

Optional courses / groups of courses (specialization AAE) Number of ECTS points **30**

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[1] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	ETEA00208W	DSP Architectures	2	0	0	0	0	K2EKA_W10	30	90	3	3	1.2	T/Z*	E(W)		DN	0	S
2	ETEA00208L	DSP Architectures	0	0	2	0	0	K2EKA_U07	30	90	3	3	2.1	T	Z		DN	P(3)	S
3	ETEA00209W	Hardware Programming	2	0	0	0	0	K2EKA_W10	30	90	3	3	1.8	T/Z*	E(W)		DN	0	S
4	ETEA00209L	Hardware Programming	0	0	2	0	0	K2EKA_U06 K2EKA_U11	30	90	3	3	2.1	T	Z		DN	P(3)	S
5	ETEA00106W	Lasers and Applications	2	0	0	0	0	K2EKA_W04	30	60	2	2	1	T/Z*	Z		DN	0	S
6	ETEA00106L	Lasers and Applications	0	0	1	0	0	K2EKA_u08	15	30	1	1	0.7	T	Z		DN	P(1)	S
7	ETEA00202W	Analog Peripherals of Digital Sys	1	0	0	0	0	K2EKA_W09	15	30	1	1	0.5	T/Z*	E(W)		DN	0	S
8	ETEA00202L	Analog Peripherals of Digital Sys	0	0	2	0	0	K2EKA_U08	30	90	3	3	1.4	T	Z		DN	P(3)	S
9	ETEA00202P	Analog Peripherals of Digital Sys	0	0	0	1	0	K2EKA_U07	15	30	1	1	0.5	T	Z		DN	P(1)	S
10	ETEA00203W	Machine Learning Methods	1	0	0	0	0	K2EKA_W06	15	30	1	1	0.5	T/Z*	Z		DN	0	S
11	ETEA00203l	Machine Learning Methods	0	0	1	0	0	K2EKA_U06	15	30	1	1	0.7	T	Z		DN	P(1)	S
12	ETEA00203s	Machine Learning Methods	0	0	0	0	1	K2EKA_U06	15	30	1	1	0.5	T/Z*	Z		DN	P(1)	S
13	ETEA00204W	RF Circuits Design	1	0	0	0	0	K2EKA_W08	15	30	1	1	0.5	T/Z*	Z		DN	0	S
14	ETEA00204L	RF Circuits Design	0	0	2	0	0	K2EKA_U08	30	60	2	2	1.4	T	Z		DN	P(2)	S
15	ETEA00204P	RF Circuits Design	0	0	0	1	0	K2EKA_U07	15	60	2	2	1.4	T	Z		DN	P(2)	S
16	ETEA00205S	Specialization seminar	0	0	0	0	2	K2EKA_U03 K2EKA_U09 K2EKA_K02 K2EKA_K04	30	60	2	2	1	T/Z*	Z		DN	P(2)	S
		Total	**9**	**0**	**10**	**2**	**3**	**-**	**360**	**900**	**30**	**30**	**17.3**	**-**	**-**	**-**	**30**	**19**	**-**

Razem w semestrze 2

Łączna liczba godzin					Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Liczba punktów ECTS zajęć DN[1]	Liczba punktów ECTS zajęć BU[1]
w	ć	l	p	s					
9	0	10	2	3	360	900	30	30	17.3

Semestr 3

Obligatory courses / groups of courses

Number of ECTS points **4**

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	ZMZ000387W	Entrepreneurship					1	K2EKA_K02 K2EKA_K03	15	30	1		1	T/Z*	Z	O			KO
2	ZMZ000387W	Entrepreneurship	1	0	0	0	0	K2EKA_W03	15	60	2		1	T/Z*	Z	O			KO
3	ETEA00211W	New Approaches to Electronics and Photonics	2	0	0	0	0	K2EKA_W07 K2EKA_K02	30	30	1	1	1	T/Z*	Z		DN	0	K
		Total	**1**	**0**	**0**	**0**	**1**	**-**	**60**	**120**	**4**	**1**	**3**	**-**	**-**	**-**	**0**	**0**	**-**

Optional courses / groups of courses (minimum 330 hours)

Number of ECTS points **26**

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	ETEA00220	Praca dyplomowa						K2EKA_U12 K2EKA_U13 K2EKA_K02	180	510	17	17	7	T	Z		DN	P(10)	S
2	ETEA17109S	Diploma Seminar	0	0	0	0	2	K2EKA_U09 K2EKA_U10 K2EKA_K02 K2EKA_K04	30	90	3	3	2	T/Z*	Z		DN	P(3)	S
3		Optional courses from table below (minimum 6 ECTS)	3		3			Table below	90	180	6	6	3	tab.bel	Z		DN	P(3)	S
		Total	**3**	**0**	**3**	**0**	**2**	**0**	**300**	**780**	**26**	**26**	**12**	**0**	**0**	**0**	**0**	**16**	**0**

Razem w semestrze 3

Łączna liczba godzin					Łączna liczba godzin ZZU	Łączna liczba godzin CNPS	Łączna liczba punktów ECTS	Liczba punktów ECTS zajęć DN[1]	Liczba punktów ECTS zajęć BU[1]	
w	ć	l	p	s						
4	0	3	0	3	360	900	30	27	15	

Optional courses / groups of courses (minimum 6ECTS)

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	ETEA00113W	Real-time operating systems	2	0	0	0	0	K2EKA_W02	30	60	2	2	1	T/Z*	Z		DN	0	S
2	ETEA00113L	Real-time operating systems	0	0	2	0	0	K2EKA_U06	30	60	2	2	1	T	Z		DN	P(2)	S
3	ETEA00116W	Optics and Nonlinear Optics	1	0	0	0	0	K2EKA_W04	15	30	1	1	0.5	T/Z*	Z		DN	0	S
4	ETEA00116C	Optics and Nonlinear Optics	0	1	0	0	0	K2EKA_U08	15	30	1	1	0.5	T	Z		DN	P(1)	S
5	ETEA00123W	IoT modules	1	0	0	0	0	K2EKA_W08	15	30	1	1	0.5	T/Z*	Z		DN	0	S
6	ETEA00123P	IoT modules	0	0	0	1	0	K2EKA_U06	15	30	1	1	0.5	T	Z		DN	P(1)	S
7	ETEA00122W	Electrotechnics	2	0	0	0	0	K2EKA_W08	30	60	2	2	1	T/Z*	Z		DN	0	S
8	ETEA00122L	Electrotechnics	0	0	1	0	0	K2EKA_U08	15	30	1	1	0.5	T	Z		DN	P(1)	S
9	ETEA00124W	Advanced Obective Programming	2	0	0	0	0	K2EKA_W10	30	60	2	2	1	T/Z*	Z		DN	0	S
10	ETEA00124L	Advanced Obective Programming	0	0	2	0	0	K2EKA_U06	30	60	2	2	1	T	Z		DN	P(2)	S
		Total	**8**	**1**	**5**	**1**	**0**		**225**	**450**	**15**	**15**	**7.5**	**-**	**-**	**-**	**15**	**7**	**-**

2. Set of examinations in semestral arrangement

Kod kursu/grupy kursów	Nazwy kursów/ grup kursów kończących się egzaminem	Semestr
ETEA00009	Microcontroller Programming	1
ETEA00004	Optical Fibres And Optocommunication	1
ETEA00106	Hardware Programming	2
ETEA00105	DSP Architecture	2

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

Semestr	Dopuszczalny deficyt punktów ECTS po semestrze
1	8
2	8

Opinion of student government legislative body

.....

Date Name and surname, signature of student representative

.....

Date Dean’s signature

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

[2]Traditional – T, remote – Z, remote in synchronous mode - Z*

[3]Exam – enter E, crediting – enter Z. For the group of courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)

[4]University-wide course /group of courses – enter O

[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Zał. nr 5 do ZW 16/2020

Faculty of Fundamental Problems of Technology (W11) / K64W11D11 (K64W11D11)

SUBJECT CARD

Name of subject in Polish: **Metody numeryczne w równaniach różniczkowych**
Name of subject in English: **Numerical methods in differential equations**
Main field of study (if applicable): **Electronics (EKA)**
Specialization: **Advanced Applied Electronics (AAE)**
Profile: **academic**
Level and form of studies: **2nd level, full-time**
Kind of subject: **obligatory**
Subject code: **MAEA00100**
Group of courses: **No**

	Lecture	Exercise	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	60		90		
Form of crediting	Crediting with grade		Crediting with grade		
For group of courses mark (X) the final course					
Number of ECTS points	2		3		
including number of ECTS points for practical (P) classes			3.0		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.0		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has basic knowledge and abilities on mathematical analysis.
2. Student has basic knowledge concerning programming environments: Matlab/Mathematica/Mapple.

SUBJECT OBJECTIVES

C1. Study of basic notions and knowledge in the area of numerical methods applied in differential equations

C2. Study of basic numerical techniques used in discretization of differential equations.

C3. Acquisition of basis abilities in construing and analyzing difference schemes for differential equations

SUBJECT LEARNING OUTCOMES
Relating to knowledge: PEU_W01 - student knows the most important numerical techniques used in solving problems for differential equations PEU_W02 - student knows bases of construing own numerical schemes Relating to skills: PEU_U01 - student is able to analyze basic problems in differential equations with respect to application of suitable approximate methods PEU_U02 - student is able to construct mathematical models used in concrete applications of mathematics, based on differential equations and their discrete forms Relating to social competences: PEU_K01 - student can, based on the concepts learned, find the necessary information in the literature

PROGRAM CONTENT		
Lecture		**Number of hours**
Lec1	Recalling basic facts of theory of ordinary differential equations.	2
Lec2	Explicit and implicit Euler method of approximate solving of ordinary differential equations and their systems.	2
Lec3	Runge-Kutta type methods and other schemes of approximation of ordinary differential equations and their systems	2
Lec4	Multi-step methods, stability of numerical methods. Stiff problems	2
Lec5	Methods of approximation of boundary value problems for second order ordinary differential equations: shooting methods and difference methods	2
Lec6	Methods of approximation of boundary value problems for second order ordinary differentia equations: Ritz-Galerkin method	2
Lec7	Difference methods for first order partial differential equations. CFL condition	2
Lec8	Recalling basic facts of theory of second order partial differential equations	2
Lec9	Difference approximation of elliptic boundary value problems on the plane	2
Lec10	Variational formulation of boundary value problems for elliptic type equations	2
Lec11	Ritz-Galerkin and finite element methods for elliptic problems	2
Lec12	Difference methods for parabolic problems. Explicit and implicit schemes for heat conduction equation	2
Lec13	Stability of approximate method. Cranck-Nicholson scheme for equations of parabolic type	2
Lec14	Difference methods for the vibrating string problem and other hyperbolic problems	3
Lec15	Summary	1
	Total hours:	30

Laboratory		**Number of hours**
Lab1	Computer construction of solution of ordinary differential equations	4
Lab2	Practical verifying of efficacy of automatic exactness control.	2
Lab3	Visualization and comparison of usefulness of various methods.	4

Lab4	Algorithms for numerical methods of solution of one-dimensional boundary value problems for elliptic equations	4
Lab5	Discretization of hyperbolic first order problems. Conditions of stability and convergence of approximate methods.	4
Lab6	Discretization of two-dimensional boundary value problem for elliptic equations.	4
Lab7	Difference schemes of approximation of one-dimensional parabolic equation.	4
Lab8	Difference method of discretization of the vibrating string equation.	4
	Total hours:	30

TEACHING TOOLS USED
N1. Lecture in a traditional form and/or onlinne with usage of multimedia tools
N2. Computing laboratory - problems solved on the Matlab and/or Python platforms
N3. Computing laboratory - materials placed on the website

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation: F — forming (during semester), C — concluding (at semester end)	Learning outcome code	Way of evaluating learning outcome achievement
F1	PEK_W01 PEK_W02	Presentation of given problem
F2	PEU_U01 PEK_U02	Oral presentation, quizes, final test
P(W)=F1; P(L)=F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Richard L. Burden, J. Douglas Faires, Numerical Analysis.

[2] A. Quarteroni, R. Sacco, F. Saleri, Numerical Mathematics, Springer Berlin Heidelberg 2007

[3] J. C. Butcher, Numerical Methods for Ordinary Differential Equations, John Wiley & Sons 2003

[4] K. W. Morton, D. F. Mayers, Numerical Solution of Partial Differential Equations. An Introduction, Cambridge University Press 2005

SECONDARY LITERATURE:

[1] L. Lapidus, G. F. Pinder, Numerical solution of partial differential equations in science and engineering, John Wiley & Sons, 1998

[2] R. M. Mattheij, S. W. Rienstra, J.H.M. ten Thije Boonkkamp, Partial differentialequations. Modeling, analysis and computations.

[3] Stig Larsson, Vidar Thomee, Partial differential equations with numerical methods.

[4] R. J. Le Vegue, Numerical Methods for conservation laws, Birkhauser, Basel 1990

[5] J. W. Thomas, Numerical partial differential equations: conservation laws and elliptic equations, Springer, New York 1999

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W12N (W12N) / Department of Field Theory, Electronic Circuits and Optoelectronics (K35W04D02)

SUBJECT CARD

Name of subject in Polish: **Architektury cyfrowego przetwarzanie sygnałów**
Name of subject in English: **DSP Architectures**
Main field of study (if applicable): **Electronics (EKA)**
Specialization: **Advanced Applied Electronics (AAE)**
Profile: **academic**
Level and form of studies: **2nd level, full-time**
Kind of subject: **obligatory**
Subject code: **ETEA00208**
Group of courses: **No**

	Lecture	Exercise	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	90		90		
Form of crediting	Examination		Crediting with grade		
For group of courses mark (X) the final course					
Number of ECTS points	3		3		
including number of ECTS points for practical (P) classes			3.0		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2		2.1		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basics of digital signal processing
2. Basics of C language programming
3. Basics of microcontroller program development tools

SUBJECT OBJECTIVES

C1. Getting to know the architecture and operation of DSP processing structures, in particular multi-core processors supporting DSP processing

C2. Learn and become skilled in using code generation tools, running signal processors and their environment

C3. Ability to identify and evaluate processor chip architectures that support signal processing and hardware to facilitate multi-core processor designs

SUBJECT LEARNING OUTCOMES
Relating to knowledge: PEU_W01 - As a result of the course, the student should be familiar with the architectures and operations of DSP processing structures, particularly signal microcontrollers. Relating to skills: PEU_U01 - As a result of the classes the student should be able to use development tools starting from the installation stage through configuration and preparation to running and debugging the program

PROGRAM CONTENT		
Lecture		**Number of hours**
Lec1	Requirements, introduction to signal processing, peripheral tasks, introduction to DSP technology	2
Lec2	Basic architecture of DSP controllers and its incorporation into multicore structures on the example of STM32MP family, basic mechanisms of efficient operation.	2
Lec3	Data representation in DSP, limitations, implications, IQ-math library support for fixed-point structures.	2
Lec4	From analog world to vector digital representation of analog signal.	2
Lec5	Space of time and frequency - Discrete Fourier Transform a useful tool - a connector of these two spaces.	2
Lec6	Accelerate signal analysis with the Fast FFT transform.	2
Lec7	FIR and IIR digital filters.	2
Lec8	Multirate systems - with variable sampling rate, mechanisms of changing the frequency of signal representation - decimation and interpolation. Possibilities, limitations.	2
Lec9	Briefly on quadrature signals, problems and possibilities. The Hilbert transform.	2
Lec10	Data compression and security.	2
Lec11	Linux in DSP processing. Using the system shell and Phyton and C languages in accessing peripherals.	2
Lec12	Using Raspberry-Pi for signal processing. Initialization of basic blocks, programming.	2
Lec13	Using the OpenCV library to process images in a recognized environment.	2
Lec14	Neural networks in DSP processing.	2
Lec15	Credit test	2
	Total hours:	30

Laboratory		**Number of hours**
Lab1	Signal processing environment in the lab, - CubeIDE, introduction to using STM32 family, initialization and basic blocks.	2
Lab2	STM32MP1 lab module - structure and application	2
Lab3	DAC usage and support	2
Lab4	DDS technology and implementation	2
Lab5	Basic signal processing path, from ADC to DAC - preparation and start-up	2

Lab6	FIR and IIR filters and its implementation in the system	2
Lab7	Fast Fourier Transform	2
Lab8	Linux for STM32MP1 system.	2
Lab9	Inter-core Communication in STM32MP1	2
Lab10	Raspberry Pi - Preparing and Initialization.	2
Lab11	Operating system under Phyton and bash.	2
Lab12	OPENCV (functions, camera connection, image processing).	2
Lab13	Neural networks - perceptron	2
Lab14, 15	Using neural networks in image processing.	4
	Total hours:	30

TEACHING TOOLS USED
N1. A traditional and/or online lecture using multimedia tools
N2. WEB page of the course with shared literature, illustration slides and company documentation
N3. Developing problems on the course WIKI
N4. Consultation of problems by the lecturer
N5. Self-work, preparation for laboratory exercises controlled by an input test
N6. Hands-on laboratory exercises ending with a report
N7. Individual studies of technical documentation
N8. Own work - independent studies and preparation for a credit test

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation: F — forming (during semester), C — concluding (at semester end)	Learning outcome code	Way of evaluating learning outcome achievement
F1	PEU_W01	Written and oral exams
F2	PEU_U01	Grade point average for input tests, reports and discussion of problems during the laboratory
.P(W)=F1; P(L)=F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Understanding-digital-signal-processing. 3-th.Ed.- Richard-G. Lyons [Available Polish translation – „Wprowadzenie do cyfrowego przetwarzania sygnałów"; Richard G. Lyons; WKŁ 2010]

[2] The Scientist and Engineer's Guide to DSP- S.W.Smith [Available Polish translation – „Cyfrowe przetwarzania sygnałów. Praktyczny poradnik dla inżynierów i naukowców"; Steven W. Smith; BTC]

SECONDARY LITERATURE:

[1] Data Compression Explained - Matt Mahoney; http://mattmahoney.net/dc/dce.html

[2] Introduction to Computer Organization : ARM Assembly Language Using the Raspberry Pi [https://bob.cs.sonoma.edu/IntroCompOrg-RPi/intro-co-rpi.html]

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W12N (W12N) / Department of Field Theory, Electronic Circuits and Optoelectronics (K35W04D02)

SUBJECT CARD

Name of subject in Polish: **Analogowe układy peryferyjne systemów cyfrowych**
Name of subject in English: **Analog Peripherals of Digital Sys**
Main field of study (if applicable): **Electronics (EKA)**
Specialization: **Advanced Applied Electronics (AAE)**
Profile: **academic**
Level and form of studies: **2nd level, full-time**
Kind of subject: **obligatory**
Subject code: **ETEA00202**
Group of courses: **No**

	Lecture	Exercise	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30	15	
Number of hours of total student workload (CNPS)	30		90	30	
Form of crediting	Examination		Crediting with grade	Crediting with grade	
For group of courses mark (X) the final course					
Number of ECTS points	1		3	1	
including number of ECTS points for practical (P) classes			3.0	1.0	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.5		1.4	0.5	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of electronic circuits from the first cycle of studies.

SUBJECT OBJECTIVES

C1. Obtaining knowledge about the electronic elements, analog circuits and systems used in digital electronic systems.

C2. Obtaining knowledge about the sources of self-noise and interference in electronic systems, methods of their reduction and their influence on signal integrity.

C3. Acquiring the ability to design analog circuits and laboratory experiments using advanced measuring equipment for complex electronic circuits and systems.

SUBJECT LEARNING OUTCOMES
Relating to knowledge: PEU_W01 - The student characterizes the basic requirements for analog circuits in digital systems and the configuration of the electronic system to a given area of application and required parameters. Among other things, the student defines the sources of self-noise and disturbances in electronic systems, explains how to reduce them and their impact on the integrity of signals Relating to skills: PEU_U01 - The student conduct a laboratory experiment using advanced measuring equipment for complex electronic circuits. PEU_U02 - The student selects the configuration of the analog system cooperating with the digital system, taking into account the problems of noise reduction and resistance to external disturbances

PROGRAM CONTENT		
Lecture		**Number of hours**
Lec1	Analog measurement circuits and systems (sensors, analog signal conditioning, ”front-end” systems)	5
Lec2	Analog to digital and digital to analog conversion	1
Lec3	Electric actuators; Power factor problem	2
Lec4	Basic EMC issues; Legal regulations concerning the emission of electromagnetic disturbances; Protection of the electromagnetic environment.	1
Lec5	Sources of interferences and paths of their penetration; Signal integrity in electronic circuits design aspects: balancing, filtering, grounding; RFI elements: shielding, protection of connectors; Interference in digital circuits - emission reduction; Electrostatic and atmospheric discharges - protection	5
Lec1	Summary	1
	Total hours:	15

Laboratory		**Number of hours**
Lab1	Four labs chosen from: Power factor measurements, Stepper motor controller; Phase Locked Loop; Pressure MEMS sensor with AD converter, Operating amplifier – instrumentation amp, Front-end circuits – transconductance amplifier, Front-end circuits – instrumentation amplifier; Optoelectronics – light sources; Optoelectronics - light detectors; Electromechanical relays and SSR; PM motor; Biomedical sensors, Gas sensors	15
Lab2	Four lab chosen from: PCB designing , signal integrity I routing; PCB designing , signal integrity II radiation; Coaxial cable –(trans impedance); PCB designing , signal integrity III – coupling Resonant frequencies of capacitors - types of capacitors ; Resonant frequencies of capacitors - assembling ; Filter effectiveness; PCB designing , signal integrity VI – stabs; PCB designing , signal integrity V – grounding, PCB designing , signal integrity IV– power decoupling	15
	Total hours:	30

Project		Number of hours
Pr1	Sensors, analogue signal conditioning, front-end circuits Actuator for elektromechanical relay Acctuator for electric motor (PM, BLCD, stepper e.t.c) EMI emission and immunity to interferrences problems. Thermal noise sources – low noise designs and calculations	15
	Total hours:	15

TEACHING TOOLS USED
N1. Traditional lectures and lectures with the use of multimedia
N2. Laboratory stands equipped with digital scopes, DDS generator, Power factor measurement setup, stepper motor controller with microcontroller, optical spectrum analyser, electronic materials (PCB boards, electronic elements, tools)
N3. Laboratory stands equipped with digital scop, DDS generator, spectrum analyzer up to 6GHz, PCB with tested circuits
N4. Self education
N5. Consultations

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation: F — forming (during semester), C — concluding (at semester end)	Learning outcome code	Way of evaluating learning outcome achievement
F1	PKE_W01	Final test
F2	PKE_U01	Carrying out laboratory measurements; Report from the conducted laboratories
F3	PKE_U02	Independent design of the electronic circuit and its presentation
P(W)=F1; P(L)=F2; P(P)=F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] H.W.Ott, Electromagnetic Compatibility, WILEY, 2009
[2] U. Tietze, Ch. Schenk, Electronic circuits. Handbook for Design and Application, Springer, 2009.
[3] P. Horowitz, W. Hill, The Art. Of Electronics, Cambridge University Press 2015

SECONDARY LITERATURE:

[1] C. Kitchin, L. Counts, A Designer's Guide To Instrumentation Amplifiers, Analog Devices,3rd edition, 2006.
[2] A. Pressman , K. Billings, T. Morey, Switching Power Supply Design, McGraw-Hill
[3] T. Wiliams, EMC for Product Designers, 4th edition, ELSEVIER, 2009
[4] M.I. Monterose, Printed Circuit Board Design Techniques for EMC Compliance, Wiley, 2012
[5] References given during lectures

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

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W12N (W12N) / Department of Field Theory, Electronic Circuits and Optoelectronics (K35W04D02)

SUBJECT CARD

Name of subject in Polish: **Komputerowe systemy operacyjne**
Name of subject in English: **Computer Operating Systems**
Main field of study (if applicable): **Electronics (EKA)**
Specialization: **Advanced Applied Electronics (AAE)**
Profile: **academic**
Level and form of studies: **2nd level, full-time**
Kind of subject: **obligatory**
Subject code: **ETEA00210**
Group of courses: **No**

	Lecture	Exercise	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Crediting with grade		Crediting with grade		
For group of courses mark (X) the final course					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2.0		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.5		1.2		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of C/C++ programming

SUBJECT OBJECTIVES

C1. Learning how modern operating systems work

C2. Knowledge of a Data Communication and Protocols for Communications.

SUBJECT LEARNING OUTCOMES

Relating to knowledge:

PEU_W01 - Acquiring knowledge about the operation of modern operating systems - process management, inter-process communication mechanisms, synchronisation problems and methods

Relating to skills:

PEU_U01 - Acquire the ability to create multi-threaded and multi-process concurrent programs using communication and synchronization mechanisms.

PROGRAM CONTENT		
Lecture		**Number of hours**
Lec1	Introduction	1
Lec2	Processes	2
Lec3	Interprocess communictaion	2
Lec4	Threads and concurrency	2
Lec5	CPU scheduling	2
Lec6	Synchronization tools	2
Lec7	Synchronization examples	2
Lec8	Deadlocks	2
	Total hours:	15

Laboratory		**Number of hours**
Lab1	Introduction. Basics of working with the Unix shell.	2
Lab2	File and directory handling in C/C++ at the system function level. File attributes.	4
Lab3	Process creation and handling with system functions.	4
Lab4	IPC - pipes, message queues, shared memory.	4
Lab6	Creation and handling of threads with system function calls and using mechanisms made available in the latest versions of the C++ standard	4
Lab5	Basic process and thread synchronisation mechanisms.	4
Lab7	Network communication. TCP and UDP protocols	4
Lab8	High level networking libraries	4
	Total hours:	30

TEACHING TOOLS USED
N1. FIXME: Translate
N2. FIXME: Translate
N3. FIXME: Translate

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation: F — forming (during semester), C — concluding (at semester end)	Learning outcome code	Way of evaluating learning outcome achievement
F1	PEU_W01	Final test
F2	PEU_U01	Grading of programmes developed during the laboratory
P(W)=F1, P(L) = F2		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: [1] A. Silberschatz, P. Galvin, G. Gagne, "Operating System Concepts" [2] R. Stevens, UNIX Network Programming [3] System manuals

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)
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W12N (W12N) / Department of Field Theory, Electronic Circuits and Optoelectronics (K35W04D02)

SUBJECT CARD

Name of subject in Polish: **Elektrotechnika praktyczna**
Name of subject in English: **Electrotechnics**
Main field of study (if applicable): **Electronics (EKA)**
Specialization: **Advanced Applied Electronics (AAE)**
Profile: **academic**
Level and form of studies: **2nd level, full-time**
Kind of subject: **facultative**
Subject code: **ETEA00122**
Group of courses: **No**

	Lecture	Exercise	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
For group of courses mark (X) the final course					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1.0		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.0		0.5		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

C1. Learning the basic principles of building low voltage electrical installations
C2. Getting to know the principles of functioning of electric shock protection systems in low voltage installations
C3. Effectiveness of protection against electric shock in low voltage installations
C4. Getting to know the principles of testing low voltage electrical installations

SUBJECT LEARNING OUTCOMES
Relating to knowledge: PEU_W01 - Knows the effects of electric current on the human body, means of electric shock protection and its effectiveness criteria in low voltage installations Relating to skills: PEU_U01 - Be able to perform measurements on low voltage electrical installations, evaluate their results and prepare documentation Relating to social competences: PEU_K01 - Works as part of a team to perform electrical system testing

PROGRAM CONTENT		
Lecture		**Number of hours**
Lec1, 2	General characteristics of regulations and standards for the construction of electrical equipment, installations and networks.	4
Lec3, 4	Generation, transmission, distribution of electric energy. Electric power system and its parameters.	4
Lec5-9	Protection against electric shock - technical means of protection. Protection against direct and indirect contact in network systems with voltage up to 1kV.	10
Lec10, 11	Principles of operation and operating instructions for electrical power equipment, installations and networks.1kV	4
Lec12-14	Electrical machines and apparatus. Types, principles of construction, types of overload and short circuit protection.	6
Lec15	Final test	2
	Total hours:	30

Laboratory		**Number of hours**
Lab1	Admission: - Familiarize students with the principles of safety in the laboratory;	1
Lab2	Fault loop impedance measurements. Measurement of protective conductor continuity. Insulation resistance wires. Measurements RCDs. Earth resistance measurements.	7
Lab3	Combining basic circuit low voltage electrical installations (way switches, circuit breakers cross, bistable switches, stair machines, dusk sensors, PIR motion detectors).	7
	Total hours:	15

TEACHING TOOLS USED
N1. Traditional lecture with the use of multimedia presentations N2. Consulting N3. Laboratory N4. Own work

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation: F — forming (during semester), C — concluding (at semester end)	Learning outcome code	Way of evaluating learning outcome achievement
F1	PEU_W01	Final test
F2	PEU_U01	Evaluation of reports and activity in laboratory classes
P(W)=F1; P(L)=F2;		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE:
[1] The Electrical Engineering Handbook, Wai-Kai Chen, 2005 Elsevier Inc.
[2] Electrical installation guide, 2008 Schneider Electric
[3] PN-HD 60364 Instalacje elektryczne niskiego napięcia

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)
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W12N (W12N) / Department of Field Theory, Electronic Circuits and Optoelectronics (K35W04D02)

SUBJECT CARD

Name of subject in Polish: **Światłowody i optokomunikacja**
Name of subject in English: **Optical Fibers and Optocommunications**
Main field of study (if applicable): **Electronics (EKA)**
Specialization: **Advanced Applied Electronics (AAE)**
Profile: **academic**
Level and form of studies: **2nd level, full-time**
Kind of subject: **obligatory**
Subject code: **ETEA00004**
Group of courses: **No**

	Lecture	Exercise	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		15
Number of hours of total student workload (CNPS)	90		60		30
Form of crediting	Examination		Crediting with grade		Crediting with grade
For group of courses mark (X) the final course					
Number of ECTS points	3		2		1
including number of ECTS points for practical (P) classes			2.0		1.0
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.8		1.4		0.5

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES
C1. To make wider and deeper the knowladge of physics needed to understand physical phenomena in the optical fiber field
C2. Understanding of basic knowladge of light propagation in fibers. Familiarization with optical fiber technology, basic types of fibers and their parameters
C3. Recognision of basic optical fiber telecommunication systems
C4. The acquisition of skills in experimental works in the fiber optics domain (the start-up of fiber devices such as fiber amplifier, fiber laser, modulation, and detection in fiber systems in representative experiments)
C5. Acquiring the ability to obtain information from the conference materials written in English, conferences in the optocommunication area (for example ECOC – European Conference on Optic Communications)
C6. Acquiring the ability in preparation presentations in English

SUBJECT LEARNING OUTCOMES
Relating to knowledge:
PEU_W01 - The student has wider and deeper knowledge into physics needed to understand physical phenomena in the fiber optics
PEU_W02 - The student is able to explain basic knowledge of light propagation in fibers. Familiarization with fiber technology, basic types of fibers, and their parameters
PEU_W03 - The student recognizes the basics of optical fiber telecommunication systems. He can explain different telecommunication methods and their parameters
Relating to skills:
PEU_U01 - Students can perform elementary experiments in the field of optical fibers. He can run with such devices fiber amplifiers, fiber lasers, light modulation, and detection. He can apply optical fiber elements in basic experiments.
PEU_U02 - The student is able to find the necessary information from the conference materials written in English in optocommunications or optoelectronics (for example ECOC - European Conference on Optic Communications)
PEU_U03 - The student is able to prepare and to present the talk on a chosen subject in English

PROGRAM CONTENT		
Lecture		**Number of hours**
Lec1	Principles of optical fibers 1	2
Lec2	Principles of optical fibers 2	2
Lec3	Planar fibers	2
Lec4	Optical fibers characteristics	2
Lec5	Special optical fibers	2
Lec6	Photonic crystal fibers (PCF)	2
Lec7	Other passive optical system components	2
Lec8	Introduction to modern optocommunications. Fiber-optic communication systems based on Wavelenth Division Multiplexing technique (WDM, DWDM, CWDM, etc)	2
Lec9	Semiconductor light sources (LED/LD) and transmitters (Tx) for fiber-optic communication	2
Lec10	Semiconductor light detectors (photodiodes) and receivers (Rx)	2

Lec11	Optical amplifiers (OA) and repeaters for fiber-optic communication systems and networks.	2
Lec12	Analysis and design rules of fiber-optic communication links and networks. Power budget. Dispersion management.	2
Lec13	Modern optocommunication systems. ROADMs. Line codes and modulation formats in fiber-opic communication.	2
Lec14	Non-telecom applications of optical fibers 1.	2
Lec15	Non-telecom applications of optical fibers 2	2
	Total hours:	30

Laboratory		**Number of hours**
Lab1	Introduction, safety issues in the laboratory, organizing matters	1
Lab2	Basic parameters of optical fibers. Optical fiber connectors	2
Lab3	Basic passive fiber components: couplers, circulators, fiber isolators	2
Lab4	Optical fiber interferometers	2
Lab5	Erbium Doped Fiber Amplifier (EDFA) – parameters and characteristics	2
Lab6	OTDR (Optical Time Domain Reflectometer) measurements	2
Lab7	Fiber splicing	2
Lab8	Compensatory term	2
	Total hours:	15

Seminar		**Number of hours**
Sem1	Introductory meeting. Description of subject and rules of the seminar, distribution of seminar subjects.	1
Sem2	The seminar is based on presentation by each student individually twice through the semester about 20 minutes talk based on chosen contribution paper based on famous and prestigious conference ECOC(European Conference on Optical Communication) dealing with subjects: Fibers, fiber devices and amplifiers; Waveguide and optoelectronic devices; Subsystems and Network elements for optical networks; Transmission systems; Backbone and core networks; Access and local area networks	14
	Total hours:	15

TEACHING TOOLS USED
N1. Classroom (blackboard and chalk)
N2. Projector, computer with software (for example PowerPoint)
N3. Laboratory equipped with modern laser-fiber equipment
N4. Self-study of conference papers written in English
N5. Preparing and delivering a presentation in English
N6. Working alone (self-education)
N7. Consultations

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation: F — forming (during semester), C — concluding (at semester end)	Learning outcome code	Way of evaluating learning outcome achievement
F1	PEU_W01-W03	Final exam
F2	PEU_U02-03	Ratings for the preparation and presentation of tutorials
F3	PEU_U01	Grades for preparation and execution of experiments
P(W)=F1; P(L)=F2; P(S)=F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] G.P. Agraval, Fiber-Optics Communication Systems, John Wiles&Sons, third edition, 2002

[2] E. Desurvire, Erbiu-Doped Fiber Amplifiers, Device and System Developments, Wiley-Interscience, 2002

[3] Edited by A. Dutta, N. Dutta, M. Fujiwara, WDM Technologies: Passive Optical Componenets, Academic Press, Elsevier Science, 2003

[4] C.M. DeCusatis, C.J. SherDeCusatis, Fiber Optic Essentials, Academic Press, Elsevier Science, 2006

SECONDARY LITERATURE:

[1] B.P Keyworth, ROADM Subsystem and Technologies, Proceedings of OFC/NFOEC 2005, 6-11 march, 2005 p.OWB5

[2] Edited by I.P. Kaminow, T.LKoch, Optical Fiber Telecommunications III A&B, Academic Press, 1997,

[3] P.J. Winzer, R.J. Essiambre, Advanced Modulation Formats for High-Capacity Optical Transport Networks, Journal of Lightwave Technology, vol.24, pp.4711-4728, 2006

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W12N (W12N) / Department of Field Theory, Electronic Circuits and Optoelectronics (K35W04D02)

SUBJECT CARD

Name of subject in Polish: **Lasery i zastosowania**
Name of subject in English: **Lasers and Applications**
Main field of study (if applicable): **Electronics (EKA)**
Specialization: **Advanced Applied Electronics (AAE)**
Profile: **academic**
Level and form of studies: **2nd level, full-time**
Kind of subject: **obligatory**
Subject code: **ETEA00106**
Group of courses: **No**

	Lecture	Exercise	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
For group of courses mark (X) the final course					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1.0		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.0		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

C1. Understanding of quantum mechanisms governing the laser action. The knowledge of basic laser parameters, their types, and applications.

C2. Skills in performing experiments in the fields of laser techniques

C3. Skills in using elementary equipment in laser technique

C4. The ability of interpretation obtained experimental results

SUBJECT LEARNING OUTCOMES
Relating to knowledge: PEU_W01 - Student understands quantum mechanisms governing laser action. Student knows basic parameters of lasers, their types and applications. Relating to skills: PEU_U01 - The student is able to perform experiments in the laser technique area. He is able to use elementary equipment used in laser techniques. He is able to make his own interpretation of obtained results.

PROGRAM CONTENT		
Lecture		**Number of hours**
LecW1	Elementary properties of electromagnetic radiation. Coherence, polarization	2
LecW2	Black body radiation. Planck's model. Einstein model. Quantum conditions of amplification of radiation	2
LecW3	The Fabry-Perot resonator and its spectral properties. Optical resonators and their mode structures. Gaussian beams	2
LecW4	Gas lasers: atomic, molecular, and ion lasers	2
LecW5	Semiconductor lasers	2
LecW6	Solid-state lasers	2
LecW7	Fiber lasers	2
LecW8	Pulsed lasers: gain-switching, Q-switching and mode-locking	2
LecW9	Mode-locked lasers	2
LecW10	Nonlinear optics and ultrashort pulse propagation	2
LecW11	Optical frequency combs; stabilization of lasers	2
LecW12	Mid-infrared lasers	2
LecW13	Selected applications of lasers	4
LecW14	Final test	2
	Total hours:	30

Laboratory		**Number of hours**
LabL1	Introduction, safety issues in the laboratory, organizing matters.	1
LabL2	He-Ne lasers (543nm, 594nm, 628.3nm). Diffraction and interference of lightwaves.	2
LabL3	Transverse modes of laser radiation. Stability of a laser resonator. Analysis of the laser longitudinal modes. Alignment of a laser.	2
LabL4	Semiconductor lasers. Temperature influence on laser characteristics. Spectral properties of semiconductor lasers.	2
LabL5	Coherent detection	2
LabL6	Acoustooptical Bragg modulator. Acoustooptical light diffraction.	2

LabL7	Q-switched fiber laser	2
LabL8	Compensatory term.	2
	Total hours:	15

TEACHING TOOLS USED
N1. Classroom (blackboard and chalk)
N2. Projector, computer with software (for example PowerPoint)
N3. Laboratory equipped into modern laser-fiber equipment
N4. Self-study of conference papers written in English
N5. Working alone (selfeducation)
N6. Consultations

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation: F — forming (during semester), C — concluding (at semester end)	Learning outcome code	Way of evaluating learning outcome achievement
F1	PEU_W01	Final test
F2	PEU_U01	Grades for preparation and execution of experiments
P(W)=F1; P(L)=F2		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE:
[1] J.T. Verdeyen, Laser Electronics, Prentice Hall, Englewood Cliffs, 1995
[2] O. Svelto, Principles of Lasers, Plenum Press, New York, 1998
[3] C.C. Davies, Lasers and Electro-Optics, Cambridge University Press, 1996
[4] P.W. Milonni, J.J.H. Eberly, Lasers, John Wiley & Sons, New York, 1988
SECONDARY LITERATURE:
[1] A. Yariv, Quantum Electronics, John Wiley & Sons, 1989
[2] A.A. Siegman, Lasers, University Science Book, Mill Valey, California, 1986
[3] R. Paschotta, The Encyclopedia of Laser Physics and Technology (rp-photonics.com)

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W12N (W12N) / Department of Field Theory, Electronic Circuits and Optoelectronics (K35W04D02)

SUBJECT CARD

Name of subject in Polish: **Moduły IoT**
Name of subject in English: **IoT modules**
Main field of study (if applicable): **Electronics (EKA)**
Specialization: **Advanced Applied Electronics (AAE)**
Profile: **academic**
Level and form of studies: **2nd level, full-time**
Kind of subject: **obligatory**
Subject code: **ETEA00123**
Group of courses: **No**

	Lecture	Exercise	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
For group of courses mark (X) the final course					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1.0	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.5			0.5	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. None
2. None

SUBJECT OBJECTIVES

C1. Learning methods of wireless communication between electronic modules
C2. Gaining design skills of designing electronic module for wireless data exchange

SUBJECT LEARNING OUTCOMES
Relating to knowledge: PEU_W01 - have a basic understanding of the methods of wireless data transmission PEU_W02 - have knowledge about wireless data modules using protocols: ZigBee, Bluetooth, WiFi, GSM - GPRS and EDGE Relating to skills: PEU_U01 - can choose the right method for wireless data depending on the application PEU_U02 - can use practically electronic modules for the construction of the device transmitting / receiving wireless data path

PROGRAM CONTENT		
Lecture		**Number of hours**
Lec1	Introduction. Basic definitions	2
Lec2	Wireless data transfer - proprietary solutions	2
Lec3	IoT modules based on IEEE 802.15.1 - Bluetooth BR and BLE	2
Lec4	IoT modules based on IEEE 802.15.4 - OpenThread and ZigBee	3
Lec5	NFC and RFID modules	2
Lec6	Wireless data transfer in mobile networks - 2G, 3G, LTE	3
Lec7	Final test	1
	Total hours:	15

Project		**Number of hours**
Pr1	Introduction	2
Pr2	The choice of theme projects	2
Pr3	PCB Design	2
Pr4	Running of designed circuit	2
Pr5	Software design	6
Pr6	Overview of projects	1
	Total hours:	15

TEACHING TOOLS USED
N1. Lecture with blackboard, projector and slides N2. Project activities

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation: F — forming (during semester), C — concluding (at semester end)	Learning outcome code	Way of evaluating learning outcome achievement
F1	PEK_U01-02	Discussions, written reports
F2	PEK_W01-02	Written exam

P(W)=F1; P(P)=F2;

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE:
[1] The materials available on the subject webpage
[2] Papers and webpages recommended by the teacher

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SUBJECT CARD

Name of subject in Polish: **Metody uczenia maszynowego**
Name of subject in English: **Machine Learning Methods**
Main field of study (if applicable): **Electronics (EKA)**
Specialization: **Advanced Applied Electronics (AAE)**
Profile: **academic**
Level and form of studies: **2nd level, full-time**
Kind of subject: **obligatory**
Subject code: **ETEA00203**
Group of courses: **No**

	Lecture	Exercise	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		15
Number of hours of total student workload (CNPS)	30		30		30
Form of crediting	Crediting with grade		Crediting with grade		Crediting with grade
For group of courses mark (X) the final course					
Number of ECTS points	1		1		1
including number of ECTS points for practical (P) classes			1.0		1.0
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.5		0.7		0.5

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

C1. Be familiar with unsupervised learning methods

C2. Be familiar with supervised learning methods

SUBJECT LEARNING OUTCOMES
Relating to knowledge: PEU_W01 - lists and explains fundamental methods for dimensionality reduction and feature extraction PEU_W02 - lists and explains fundamental blind source separation methods for statistically independent signals PEU_W03 - lists and explains fundamental statistical classifiers PEU_W04 - ists and explains fundamental clustering methods Relating to skills: PEU_U01 - be able to reduce the dimensionality and extract features from analyzed data PEU_U02 - be able to use selected blind source separation methods PEU_U03 - be able to select the right classifier to a given problem PEU_U04 - be able to find hidden structure in analyzed data Relating to social competences: PEU_K01 - Prepares a presentation on a given topic from the scope of the course PEU_K02 - Presents the prepared topic and takes an active part in the discussion, also taking the role of a moderator

PROGRAM CONTENT		
Lecture		**Number of hours**
LecW1	Dimensionality reduction methods: PCA	3
LecW2	Dimensionality reduction methods: NMF	3
LecW3	Multilinear dimensionality reduction methods	3
LecW4	Blind source separation methods for statistically independent signals	2
LecW5	Statistical classifiers	2
LecW6	Clustering methods	1
LecW7	Test	1
	Total hours:	15

Laboratory		**Number of hours**
LabL1	The general rules of working with ”Statistical and Machine Learning Toolbox” in Matlab. Examples	1
LabL2	Implementation and tests of PCA method	3
LabL3	Implementation and tests of NMF method	2
LabL4	Implementation, tests, and analysis of advanced classifiers	2
LabL5	Implementation and tests of selected clustering methods	2
LabL6	Implementation and tests of selected tensor decomposition methods	2
LabL7	Implementation and tests of selected methods for blind source separation of statistically independent signals	3
	Total hours:	15

Seminar		Number of hours
SemS1	Assignment of seminar topics to students	1
SemS2	Unsupervised machine learning methods	7
SemS3	Supervised machine learning methods	7
	Total hours:	15

TEACHING TOOLS USED
N1. Lecture notes and slides
N2. Computational works and discussions
N3. Programming works – coding of numerical algorithms in Matlab
N4. Consultation hours
N5. Homework – preparation to laboratory work
N6. Homework – self-studying and preparation to examination

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation: F — forming (during semester), C — concluding (at semester end)	Learning outcome code	Way of evaluating learning outcome achievement
F1	PEU_W01-04	Written exam
F2	PEU_U01-04	Preparation to labs, written reports, activity during tasks execution
F3	PEU_K02-02	Assessment of preparation for the seminar, activity and the ability to conduct substantive discussion in various roles.
P(W)=F1; P(L)=F2; P(S)=F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Ch. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006

[2] J. Hopcroft, R. Kannan, Foundations of Data Science, E-book, 2014, http://www.ime.usp.br/ yoshi/TMP/Hopcroft-Kannan.pdf

[3] D. Barber, Bayesian Reasoning and Machine Learning, Cambridge University Press, 2012

[4] E. Alpaydin, Introduction to Machine Learning, The MIT Press, Cambridge, Massachusetts, 2010

[5] A. Cichocki, R. Zdunek, A. H. Phan, S.-I. Amari, Nonnegative Matrix and Tensor Factorization: Applications to Exploratory Multi-way Data Analysis and Blind Source Separation, Wiley and Sons, UK, 2009

SECONDARY LITERATURE:

[1] Latest paper from IEEE Press devoted to machine learning methods

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W12N (W12N) / Department of Field Theory, Electronic Circuits and Optoelectronics (K35W04D02)

SUBJECT CARD

Name of subject in Polish: **Nowe trendy w Elektronice i Fotonice**
Name of subject in English: **New Approaches to Electronics and Photonics**
Main field of study (if applicable): **Electronics (EKA)**
Specialization: **Advanced Applied Electronics (AAE)**
Profile: **academic**
Level and form of studies: **2nd level, full-time**
Kind of subject: **obligatory**
Subject code: **ETEA00211**
Group of courses: **No**

	Lecture	Exercise	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
For group of courses mark (X) the final course					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.0				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

C1. Gain current knowledge of development trends and the most relevant new developments in the area of the studied scientific discipline including advanced electronic circuits and photonics.

SUBJECT LEARNING OUTCOMES

Relating to knowledge:

PEU_W01 - He/she has up-to-date knowledge of the development trends and the most significant new developments in the area of the studied scientific discipline including advanced electronic circuits and photonics.

Relating to skills:

PEU_U01 - Is able to critically discuss scientific and technical problems

PROGRAM CONTENT		
Lecture		**Number of hours**
Lec1-15	The lecture presents the current development of the scientific discipline with the main focus on electronics and photonics. The formula of conducting classes assumes the presentation of the most current content by experts carrying out scientific research (in particular, persons returning from scientific internships in domestic and foreign centers). Therefore, the list of lectures is modified from year to year. An example set of lectures conducted as part of the course in 2021: 1. Optical spectroscopy - fundametals (2h) (dr M. Nikodem) 2-3. Trace gas detection with laser spectroscopy (4h) (dr M. Nikodem) 4. New techniques in optical spectroscopy (2h) (dr M. Nikodem) 5. Optical frequency combs (2h) (dr M. Nikodem) 6. Optical clocks (2h) (dr M. Nikodem) 7. Bimsuth-doped fiber amplifiers (2h) (dr M. Nikodem) 8. Blue laser diodes (2h) (dr M. Nikodem) 9. Passive fiber components fabrication technologies and their application in the all-fiber construction of fiber lasers and amplifiers (dr D. Stachowiak) 10. Spectroscopy using chip-scale optical frequency combs (dr Ł. Sterczewski) 11. Laser processing of materials using ns, ps and fs laser pulses (dr P. Kozioł) 12-13. Ultrafast fiber lasers for biophotonics: from imaging single cells to human eye (dr J. Boguslawski)	30
	Total hours:	30

TEACHING TOOLS USED
N1. Classroom (chalk and whiteboard)
N2. Projector, computer with presentation software (e.g. PowerPoint)
N3. Teleconference, in case of a lecture from abroad or another national center
N4. Consultations

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation: F — forming (during semester), C — concluding (at semester end)	Learning outcome code	Way of evaluating learning outcome achievement
F1	PEK_W01, PEK_U01	Student's attendance during lectures and activity in discussions
P=F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE:
[1] Materiały dostarczone przez wykładowcę / Materials provided by the lecturer
SECONDARY LITERATURE:
[1] Proponowana literatura przez wykładowcę / Suggested literature by the lecturer

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)
Jarosław Sotor, jaroslaw.sotor@pwr.edu.pl

W12N (W12N) / Department of Field Theory, Electronic Circuits and Optoelectronics (K35W04D02)

SUBJECT CARD

Name of subject in Polish: **Optyka i optyka nieliniowa**
Name of subject in English: **Optics and Nonlinear Optics**
Main field of study (if applicable): **Electronics (EKA)**
Specialization: **Advanced Applied Electronics (AAE)**
Profile: **academic**
Level and form of studies: **2nd level, full-time**
Kind of subject: **facultative**
Subject code: **ETEA00116**
Group of courses: **No**

	Lecture	Exercise	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	15			
Number of hours of total student workload (CNPS)	30	30			
Form of crediting	Crediting with grade	Crediting with grade			
For group of courses mark (X) the final course					
Number of ECTS points	1	1			
including number of ECTS points for practical (P) classes		1.0			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.5	0.5			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

C1. Poznanie podstawowych zagadnienia z optyki geometrycznej i falowej, podstawowych zjawisk optyki nieliniowej, dotyczących światłowodów oraz klasyfikuje elementy optyczne

C2. Poznanie elementarnych obliczeń z optyki klasycznej

C3. Zdobycie umiejętności przeprowadzania podstawowych obliczenia dla zjawisk optycznych typu: odbicie i transmisja światła, polaryzacja światła, dwójłomność, interferometria, dyfrakcja i optyka fourierowska.

SUBJECT LEARNING OUTCOMES
Relating to knowledge:
PEU_W01 - Rozróżnia podstawowe zagadnienia z optyki geometrycznej i falowej; wymienia i interpretuje podstawowe zjawiska optyki nieliniowej, zwłaszcza dotyczące światłowodów; klasyfikuje elementy optyczne
PEU_W02 - Wyjaśnia sposoby elementarnych obliczeń z optyki klasycznej
Relating to skills:
PEU_U01 - Przeprowadza obliczenia w podstawowych zjawiskach optycznych typu: odbicie i transmisja światła, polaryzacja światła, dwójłomność, interferometria, dyfrakcja i optyka fourierowska

PROGRAM CONTENT		
Lecture		**Number of hours**
Lec1	Introduction to linear and nonlinear optics	2
Lec2	Nonlinear polarization, nonlinear susceptibility, wave equation for nonlinear media	2
Lec3	Second-order nonlinear processes	2
Lec4	Third-order nonlinear processes	2
Lec5	Construction and practical implementation of nonlinear optical setups	2
Lec6	Nonlinear effects in optical fibers	2
Lec7	Propagation of ultrashort pulses in optical fibers - selected practical aspects	2
Lec8	Test	1
	Total hours:	15

Exercise		**Number of hours**
Ex1-7	Ćwiczenia obejmują obliczenia rachunkowe prowadzone w formie rozwiązywania zadań i omówień. Światło jako fala, koherencja, polaryzacja, optyka geometryczna, soczewki, interferencja, dyfrakcja Fresnela I Fraunhoffera, optyka Fourierowska, tworzenie obrazu, optyczna funkcja transmitancji. Obliczenia konstrukcji układów optycznych liniowych i nieliniowych	15
	Total hours:	15

TEACHING TOOLS USED
N1. Wykład tradycyjny i/lub online z wykorzystaniem narzędzi multimedialnych
N2. Komputer z oprogramowaniem MATLAB lub/i LabView.
N3. Projektor, komputer z oprogramowaniem do prezentacji (np. PowerPoint)
N4. Ćwiczenia rachunkowe
N5. Konsultacje
N6. Praca samodzielna

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation: F — forming (during semester), C — concluding (at semester end)	Learning outcome code	Way of evaluating learning outcome achievement
F1	PEK_W01, PEK_W02	Test
F2	PEK_U01	Assessment of tasks to be solved
P(W)=F1; P(C)=F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] K.K. Sharma, Optics. Principles and applications., Academic Press, Amsterdam, 2006

[2] Peter E. Powers, Joseph W. Haus, Fundamentals of Nonlinear Optics, Second Edition, CRC Press Taylor & Francis Group, 2017

SECONDARY LITERATURE:

[1] G. P. Agrawal, Nonlinear fiber optics, Academic Press, San Diego, 2019

[2] G. P. Agrawal„ Applications of Nonlinear Fiber Optics, Academic Press, 2020

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

Grzegorz Soboń, grzegorz.sobon@pwr.edu.pl

W12N (W12N) / Department of Field Theory, Electronic Circuits and Optoelectronics (K35W04D02)

SUBJECT CARD

Name of subject in Polish: **Metody numeryczne i optymalizacja**
Name of subject in English: **Numerical methods and optimization**
Main field of study (if applicable): **Electronics (EKA)**
Profile: **academic**
Level and form of studies: **2nd level, full-time**
Kind of subject: **obligatory**
Subject code: **EKEU00010**
Group of courses: **No**

	Lecture	Exercise	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	60		90		
Form of crediting	Examination		Crediting with grade		
For group of courses mark (X) the final course					
Number of ECTS points	2		3		
including number of ECTS points for practical (P) classes			3.0		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.0		2.1		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of basic mathematics
2. Knowledge of programming techniques
3. Knowledge of computational and simulation techniques

SUBJECT OBJECTIVES

C1. To be familiar with various numerical algorithms
C2. To be skilled in using numerical algorithms for solving various problems in electronics
C3. To be skilled in coding and testing computational algorithms in Matlab, and working with „Optimization Toolbox” in Matlab

SUBJECT LEARNING OUTCOMES
Relating to knowledge: PEU_W01 - has a fundamental knowledge on matrix factorization algorithms PEU_W02 - has a fundamental knowledge on methods for eigenproblems PEU_W03 - has a fundamental knowledge on linear least squares problems PEU_W04 - has a fundamental knowledge on underdetermined problems PEU_W05 - has a fundamental knowledge on iterative methods PEU_W06 - has a fundamental knowledge on numerical methods for linear programming PEU_W07 - has a fundamental knowledge on algorithms for unconstrained optimization PEU_W08 - has a fundamental knowledge on algorithms for solving systems of nonlinear equations PEU_W09 - has a fundamental knowledge on algorithms for constrained optimization PEU_W10 - has a basic knowledge on heuristic optimization
Relating to skills: PEU_U01 - skilled in efficient coding and testing numerical algorithms in the computational environment PEU_U02 - skilled in using Matlab for coding numerical algorithms PEU_U03 - skilled in formulating an optimization problem, analyzing its numerical properties, and selecting the right algorithm for solving it

PROGRAM CONTENT		
Lecture		**Number of hours**
LecW1	Inroduction, requirements, understanding Gaussian elimination, basic matrix factorization methods	4
LecW2	Eigenproblems	2
LecW3	Linear least-squares problems, ill-posed problems and regularization	4
LecW4	Underdetermined problems	2
LecW5	Iterative methods	2
LecW6	Linear programming	2
LecW7	Methods for unconstrained optimization	4
LecW8	Systems of nonlinear equations	2
LecW9	Constrained optimization	4
LecW10	Metaheuristics, NP-hard problems	3
LecW11	Test	1
	Total hours:	30

Laboratory		**Number of hours**
LabL1	Direct methods for solving systems of linear equations and matrix factorization methods	4
LabL2	Eigenproblems	2
LabL3	Linear least-squares problems, ill-posed problems and regularization	4
LabL4	Underdetermined problems	2
LabL5	Iterative methods	2

LabL6	Linear programming	2
LabL7	Methods for unconstrained optimization	4
LabL8	Systems of nonlinear equations	2
LabL9	Constrained optimization	4
LabL10	Metaheuristics, NP-hard problems	4
	Total hours:	30

TEACHING TOOLS USED
N1. Lecture notes and slides
N2. Lecture materials and laboratory instructions accessible from the websites: http://www.studia.pwr.wroc.pl/materialy/ http://ue.pwr.wroc.pl/advanced_electronics.html
N3. Computational works and discussions
N4. Programming works – coding of numerical algorithms in Matlab
N5. Consultation hours
N6. Homework – preparation to laboratory work
N7. Homework – self-studying and preparation to examination

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation: F — forming (during semester), C — concluding (at semester end)	Learning outcome code	Way of evaluating learning outcome achievement
F1	PEU_W01-010	Written exam
F2	PEU_U01-03	Evaluation of written reports
P(W)=F1; P(L)=F2;		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] J. Nocedal, S. J. Wright, Numerical Optimization, Springer, 1999

[2] D. G. Luenberger, Y. Ye, Linear and Nonlinear Programming, Springer, 2008 (3rd Edition).

[3] S. Boyd, L. Vandenberghe, Convex Optimization, Cambridge University Press, 2004

[4] J. Dreo, A. Petrowski, D. Siarry, E. Taillard, Metaheuristics for Hard Optimization: Simulated Annealing, Tabu Search, Evolutionary and Genetic Algorithms, Ant Colonies, Methods and Case Studies. Springer 2006

[5] A. Bjorck, Numerical Methods for Least-Squares Problems, SIAM, Philadelphia, 1996

[6] Ch. Hansen, Rank-Deficient and Discrete Ill-Posed Problems, SIAM, Philadelphia, 1998

SECONDARY LITERATURE:

[1] J. Stoer and R. Bulirsch, Introduction to Numerical Analysis, Second Edition, Springer-. Verlag, 2001

[2] M. Sysło, N. Deo, J. Kowalik, Algorytmy optymalizacji dyskretnej, PWN, Warszawa 1995

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)
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W12N (W12N) / Department of Field Theory, Electronic Circuits and Optoelectronics (K35W04D02)

SUBJECT CARD

Name of subject in Polish: **Praca dyplomowa**
Name of subject in English: **Master Thesis**
Main field of study (if applicable): **Electronics (EKA)**
Specialization: **Advanced Applied Electronics (AAE)**
Profile: **academic**
Level and form of studies: **2nd level, full-time**
Kind of subject: **obligatory**
Subject code: **ETEA00220**
Group of courses: **No**

	Lecture	Exercise	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					
Number of hours of total student workload (CNPS)					
Form of crediting					
For group of courses mark (X) the final course					
Number of ECTS points					
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

C1. Demontrat the knowladge and skills ackuired during studies

C2. Preparation for the final exam.

C3. Develpment of creative thinking and taking action. Acquisition of competence appriopriate to determine the priorities for the implementation of selected task.

SUBJECT LEARNING OUTCOMES

Relating to skills:

PEU_U01 - Student prepares a master's thesis containing research aspects. The prepared disertation should proof hat stunent: - can obtain information from literature, databases and other sources, integrates it, interprets and critically evaluates it, - can plan and conducts experiments, including measurements and computer simulations, - can interpret the obtained results and draws conclusions, - uses analytical, simulation and experimental methods to formulate and solve problems, - formulates and tests hypotheses related to research problems, - integrates knowledge from various fields and disciplines and applies a systemic approach, also taking into account non-technical aspects, - assesses the usefulness and the possibility of using new achievements (techniques and technologies) in the represented discipline, - proposes improvements / rationalization of existing technical solutions, - interprets the obtained research results, draws appropriate conclusions and formulates recommendations, - can edits the master's thesis in accordance with formal requirements.

PROGRAM CONTENT

TEACHING TOOLS USED

N1. selfstudys

N2. laboratory work

N3. consultation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation: F — forming (during semester), C — concluding (at semester end)	Learning outcome code	Way of evaluating learning outcome achievement
F1	PEU_U01	Supervisor assessment
F2	PKE_U01	Reviewer's rating
P = (F1 + F2) / 2 if F1 and F2 differ significantly, one more reviewer may be appointed.		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Dobierana przez studenta indywidualnie do tematu pracy. Selected by the student individually to the topic.

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

Jarosław Sotor, jaroslaw.sotor@pwr.edu.pl

W12N (W12N) / Department of Field Theory, Electronic Circuits and Optoelectronics (K35W04D02)

SUBJECT CARD

Name of subject in Polish: **Programowanie mikrokontrolerów**
Name of subject in English: **Microcontrollers Programming**
Main field of study (if applicable): **Electronics (EKA)**
Specialization: **Advanced Applied Electronics (AAE)**
Profile: **academic**
Level and form of studies: **2nd level, full-time**
Kind of subject: **obligatory**
Subject code: **ETEA00009**
Group of courses: **No**

	Lecture	Exercise	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			30	
Number of hours of total student workload (CNPS)	90			90	
Form of crediting	Examination			Crediting with grade	
For group of courses mark (X) the final course					
Number of ECTS points	3			3	
including number of ECTS points for practical (P) classes				3.0	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.2			2.1	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

C1. Acquisition of knowledge of modern microcontrollers, 8 -, 16 - and 32-bit systems
C2. Knowledge of architectures of basic families of microcontrollers
C3. Knowledge of architectures of advanced families of microcontrollers
C4. Acquisition of basic knowledge of microcontroller applications

SUBJECT LEARNING OUTCOMES
Relating to knowledge: PEU_W01 - has a basic knowledge of modern microcontrollers PEU_W02 - has knowledge of a variety of architectures and applications of microcontrollers PEU_W03 - knows the methods and tools for programming microcontrollers PEU_W04 - is able to choose the right type of microcontroller, depending on the application Relating to skills: PEU_U01 - can set up your development environment to work PEU_U02 - can design a printed circuit board using a microcontroller PEU_U03 - can take advantage of the functional blocks microcontrollers PEU_U04 - working in a group is able to direct the work of the team

PROGRAM CONTENT		
Lecture		**Number of hours**
Lec1	Introduction. Basic definitions	2
Lec2, 3	Microprocessor – building blocks, memory map, addressing modes. Main programming techniques. Low level programming languages vs high level programming languages	4
Lec4, 5	8-bit microcontrollers: PIC Micro, AVR and 8051 based families	4
Lec5, 6	Programming serial and parallel interfaces: SCI, SPI, I2C, USB, CAN, Ethernet	4
Lec7	Low power software and hardware	2
Lec8	Midsemester test	2
Lec9, 10, 11	32-bit Microcontrollers: ARM family. Cortex-M, Cortex-R, Cortex-A	6
Lec12, 13	Advanced peripherals (ADC, DAC, DMA, IPCC, HASH, etc.)	4
Lec14	Digital Signal Controllers	2
Lec15	Multiple core processing in SIMD and MIMD configurations	2
	Total hours:	32

Project		**Number of hours**
Pr1	Introduction	2
Pr2, 3	Getting familiar with the KeilARM environment and with the STM32 processor	4
Pr4	Discussion projects topics	2
Pr5 - 8	Work on the design and manufacture of printed circuit boards	8
Pr9 - 14	Work on designed software modules	12
Pr15	Examination	2
	Total hours:	30

TEACHING TOOLS USED
N1. Discussions, written reports
N2. Own work - independent study
N3. Written exam

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation: F — forming (during semester), C — concluding (at semester end)	Learning outcome code	Way of evaluating learning outcome achievement
F1	PEU_U01-U04	Discussions, written reports, cooperation in a group
F2	PEK_W01-04	Written exam
P(W)=F1; P(P)=F2;		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Furber S., "ARM System On-Chip Architecture", Pearsons Educated Limited, 2000
[2] Franklin M., "Network Processor Design: Issues and Practices", Elsevier, 2003
[3] Yui J., "The Definitive Guide to the ARM Cortex-M3", Newnes, 2007

SECONDARY LITERATURE:

[1] "Architecture and Programming of PSoC Microcontrollers", http://www.easypsoc.com/book/
[2] Lane J., "DSP Filter Cookbook", Prompt, 2008
[3] Webpages: www.atmel.com, www.ti.com, www.arm.com, www.analog.com

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)
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W12N (W12N) / Department of Field Theory, Electronic Circuits and Optoelectronics (K35W04D02)

SUBJECT CARD

Name of subject in Polish: **Programowanie sprzętowe**
Name of subject in English: **Hardware Programming**
Main field of study (if applicable): **Electronics (EKA)**
Specialization: **Advanced Applied Electronics (AAE)**
Profile: **academic**
Level and form of studies: **2nd level, full-time**
Kind of subject: **obligatory**
Subject code: **ETEA00209**
Group of courses: **No**

	Lecture	Exercise	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	90		90		
Form of crediting	Examination		Crediting with grade		
For group of courses mark (X) the final course					
Number of ECTS points	3		3		
including number of ECTS points for practical (P) classes			3.0		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.8		2.1		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. None

SUBJECT OBJECTIVES

C1. Acquisition of knowledge of modern structures of programmable devices
C2. Gaining basic knowledge of the main structures, parameters and applications
C3. Acquisition of knowledge of the basics of the VHDL language

SUBJECT LEARNING OUTCOMES
Relating to knowledge: PEU_W01 - have a basic understanding of the various programmable structures PEU_W02 - have knowledge of the functional units occurring in FPGA and ASIC PEU_W03 - knows the basics of hardware description languages PEU_W04 - being able to choose the right type of microcontroller, depending on the application Relating to skills: PEU_U01 - can implement the systems, programmable logic core logic PEU_U02 - can set up your development environment to work PEU_U03 - can take advantage of the functional blocks of the FPGA PEU_U04 - working in a group is able to direct the work of the team

PROGRAM CONTENT		
Lecture		**Number of hours**
Lec1	Introduction. Overview of the basic structures of PLD, PLA, and CPLD	2
Lec2, 3	Overview of FPGA and ASIC structures	4
Lec4 - 6	Programming in VHDL language	6
Lec7	Combinational & sequential circuits in HDL	2
Lec8	Midterm test	2
Lec9	HDL programming environments	2
Lec10	Advanced issues in VHDL - attributes and constraints	2
Lec11	Advanced issues in VHDL - Clocking	2
Lec12	Advanced issues in VHDL - IP Cores	2
Lec13	Alternate HDLs - Verilog, SystemVerilog, System C	2
Lec14	Math algorithms in HDLs	2
Lec15	Software and hardware CPUs in FPGAs	2
	Total hours:	30

Laboratory		**Number of hours**
Lab1	Introduction	2
Lab2	Getting familiar with the environment Xilinx ISE	4
Lab3	The implementation of simple logic structures	6
Lab4	User interface and communication with PC	8
Lab5	Use of functional blocks	4
Lab6	Implementation of microcontroller cores in the logic structures	4
Lab7	Summary	4
	Total hours:	32

TEACHING TOOLS USED
N1. Lecture with blackboard, projector and slides
N2. Laboratory, solving engineering problems using a computer
N3. Own work, preparation for laboratory exercises

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation: F — forming (during semester), C — concluding (at semester end)	Learning outcome code	Way of evaluating learning outcome achievement
F1	PEK_U01-04	Discussions, written reports, cooperation in a group
F2	PEK_W01-04	Written exam
P(W)=F1; P(L)=F2;		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Lin, Ming-Bo, "Digital system designs and practices : using Verilog HDL and FPGAs", John Wiley & Sons (Asia), 2008

[2] Woods R., "FPGA - based implementation of signal processing systems", John Wiley and Sons, Ltd., 2008

SECONDARY LITERATURE:

[1] Frey B., "PowerPC Architecture Book, v. 2.02", http://www.ibm.com/developerworks/power/library/pa-archguidev2/

[2] Pong Chu, "FPGA Prototyping by VHDL Examples: Xilinx Spartan-3 Version", John Wiley and Sons, Ltd., 2008

[3] Kilts S., "Advanced FPGA Design", John Wiley and Sons, Ltd., 2007

[4] Webpages: www.xilinx.com, www.altera.com, www.atmel.com

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W12N (W12N) / Department of Field Theory, Electronic Circuits and Optoelectronics (K35W04D02)

SUBJECT CARD

Name of subject in Polish: **Projektowanie układów RF**
Name of subject in English: **RF Circuits Design**
Main field of study (if applicable): **Electronics (EKA)**
Specialization: **Advanced Applied Electronics (AAE)**
Profile: **academic**
Level and form of studies: **2nd level, full-time**
Kind of subject: **obligatory**
Subject code: **ETEA00204**
Group of courses: **No**

	Lecture	Exercise	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30	15	
Number of hours of total student workload (CNPS)	30		60	60	
Form of crediting	Crediting with grade		Crediting with grade	Crediting with grade	
For group of courses mark (X) the final course					
Number of ECTS points	1		2	2	
including number of ECTS points for practical (P) classes			2.0	2.0	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.5		1.4	1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of physics, necessary to understand the physical phenomena in the field of telecommunications.
2. Basic knowledge in selected branches of mathematics necessary to understand the issues described with differential equations and complex numbers

SUBJECT OBJECTIVES
C1. Familiarize students with the use of microwave technology in electronics, telecommunications, industry, medicine, navigation, transportation and research in the field of solid state physics and astronomy.
C2. Acquirement of knowledge including the basic circuit and field parameters describing microwave systems (VSWR, reflection coefficient, return loss, Scattering Matrix) as well as impedance matching and power transmission issues in high frequency circuits.
C3. Acquirement of knowledge including basic passive and active high frequency systems manufactured in: microstrip, stripline, LTCC and MMIC technology.

SUBJECT LEARNING OUTCOMES
Relating to knowledge:
PEU_W01 - FIXME: knowledge of microwave technology applications in electronics, telecommunications, industry, medicine, navigation, transportation
PEU_W02 - FIXME: Knowledge of the basic circuit and field parameters describing high frequecy circuits and systems.
PEU_W03 - FIXME: Knowledge of the construction and parameters of basic passive and active high frequency circuits and systems manufactured in: microstrip, stripline, LTCC and MMIC technology.
PEU_W04 - FIXME: Knowledge of design methods in mictrostrip technology and knowledge of CAE software for high frequency circuit analysis and design
PEU_W05 - FIXME: Knowledge of high frequency measurements equipement, methods and techniques
Relating to skills:
PEU_U01 - FIXME: Skill in using of basic concepts and fundamental field and circuits parameters describing transmission lines and high frequency circuits and systems
PEU_U02 - FIXME: Skill in using CAE software for high frequency circuit analysis and design.
PEU_U03 - FIXME: Ability to design of basic high frequency circuits with the aid of CAE software using appropriately selected electronic components and MMIC chips.
PEU_U04 - FIXME: Ability to prepare and perform basic measurements utilizing methods and equipment used in high frequency technique

PROGRAM CONTENT		
Lecture		**Number of hours**
Lec1	FIXME: Introduction. Organizational matters. Usage of microwave technology in electronics, telecommunications, industry, medicine, navigation, transportation and research in the field of solid state physics and astronomy.	1
Lec2-3	FIXME: Basic circuit and field parameters of transmission lines and RF circuits. Scattering Matrix. Impedance matching and power transmission issues in high frequency circuits.	4
Lec4	FIXME:Waveguide and microstrip planar lines technology - propagation, technology and construction issues.	2
Lec5	FIXME: Basic passive and active high frequency circuits manufactured in: Microstrip, Stripline, LTCC and MMIC technology.	2
Lec6	FIXME: Design methods of high frequency circuits in mictrostrip technology with the aid of CAE software (power dividers/combiners, couplers, filters and amplifiers)	2
Lec7	FIXME: High frequency measurements equipement, methods and techniques	2

Lec8	FIXME: Repetitory	2
	Total hours:	15

Laboratory		**Number of hours**
Lab1	FIXME: Introduction. Presentation of HF elements, components and systems. Presentation of equipment and measurement methods used in HF technique	2
Lab2-8	FIXME: Measurement of passive and active HF components and circuits with a vector network analyzer, scalar network analyzer and spectrum analyzer. Slotted line measurements using HF signal sources, multimeters and HF detectors and amplifiers.	28
	Total hours:	30

Project		**Number of hours**
Pr1	FIXME: Introduction. Presentation and discussion of project themes. Division into design groups. Selection and assignment of design tasks to groups.	1
Pr2-6	FIXME: Preparation of the project involving the concept of a circuit, calculations, computer simulations and a printed circuit board design. Report writing.	12
Pr7-8	FIXME: Presentation and evaluation of completed projects.	2
	Total hours:	15

TEACHING TOOLS USED
N1. FIXME: Multimedia presentation
N2. FIXME: Exercises with simulation tools and CAE software
N3. FIXME: Lab, performing and documenting measurements. Personal presentation of equipment operating
N4. FIXME: Consultations
N5. FIXME: Self-study

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation: F — forming (during semester), C — concluding (at semester end)	Learning outcome code	Way of evaluating learning outcome achievement
F1	PEU_U01-U03	Evaluation of the project report.
F2	PEU_U04	Assessment of knowledge prior to measurements. Evaluation of the measurement report.
F3	PEU_W01-W07	Written test at the end of semester
P(W)=F1; P(L)=F2; P(P)=F3		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE:
[1] Golio M., "RF and Microwave Passive and Active Technologies", CRC Press 2008
[2] Teitze U., Schenk C., "Electronic circuits : handbook for design and application", Springer 2008,
[3] Pozar D. M., „Microwave engineering 3rd Edition", Willey, New York 2012
[4] Materiały do wykładu na stronie przedmiotu
SECONDARY LITERATURE:
[1] J. A. Dobrowolski, Technika wielkich częstotliwości, OWPW, Warszawa, 2003
[2] B. Galwas, Miernictwo mikrofalowe, WKiŁ, Warszawa, 1985
[3] Publikacje dostępne w bazie IEEE Xplore, http://ieeexplore.ieee.org/Xplore /home.jsp
[4] M.Pasternak, Podstawy techniki mikrofal, skrypt elektroniczny, Warszawa 2001

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W12N (W12N) / Department of Cybernetics and Robotics (K29W04D02)

SUBJECT CARD

Name of subject in Polish: **Systemy operacyjne czasu rzeczywistego**
Name of subject in English: **Real-time operating systems**
Main field of study (if applicable): **Electronics (EKA)**
Specialization: **Advanced Applied Electronics (AAE)**
Profile: **academic**
Level and form of studies: **2nd level, full-time**
Kind of subject: **facultative**
Subject code: **ETEA00113**
Group of courses: **No**

	Lecture	Exercise	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
For group of courses mark (X) the final course					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2.0		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.0		1.0		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Programming in C/C++
2. Programming in linux

SUBJECT OBJECTIVES

C1. Acquiring knowledge about the basic structure and functions of real-time operating systems.

C2. Acquiring practical skills to use real-time mechanisms available in RTOS and to create and run applications in selected real-time operating systems.

SUBJECT LEARNING OUTCOMES
Relating to knowledge: PEU_W01 - Knows basic structure and functions of real-time operating system. Relating to skills: PEU_U01 - Is able to create efficient real-time applications for real-time operating systems.

PROGRAM CONTENT		
Lecture		**Number of hours**
Lec1	Introduction to real-time operating systems.	2
Lec2	Application of RTOS	4
Lec3	Chosen aspects of operating systems, POSIX standard.	4
Lec4	Architectures of real-time operating systems.	2
Lec5	RTOS system services	4
Lec6	Scheduler, scheduling algorithms, events handling	4
Lec7	FreeRTOS - system features, usage, tasks scheduling	6
Lec8	QNX - system features, usage, tasks scheduling	4
	Total hours:	30

Laboratory		**Number of hours**
Lab1	Programming in Unix based OS, task scheduling	4
Lab2	Multighreading and Inter-Process communication aspects in unix based systems.	6
Lab3	FreeRTOS based applications building.	10
Lab4	Building application in QNX, Xenomai or smilar OS	10
	Total hours:	30

TEACHING TOOLS USED
N1. Lecture in traditional and/or online form using a multimedia tools. N2. Laboratories N3. Own work - independent literary studies

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation: F — forming (during semester), C — concluding (at semester end)	Learning outcome code	Way of evaluating learning outcome achievement
F1	PEU_W01	Crediting with grade
F2	PEU_U01	Laboratory grade
P(W)=F1; P(L)=F2;		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE:
[1] https://www.freertos.org Reference manual
[2] Using the FreeRTOS Real Time Kernel - a Practical Guide - Standard Base Edition
[3] B.P.Douglas: Real-Time Design Patterns: Robust Scalable Architecture for Real-Time Systems, Addison-Wesley, 2002
[4] https://blackberry.qnx.com/en "QNX Neutrino System Architecture",
SECONDARY LITERATURE:
[1] "QNX Neutrino Programmer's Guide",

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)
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W12N (W12N) / Department of Field Theory, Electronic Circuits and Optoelectronics (K35W04D02)

SUBJECT CARD

Name of subject in Polish: **Seminarium dyplomowe**
Name of subject in English: **Diploma Seminar**
Main field of study (if applicable): **Electronics (EKA)**
Specialization: **Advanced Applied Electronics (AAE)**
Profile: **academic**
Level and form of studies: **2nd level, full-time**
Kind of subject: **obligatory**
Subject code: **ETEA17109**
Group of courses: **No**

	Lecture	Exercise	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					30
Number of hours of total student workload (CNPS)					90
Form of crediting					Crediting with grade
For group of courses mark (X) the final course					
Number of ECTS points					3
including number of ECTS points for practical (P) classes					3.0
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)					2.0

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES
C1. Acquire the ability to seek selective knowledge necessary to complete a thesis.
C2. Gain the ability to prepare a presentation to communicate your original ideas, concepts and solutions to an audience in a communicative manner.
C3. Acquire creative discussion skills in which one can justify and defend one's position in a factual and substantive manner.
C4. Acquire the ability to write a work that presents one's own achievements, including presenting one's own achievements against the background of developments in world thought.
C5. Inculcate a creative attitude to determine priorities for the implementation of a specific task, motivate teamwork, and understand the need to communicate information and opinions to the public regarding the achievements of technology and other aspects of the activities of a technical college graduate.

SUBJECT LEARNING OUTCOMES
Relating to skills: PEU_U01 - Can prepare a presentation including his/her own solutions PEU_U02 - Can substantiate his/her original ideas and solutions in a discussion PEU_U03 - Can critically and objectively conduct discussions (also as a moderator) on his own and others' scientific and technical solutions.

PROGRAM CONTENT

Seminar		Number of hours
Sem1	Choosing the topic and scope of the presentation with the seminar leader	2
Sem2-15	Presentations and discussions (each student prepares 3 presentations)	28
	Total hours:	30

TEACHING TOOLS USED
N1. Multimedia presentation prepared individually or in a small group
N2. Problem-based group discussion
N3. Own work
N4. Consultations

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation: F — forming (during semester), C — concluding (at semester end)	Learning outcome code	Way of evaluating learning outcome achievement
F1	PEU_U01	Evaluation of presentation,
F2	PKE_U02	The ability to justify your own solutions
F3	PKE_U03	Ability to conduct discussions in various roles
P=(F1+F2+F3)/3		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE:
[1] Dobierana indywidualnie do prezentowanego tematu / Individually tailored to the topic presented

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W12N (W12N) / Department of Field Theory, Electronic Circuits and Optoelectronics (K35W04D02)

SUBJECT CARD

Name of subject in Polish: **Seminarium specjalnościowe**
Name of subject in English: **Specialization seminar**
Main field of study (if applicable): **Electronics (EKA)**
Specialization: **Advanced Applied Electronics (AAE)**
Profile: **academic**
Level and form of studies: **2nd level, full-time**
Kind of subject: **obligatory**
Subject code: **ETEA00205**
Group of courses: **No**

	Lecture	Exercise	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					30
Number of hours of total student workload (CNPS)					60
Form of crediting					Crediting with grade
For group of courses mark (X) the final course					
Number of ECTS points					2
including number of ECTS points for practical (P) classes					2.0
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)					1.0

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

C1. Acquisition of up-to-date knowledge in the field of the studied Specialization

C2. Gain the ability to prepare a presentation to communicate your original ideas, concepts and solutions to an audience

C3. Acquire creative discussion skills in which one can justify and defend one's position in a factual and substantive manner

C4. Acquire the ability to write a work presenting one's own achievements, including the presentation of one's own achievements against the background of developments in world thought

SUBJECT LEARNING OUTCOMES

Relating to skills:

PEU_U01 - Can prepare a presentation using appropriate sources (in different languages) of information, making their analysis, synthesis and creative interpretation. Can use appropriate methods, techniques and tools of ICT techniques.

PEU_U02 - Be able to substantiate original ideas and solutions in a discussion

PEU_U03 - Be able to critically evaluate the scientific and technical solutions of own and others

PEU_U04 - Be able to lead a discussion

PROGRAM CONTENT

Seminar		Number of hours
Sem1	Choosing a topic for the presentation and discussing its scope with the teacher.	2
Sem2-15	Presentations and discussions	28
	Total hours:	30

TEACHING TOOLS USED

N1. Multimedia presentation prepared individually or in a small group

N2. Problem-based group discussion

N3. Own work

N4. Consultations

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation: F — forming (during semester), C — concluding (at semester end)	Learning outcome code	Way of evaluating learning outcome achievement
F1	PEU_U01	Assessment of the prepared presentation.
F2	PKE_U02	Assessment of the presentation in terms of content.
F3	PKE_U03	Assessment of statements about the content of other presentations.
F4	PKE_U03	Assessment of the manner of conducting the discussion.
P=(F1+F2+F3+F4)/4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Dobierana indywidualnie do prezentowanego tematu / Individually tailored to the topic presented

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SUBJECT CARD

Name of subject in Polish: **Zaawansowane programowanie obiektowe**
Name of subject in English: **Advanced Obective Programming**
Main field of study (if applicable): **Electronics (EKA)**
Specialization: **Advanced Applied Electronics (AAE)**
Profile: **academic**
Level and form of studies: **2nd level, full-time**
Kind of subject: **facultative**
Subject code: **ETEA00124**
Group of courses: **No**

	Lecture	Exercise	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
For group of courses mark (X) the final course					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2.0		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.0		1.0		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

C1. The student would be introduce in the basis of object oriented programming, its engineering and methodology

C2. The student would know how to prepare program source code using object oriented approach

SUBJECT LEARNING OUTCOMES
Relating to knowledge: PEU_W01 - Student knows the idea of the object oriented approach. PEU_W02 - Can explain the fundamentals of object oriented methodology as the tool of the comprehending the real world. PEU_W03 - Can know an idea of object oriented methodology based on Unified Modeling Language (UML). PEU_W04 - Student knows basic tools and paradigms of the object oriented approach. Relating to skills: PEU_U01 - Can independently formulate and use the technology of the object oriented programming. PEU_U02 - Can create and execute the parts of the source code containing definitions of constructors both in the basis and in the derived classes. PEU_U03 - Can create and execute the parts of the independently drawn up source code containing virtual functions and overloaded operators.

PROGRAM CONTENT		
Lecture		**Number of hours**
Lec1-2	Introduction to object oriented programming.	4
Lec3-4	Unified Modeling Language	4
Lec5-7	Object-oriented programming language C++. Main paradigms. Constructors and destructors.	6
Lec8	Mid-semester summary	2
Lec9-11	Java object oriented programming language. Main ideas. Packages and implementations.	6
Lec12-14	The *C#* object-oriented programming language. Main ideas. Interfaces and garbage collection.	6
Lec15	Summary	2
	Total hours:	30

Laboratory		**Number of hours**
Lab1-2	Getting to know the programming platform. A simple program in structured methodology.	4
Lab3-6	Application of the object-oriented approach to an individual simple C++ program agreed with the teacher.	8
Lab7-9	An individual program in C++ agreed with the teacher.	6
Lab10-12	Application of an object-oriented approach to an individual simple program in *C#* or Java agreed with the teacher.	5
Lab13-15	An individual program in *C#* or Java agreed with the teacher	6
	Total hours:	29

TEACHING TOOLS USED
N1. LCD Projector, blackboard
N2. Computer with development software.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation: F — forming (during semester), C — concluding (at semester end)	Learning outcome code	Way of evaluating learning outcome achievement
F1	PEK_W01-W05	Written or oral test
F2	PKE_U01-U03	Program code presented and credited with grade
P(W)=F1; P(L)=F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Stroustrup B., The C++ programming language, NJ, Addison-Wesley, 2013.

[2] Sahay S., Object oriented programming with C++, 2nd edition, New Delhi : Oxford University Press, 2012.

[3] Eckel, B., Thinking in Java, Upper Saddle River: Prentice Hall, 2006

[4] Hejlsberg A., Torgersen M., Wiltamuth S., Golde P., The *C#* Programming Language (3rd Edition), Microsoft .NET Development Series

[5] Malik. D. S., Introduction to C++ programming, Boston, MA: Course Technology, Cengage Learning, 2009.

[6] Actual documentation for C++, *C#*, Java

SECONDARY LITERATURE:

[1] Kubik T., Kruczkiewicz Z., UML and service description languages: information systems modelling, Wrocław University of Technology, PRINTPAP, 2011.

[2] Martin J., Odell J.J., Podstawy metod obiektowych, WNT, 1997

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