PROGRAMME OF EDUCATION

FACULTY: ***Microsystem Electronics and Photonics***

MAIN FIELD OF STUDY: ***Electronics and Telecommunications***

in area of technical science

EDUCATION LEVEL: ***1-st level engineering study***

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

PROFILE: ***general academic***

SPECIALIZATION: ***Digital Electronics***

LANGUAGE OF STUDY: ***Polish***

Content:

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

Microsystem Electronics and Photonics Faculty Council resolution no. ***118/11/2016-2020 of 17.05.2017***

In effect since ***01.10.2017***

Attachment no. 1 to Programme of Education

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

Faculty: Microsystem Electronics and Photonics
Field of study: Electronics and Telecommunications
Level of studies: first level, full time study

Legend:

K (before line/dash) – field-of-study educational effects
W – category of knowledge
U – category skills
K (after line/dash) – category of social competences
T1A – educational effects in the area of technical sciences for the first level study
01, 02, 03 and further – number of educational effects

Field of study educational effects for the 1st level studies in *Electronics and Telecommunications*	**DESCRIPTION OF FIELD OF STUDY EDUCATIONAL EFFECTS** **Upon completion of the first level study in the field of *Electronics and Telecommunications* the graduate:**	**Correlation with educational effects for 1st level study in area of technical sciences (T) and engineering competences (I)**
	KNOWLEDGE	
K1eit_W01	has elemental knowledge concerning materials used in electronic industry	T1A_W02 T1A_W04 T1A_W06 T1A_W07 InzA_W01 InzA_W02
K1eit_W02	knows and understands the processes of design and fabrication of electronic devices	T1A_W07 InzA_W02 InzA_W05
K1eit_W03	has knowledge in the field of mathematics comprising calculus of probability, algebra, analysis and the elements of discrete and applied mathematics, including mathematical and numerical methods necessary to describe and analyze the operation of electronic circuits, electronic devices, analog and digital electronic circuits as well fundamental physical phenomena occurring in these circuits and devices, description and analysis of operation of electronic systems, including the systems containing programmable units, description and analysis of the algorithms of signal processing systems, including sound and image, synthesis of electronic elements, circuits and systems	T1A_W01
K1eit_W04	has knowledge in the field of physics comprising mechanics, thermodynamics, optics, electricity and magnetism, nuclear physics and solid state physics, including the knowledge necessary to understand the fundamental physical phenomena occurring in electronic systems and devices as well as their surroundings	T1A_W01 T1A_W02 T1A_W04
K1eit_W05	has knowledge concerning theoretical and experimental bases from the field of solid state electronics and photonics	T1A_W01

K1eit_W06	has knowledge on the phenomena of electric and magnetic polarization and electrical conductivity for solving technical problems	T1A_W01
K1eit_W07	understands optical phenomena and processes occurring in semiconductors; understands physical basis of operation of typical optoelectronic devices and circuits used in telecommunication, medicine; has knowledge on advanced technologies of fabrication and mechanical treatment, measurement techniques and sensors	T1A_W04 InzA_W05
K1eit_W08	knows and understands the processes of fabrication of electronic devices, integrated circuits and microsystems	T1A_W04 T1A_W07 InzA_W02 InzA_W05
K1eit_W09	has ordered and theoretically grounded knowledge from the field of photonics, including the knowledge necessary to understand physical basis of operation of optical communication systems	T1A_W01 T1A_W03 T1A_W04
K1eit_W10	knows physical and chemical processes for microsystem manufacturing	T1A_W04 T1A_W07 InzA_W02 InzA_W05
K1eit_W11	knows the issues concerning exploitation and reliability of electronic devices	T1A_W03 T1A_W06 T1A_W08 InzA_W01 InzA_W03
K1eit_W12	has general knowledge on microwave technologies and basic methods of designing and analysis of microwave circuits	T1A_W01 T1A_W04
K1eit_W13	has knowledge on specific tools and informatics technologies useful during the course of technical studies, including operating systems, office facilities, mathematical packages, databases and basics of programming	T1A_W02 InzA_W05
K1eit_W14	has knowledge on the methods of analyzing and processing signals in time and frequency domains	T1A_W01 T1A_W04

K1eit_W15	has knowledge on available integrated circuits, their parameters and application	T1A_W03 T1A_W04 T1A_W07 InzA_W02
K1eit_W16	has knowledge on logic circuits	T1A_W02 T1A_W03 T1A_W04 T1A_W07 InzA_W02
K1eit_W17	has knowledge on the architecture of microprocessor systems and their programming	T1A_W03 T1A_W04 T1A_W07 InzA_W02
K1eit_W18	is familiar with analog and digital technologies of data transmission	T1A_W02 T1A_W03 T1A_W05 T1A_W07 T1A_W08 InzA_W02 InzA_W03
K1eit_W19	understands the physical basis of functioning semiconductor devices and the meaning of their parameters	T1A_W02
K1eit_W20	knows basic concepts of metrology and the methods of measurement of electrical quantities	T1A_W03 T1A_W07 InzA_W02
K1eit_W21	is familiar with basic techniques of packaging in electronics	T1A_W04 T1A_W06 T1A_W07 InzA_W01 InzA_W02 InzA_W05

K1eit_W22	is familiar with the principles of computer networks functioning	T1A_W02 T1A_W05 T1A_W08 InzA_W03
K1eit_W23	knows the fundamentals of the theory of circuits with passive elements	T1A_W01 T1A_W02
K1eit_W24	knows the principles of computer programming in C/C++ language	T1A_W02 T1A_W07 InzA_W02
K1eit_W25	has basic knowledge concerning management, quality management and running business	T1A_W09 InzA_W04
K1eit_W26	knows and understands basic rules and concepts concerning industrial property protection and copyright laws; can use the resources of patent information	T1A_W10
K1eit_W27	knows general rules on establishing and developing the forms of individual entrepreneurship, using the knowledge from the field of science and scientific disciplines relevant to the field of study	T1A_W11
K1eit_W28	knows the principles and methods of object-oriented programming	T1A_W02 T1A_W07 InzA_W02
K1eit_W29	knows and understands industrial safety rules	T1A_W08 InzA_W03
K1eit_W30	achieves results in the category of KNOWLEDGE in one of the following specializations: • Electronic and Photonic Engineering – IEF • Digital Electronics – EC	
K1eit_W31	knows rules concerning the principles of construction documentation (sections, views, cross-sections), dimensioning and normalization in technical documentation	T1A_W03
SKILLS		
K1eit_U01	is able to choose materials, components and design of devices according to technical requirements and exploitation conditions	T1A_U16 InzA_U08
K1eit_U02	is able, by himself/herself to solve the tasks from the field of algebra, mathematical analysis, calculus of probability and mathematical statistics	T1A_U09 InzA_U02

K1eit_U03	is able to estimate parameters of wave motion	T1A_U14 InzA_U06
K1eit_U04	is able to measure basic properties of dielectrics, magnetics and semiconductors, understands the mechanisms of physical phenomena occurring in the materials	T1A_U07 T1A_U02
K1eit_U05	is able, by himself/herself, to solve the problems concerning relations between reliability parameters, methods of device testing, characteristics of repairable systems, reliability prediction	T1A_U15 InzA_U07
K1eit_U06	is able, by himself/herself, to realize a project of a simple microwave filter, resonator, coupler, detector, mixer, motion sensor etc. using available CAD software and literature	T1A_U01 T1A_U06
K1eit_U07	is able, by himself/herself to develop an own project (from computer aided modeling, analysis of feasibility to economic analysis of undertaken activity) of a chosen device	T1A_U16 InzA_U08
K1eit_U08	is able to develop a computer program in C/C++ language	T1A_U07
K1eit_U09	knows and applies industrial safety rules	T1A_U11
K1eit_U10	is able to configure and diagnose connections between computers	T1A_U01 T1A_U10 InzA_U03
K1eit_U11	is able to design, implement and test simple logic circuits	T1A_U08 InzA_U01
K1eit_U12	is able to model electronic circuits with passive elements	T1A_U09 InzA_U02
K1eit_U13	is able to handle measuring equipment and design measurement systems	T1A_U01 T1A_U08 T1A_U11 InzA_U01
K1eit_U14	is able to deal with semiconductor devices in static and dynamic systems	T1A_U08 T1A_U11 InzA_U01
K1eit_U15	is able to deal with the techniques and equipment for surface and wire bonding	T1A_U10 T1A_U12 InzA_U03 InzA_U04

K1eit_U16	is able to design, build, implement and test electronic circuits	T1A_U05 T1A_U15 T1A_U16 InzA_U07 InzA_U08
K1eit_U17	is able to perform signal analysis using Fourier methods, can design filters, can handle the hardware and DSP software	T1A_U14 T1A_U15 InzA_U06 InzA_U07
K1eit_U18	is able to program microprocessor, microcontroller and assess its functional capability	T1A_U01 T1A_U05 T1A_U16 InzA_U08
K1eit_U19	is able to prepare and give in Polish and foreign language, an oral presentation concerning detailed tasks relevant to the studied discipline	T1A_U04
K1eit_U20	is able to write computer software	T1A_U07
K1eit_U21	achieves results in the category of SKILLS in one of the following specializations: • Electronic and Photonic Engineering – IEF • Digital Electronics – EC	
K1eit_U22	is able to draw simple 3-dimensional geometric elements with the traditional drawing technique and is able to create and read technical documentation	T1A_U02 T1A_U03
COMPETENCES		
K1eit_K01	perceives the necessity of using statistical methods for description of collected data	T1A_K01
K1eit_K02	understands the necessity to use new techniques and technologies in engineering activity, can define objectives and predict results of undertaken experimental works	T1A_K02 T1A_K05 InzA_K01
K1eit_K03	is able to work individually and in a team	T1A_K03
K1eit_K04	is able to correctly define the priorities for realization of a particular task	T1A_K04
K1eit_K05	is conscious of the importance and understands beyond technical aspects and consequences of engineering activity, including the environmental aspects and responsibility for undertaken decisions	T1A_K02 InzA_K01

K1eit_K06	is able to think and act in a creative and entrepreneurial way	T1A_K06 InzA_K02
K1eit_K07	is conscious of the social role of technical university graduates, understands the need of sharing in society, in an understandable way, the information and opinions concerning the achievements in technique	T1A_K07
K1eit_K08	knows basic rules from the field of ethics, has a basic knowledge, necessary to understand the aspects of engineering activity, correctly identifies and recognizes ethical dilemmas	T1A_K05
K1eit_K09	thinks that the conscious and systematic physical activity during studies and after graduation, helps in improvement of life quality	T1A_K01 T1A_K03
K1eit_K10	can working in a team, according to the specified rules and fair play rules, during participation in different forms of physical activity	T1A_K03

Where:
K1yyy – symbol for the field of study at the first level
K2yyy – symbol for the field of study at the second level
_W01, _W02, … – symbols for educational effects concerning KNOWLEDGE
_U01, _U02, … – symbols for educational effects concerning SKILLS
_K01, _K02, … – symbols for educational effects concerning COMPETENCES
T – educational area in the field of technical sciences
1 – first level study,
2 – second level study
A – general academic profile, P – practical profile

EDUCATIONAL EFFECTS FOR EC SPECIALIZATION

Faculty: Microsystem Electronics and Photonics
Field of study: Electronics and Telecommunications
Level of studies: first level, full time study
Specialization: Digital Electronics (EC)

Specialization educational effects at the 1st level study in *Digital Electronics*	**DESCRIPTION OF EDUCATIONAL EFFECTS** **Upon completion of the first level study in the field of *Electronics and Telecommunications* within the *Digital Electronics* specialization the graduate:**	**Correlation with educational effects for 1st level study in area of technical sciences (T) and engineering competences (I)**
KNOWLEDGE		
S1ec_W01	has knowledge concerning the methods of data processing and neural networks fuzzy logic and genetic algorithms	T1A_W04
S1ec_W02	knows the principles and methods of object-oriented programming	T1A_W03
S1ec_W03	has knowledge concerning the architecture of microprocessor systems and their programming	T1A_W02 T1A_W03
S1ec_W04	has knowledge concerning design principles of specialized VLSI digital circuits and applications of FPGA systems	T1A_W04 T1A_W05 T1A_W07 InzA_W02
S1ec_W05	has knowledge concerning design of analog and digital specialized circuits (ASIC)	T1A_W04 T1A_W09 InzA_W04 InzA_W05

S1ec_W06	has knowledge concerning programming of signal processors	T1A_W04 T1A_W05 T1A_W07 InzA_W02
S1ec_W07	has knowledge concerning advanced methods of verification of digital circuits and systems	T1A_W04 T1A_W07 InzA_W02
S1ec_W08	has knowledge on wired and wireless protocols in communication interfaces	T1A_W03 T1A_W08 InzA_W03
S1ec_W09	knows the mechanisms of embedded operating systems and the principles of writing applications for the systems	T1A_W03 T1A_W08 InzA_W03
S1ec_W10	knows methods and computer tools for design, modeling and simulation	T1A_W07 T1A_W09 InzA_W02 InzA_W04
SKILLS		
S1ec_U01	is able to choose and design fuzzy genetic neural systems	T1A_U03 T1A_U06 T1A_U10 InzA_U03
S1ec_U02	is able to develop an advanced computer program	T1A_U01 T1A_U14 InzA_U06
S1ec_U03	is able to implement an algorithm for signal processing on a signal processor	T1A_U15 InzA_U07
S1ec_U04	is able to design a specialized digital circuit	T1A_U08 T1A_U16 InzA_U01 InzA_U08

S1ec_U05	is able to program and implement a programmable logic system of *FPGA* type	T1A_U09 T1A_U11 InzA_U02
S1ec_U06	is able to organize cooperation and communication between a microprocessor and a specialized digital circuit	T1A_U04 T1A_U07 T1A_U12 InzA_U04
S1ec_U07	is able to create an environment for verification of a digital circuit or system, modeling its surroundings	T1A_U04 T1A_U07
S1ec_U08	is able to prepare and implement an application in embedded operating system of a phone or a similar device	T1A_U05 T1A_U13 InzA_U05
S1ec_U09	is able to choose and implement an interface for digital communication	T1A_U02 T1A_U07 T1A_U12 InzA_U04
S1ec_U10	is able to perform identification and formulate specification of complex engineering tasks (characteristic of the field of study), including the unusual ones, considering also their beyond technical aspects	T1A_U14
S1ec_U11	is able to write a software for microprocessor, microcontroller and asses its functional capabilities	T1A_U16
S1ec_U12	is able, by himself/herself to solve the problems from the fields of reliability, methods of investigation, characteristics of repairable systems	T1A_U15

Where:
S1yyy – symbol for specialization at the first level study
S2yyy – symbol for specialization at the second level study
_W01, _W02, … – symbols for educational effects concerning KNOWLEDGE
_U01, _U02, … – symbols for educational effects concerning SKILLS
_K01, _K02, … – symbols for educational effects concerning COMPETENCES
T – educational area in the field of technical sciences
1 – first level study,
2 – second level study
A – general academic profile, P – practical profile

Attachment no. 2 to Programme of Education

PROGRAMME OF STUDIES

1. Description

Number of semesters: ***7***	*Number of ECTS points necessary to obtain qualifications:* ***210***
Prerequisites: ***The decision of enrollment is based on the RECRUITMENT INDICATOR. Its value is determined by the selected results of the matura exam. RECRUITMENT INDICATOR is the sum of the points from the qualification courses (mathematics, physics, Polish, a modern foreign language), calculated in accordance with the principles of the candidates admissions adopted by the Senate.*** ***The threshold value of the recruitment rate is determined depending on the number of candidates.***	*Upon completion of studies graduate obtains* *professional degree of:* ***engineer*** *1-st level qualifications*
Possibility of continuing of the studies: ***The graduate is prepared to undertake study at the second level***	*Graduate profile, employability:* ***The graduate has knowledge and skills to implement and operate electronic circuits, devices and systems and the systems of telecommunication networks and services. Is prepared to work in the enterprises producing electronic and telecommunication equipment as well as in the network operating companies and telecommunication services providers. Knows a foreign language at B2 level of the Common European Framework for Languages and has the ability to use a specialist language in the field of electronics and telecommunications***
Indication of the connection with University's mission and its development strategy: *Wrocław University of Science and Technology is a pubic academy with a status of technical university, acting on the basis of the Act of July 27, 2005 "Law on Higher Education" and University Statute. In the plan of development of Wrocław University of Science and Technology there is a statement "The expression of mission underlines the role of university in maintaining and developing the competences associated with the culture of experimentation. The competences are the foundations of contemporary civilization, they determine its existence and are the main factor of its development. At the time when experimentations tend to be replaced by procedures and when pretences are considered as more important than facts, the mission is of fundamental importance.*	

Stress on creativity which changes the trajectories of future

Stress on professionalism and real skills which are the condition of technosphere functioning

Stress on partnership and cooperation with local and external partners, which enhances the effects of activities and facilitates their achievement."

This expression has been directly transferred to the Plan of Development of the Faculty of Electronic Microsystems and Photonics, but there, the word "University" has been replaced by "Faculty". It means that if an academic unit is to play the role of an intellectual center, it must understand the contemporary world and have a vision of the future. As an important technical university, Wrocław University of Science and Technology "links high theoretical, research and expert competences with the educational and didactic activities". For this reason, the main feature of the Faculty of Microsystem Electronics and Photonics of Wrocław University of Science and Technology" is its high external usefulness" The already mentioned plan of Faculty development says that "at the Faculty, the dominant role play design and technological research works associated with micro- and nanoelectronics, micro- and nanosystems and micro- and nanophotonics. This research subject is transferred into the educational profile, especially at the 2-nd and 3-rd levels. The educational profile is supplemented with the university-wide subjects, encompassing liberal-managerial subjects which create the basis of engineer's cultural education, and are available for the whole students' community". So outlined mission and vision of University/Faculty has been incorporated into the educational model, proposed by the Faculty, i.e. "interactive, discursive and experimental shaping of students' skills". Currently, the Faculty of Microsystem Electronics and Photonics educates B. Sc. engineers and M.Sc. engineers, the specialists in the field of electronics, photonics, informatics and telecommunications. The Faculty graduate is able to design and apply electronic integrated circuits - both analog and digital. Knows how to design and apply lasers, optical fibers and photovoltaic cells in solar power plants. Is able to design and operate telecommunication and teleinformatic networks. Is able to design, manufacture and apply micro- and nanosystems, i.e. microrobots used in medicine, automotive and aircraft industry, pharmacy, environment protection, building security systems and armaments industry. In the perspective of 2020, the Faculty is planning to lead or co-lead with other units of Wrocław University of Science and Technology, the following fields of study: "Electronics – 1-st and 2-nd levels (the 2-nd level oriented to Micro- and Nanoengineering), Optoelectronics (and possibly Photonics) - 1-st and 2-nd level, Materials Engineering – 1-st level." This is associated with interdisciplinary character of conducted in the Faculty research and development works. We are going to lead, "within our competences, post-graduate study and the studies of II and III age." In the currently prepared and developed concept there is included the education of specialists and innovators, which takes into account individual student's abilities. We would like to stimulate the skills enhancing competitiveness on the labor market and teach cooperation as well as provide international contacts. The way to realize this goal is, among the others, to follow the development of faculties which lead similar subjects in the world and adapt the reasonable solutions to our specificity. Student, who fulfill particular conditions may get an individual tutor and study according to interdisciplinary paths, shaped in accordance with their individual interests (the idea is possible to realize in the Faculty due to the favorable ratio of the number of students and the number of academic teachers). We are doing our best to balance our educational programme so as it contained, in suitable proportion, the knowledge enabling further professional adaptation and the knowledge building a rational image of the world.

2. **Fields of science and scientific disciplines to which educational effects apply:**
   Area: technical sciences
   Discipline: electronics
3. **Concise analysis of consistency between assumed educational effects and labor market needs**

The resources of knowledge, skills and social competences of the students/graduates of the Faculty in the field "Electronics and Telecommunication" result from assigning the educational effects at a particular field of study to the provided courses. The educational effects associated with specialization, related to the educational effects in the area of technical sciences, should provide the students/graduates (at the particular educational level) with elemental knowledge (1-st level) and theoretically grounded detailed knowledge (2-nd level) in the range of engineering areas connected with the Electronics and Telecommunication field of study or other disciplines. The applied solutions concerning "enhanced" competences upon achieving a higher qualification level and, at the same time, securing "accessibility" of the 1-st and 2-nd level studies, make possible to acquire at the higher level, more advanced knowledge and skills (at specified social competences) but in a narrower subject range. The potential prospective employers should be aware of the students/graduates of the 1-st and 2-nd level studies level of knowledge, skills and social competences.

The basic and detailed knowledge, acquired by a student/graduate in a particular area should be wide enough to enable him/her self-study within the lifetime learning process to adapt his/her competences to the changing conditions and challenges which may emerge during a long-lasting professional career. Such expectations have the employers who implement modern work organization and innovative technologies in their enterprises. The assigned to courses effects, achieved during the educational process, enable, according to the expectations of prospective employers, acquiring by the graduate the knowledge about trends in development and novel, currently implemented achievements not only in the field of electronics and telecommunications, optoelectronics, photonics and informatics but also in medicine or environment protection.

The assumed effect concerning knowledge in the educational process is acquiring by the graduate the basic knowledge about technology transfer as well as the knowledge associated with management (including quality management) and running business. As educational effect should also be concerned the general knowledge used in engineering practice, necessary to understand, social, economic, legal and other beyond technical aspects of engineering activities. The effects are attained by realization of university-wide courses, Such knowledge will enable the graduates to understand the realities concerning organization of production processes and conditions in which they are conducted. It would enable them to take into account these conditions in individual and team job, which they would be able to take up as a result of achieving these goals. Such resources of knowledge are expected to be acquired by an university graduate in the contemporary labour market. The educational effects, included in the subject cards of the courses realized in the field of study, assure additionally achieving by the graduate the ability to integrate the knowledge from various areas and disciplines with the application of system approach in formulating and solving engineering tasks. The labor market expects that the effects achieved by the graduates as a result of the educational process, will prepare them to the work in an industrial environment, with the knowledge of industrial safety rules connected with the work, especially with the work at a particular stand/apparatus. In this respect, the effects achieved during realization of laboratory courses and the courses such as Students' practice, are especially important. Student/graduate should perceive the need of improvement and modification of production process or the solutions existing on the working place. Upon achieving the assumed educational effects, they should be able, taking into account beyond technical aspects, according to the given specification, to design and complete (using suitable methods, techniques and tools) a complex device, system or process.

Having in mind that the objective of the assumed and achieved educational effects in the specialization field of study is to fulfill, at possibly high level, the expectations of entrepreneurs who employ our graduates, an important aspect of evaluation of educational process are hospitations conducted during each semester and faculty polls addressed to graduates. Verification of conformity of the assumed educational effects and the market expectations and needs takes place during numerous meetings of our graduates with the Faculty staff.

4. List of education modules

4.1. List of obligatory modules

4.1.1. List of general education modules

4.1.1.1. *Liberal-managerial subjects* module

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	FLH121611W	Ethics in business	2						30	60	2	1.2	T	Z	O		KO	Ob
2.	PKH120411W	Social communication	1						15	30	2	1.2	T	Z	O		KO	Ob
		Total	3	0	0	0	0		45	90	4	2.4						

4.1.1.2. *Foreign languages* module

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

4.1.1.3. *Sporting classes* module

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

4.1.1.4. *Information Technologies* module

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD001068W	Information technologies	1					K1eit_W13 InzA_W02 K1eit_W24 K1eit_W17	15	30	1	0.6	T	Z			KO	Ob
2.	ETD001068L	Information technologies			1			K1eit_U21 K1eit_K02 InzA_U02 K1eit_U20 K1eit_U08 K1eit_K03 InzA_K02	15	30	1	0.7	T	Z		P	KO	Ob
		Total	1	0	1	0	0		30	60	2	1.3						

Altogether for general education modules:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				
4	0	1	0	0	75	150	6	3.7

4.1.2. List of basic sciences modules

4.1.2.1. *Mathematics* module

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	MAT001402W	Algebra and analytic geometry	2					K1eit_W03	30	60	2	1.2	T	E	O		PD	Ob
2.	MAT001402C	Algebra and analytic geometry		1				K1eit_U02	15	60	2	1.4	T	Z	O	P	PD	Ob
3.	MAT001412W	Mathematical analysis 1.1 A	2					K1eit_W03	30	150	5	3.0	T	E	O		PD	Ob
4.	MAT001412C	Mathematical analysis 1.1 A		2				K1eit_U02 K1eit_K01	30	90	3	2.1	T	Z	O	P	PD	Ob
5.	MAT001424W	Mathematical analysis 2.2 A	3					K1eit_W03	45	150	5	3.0	T	E	O		PD	Ob
6.	MAT001424C	Mathematical analysis 2.2 A		2				K1eit_U02 K1eit_K01	30	90	3	2.1	T	Z	O	P	PD	Ob
7.	ETD002073W	Probabilistics	1					K1eit_W03 InzA_W02 K1eit_K01 InzA_K01	15	30	1	0.6	T	Z			PD	Ob
8.	ETD002073C	Probabilistics		1				K1eit_U02 InzA_U02 K1eit_K01 InzA_K01	15	60	2	1.4	T	Z		P	PD	Ob
		Total	8	6	0	0	0		210	690	23	14.8						

4.1.2.2. *Physics* module

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	FZP001057W	Physics 1.1	2					K1eit_W04 InzA_W02 InzA_K01	30	120	4	2.4	T	E	O		PD	Ob
2.	FZP001057C	Physics 1.1		1				K1eit_U03 K1eit_U04	15	30	1	0.7	T	Z	O	P	PD	Ob
3.	FZP002079L	Physics 3.1			1			K1eit_W20 K1eit_W29 K1eit_U04 K1eit_U13 K1eit_U19 K1eit_K03	15	60	2	1.4	T	Z	O	P	PD	Ob
4.	ETD002069W	Electricity and magnetism	2					K1eit_W04 K1eit_W06 InzA_W02 K1eit_K03 K1eit_K07	30	60	2	1.2	T	E			PD	Ob
5.	ETD002069C	Electricity and magnetism		2				K1eit_K03 K1eit_K07 K1eit_U04 K1eit_U19	30	60	2	1.4	T	Z		P	PD	Ob
6.	ETD003083W	Principles of solid state electronics	2					K1eit _W05 K1eit _W04 InzA_W02	30	60	2	1.2	T	Z			PD	Ob
7.	ETD003089W	Wave optics	1					K1eit_W04 K1eit_W07 K1eit_W09 InzA_W02	15	30	1	0.6	T	Z			PD	Ob
		Total	7	3	1	0	0		165	420	14	8.9						

4.1.2.3. *Chemistry* module

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD001070W	Materials engineering	2					K1eit_W01 InzA_W02	30	60	2	1,2	T	Z			PD	Ob
		Total	2	0	0	0	0		30	60	2	1,2						

4.1.2.4. *Informatics* module

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD001269W	The basics of computer networks	1					K1eit_W22 InzA_W02 InzA_W05	15	30	1	0.6	T	Z			PD	Ob
2.	ETD001269L	The basics of computer networks			1			K1eit_U10 K1eit_U19 InzA_U08	15	30	1	0.7	T	Z		P	PD	Ob
3.	ETD002071W	Informatics	2					K1eit_W24 InzA_W02	30	60	2	1.2	T	Z			PD	Ob
4.	ETD002071L	Informatics			2			K1eit_U08 K1eit_U20 InzA_U07 K1eit_K03 InzA_K01	30	60	2	1.4	T	Z		P	PD	Ob
5.	ETD003079W	Scripting language	1					K1eit_W28 InzA_W02	15	30	1	0.6	T	Z			PD	Ob
6.	ETD003079L	Scripting language			1			K1eit_U20 InzA_U01 K1eit_K03 InzA_K01	15	30	1	0.7	T	Z		P	PD	Ob
		Total	4	0	4	0	0		120	240	8	5.2						

Altogether for basic sciences modules:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				
21	9	5	0	0	525	1410	47	30.1

4.1.3. List of main-field-of-study modules

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

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD001066W	Introduction to electronics	2					K1eit_W01 K1eit_W02 InzA_W02 InzA_K01	30	60	2	1.2	T	Z			K	Ob
2.	ETD001067W	Engineering graphics	1					K1eit_W02 InzA_W02 InzA_K01	15	30	1	0.6	T	Z			K	Ob
3.	ETD001067P	Engineering graphics				2		K1eit_U01 K1eit_K07	30	60	2	1.4	T	Z		P	K	Ob
4.	ETD002070W	Introduction to digital and microprocessor systems I	2					K1eit_W16 K1eit_W15 InzA_W02	30	60	2	1.2	T	Z			K	Ob
5.	ETD002072W	Metrology I	2					K1eit_W20 InzA_W02 InzA_U01	30	60	2	1.2	T	Z			K	Ob
6.	ETD002074W	Analog technique	2					K1eit_W23 InzA_W02	30	60	2	1.2	T	E			K	Ob
7.	ETD002074C	Analog technique		2				InzA_W02 K1eit_U01 K1eit_ U09 K1eit_U17 InzA_U03 Keit_K02 InzA_K01	30	90	3	2.1	T	Z		P	K	Ob
8.	ETD003077W	Semiconductor devices I	2					K1eit_W07 K1eit_W08 K1eit_W15 InzA_W02	30	90	3	1.8	T	E			K	Ob
9.	ETD003077L	Semiconductor devices I			3			K1eit_K03 InzA_K01 K1eit_U13 K1eit_U14 InzA_U01	45	120	4	2.8	T	Z		P	K	Ob
10.	ETD003078W	Introduction to digital and microprocessor systems II	1					K1eit_W17 InzA_W02 K1eit_K03 InzA_K01	15	30	1	0.6	T	Z			K	Ob

11.	ETD003078L	Introduction to digital and microprocessor systems I			2			K1eit_U11 InzA_U01 K1eit_K03 InzA_K01	30	60	2	1.4	T	Z		P	K	Ob
12.	ETD003080W	Dielectric and magnetic materials	2					K1eit_W06 InzA_W02	30	90	3	1.8	T	E			K	Ob
13.	ETD003081L	Metrology II			2			K1eit_U13 InzA_U01 Kleit_K03 InzA_K01	30	60	2	1.4	T	Z		P	K	Ob
14.	ETD004076W	Analog and digital electronic circuits I	2					K1eit_W03 InzA_W02	30	60	2	1.2	T	Z			K	Ob
15.	ETD004076P	Analog and digital electronic circuits I				1		K1eit_U01, K1eit_U14 InzA_U06 K1eit_K02- K1eit_K04	15	60	2	1.4	T	Z		P	K	Ob
16.	ETD004077W	Microsystems I	2					K1eit_W05 InzA_W05	30	60	2	1.2	T	E			K	Ob
17.	ETD004078W	Optoelectronics I	2					K1eit_W01 K1eit_W04 K1eit_W19 InzA_W02	30	60	2	1.2	T	E			K	Ob
18.	ETD004079W	Foundations of electronic apparatus construction	2					K1eit_W02 K1eit_W11 K1eit_K04 K1eit_K05 K1eit_U01 InzA_W05	30	60	2	1.2	T	Z			K	Ob
19.	ETD004080L	Semiconductor, dielectric and magnetic materials			3			Kleit_K03 Kleit_U04 InzA_U01	45	120	4	2.8	T	Z		P	K	Ob
20.	ETD004081L	Semiconductor devices II			3			K1eit_U13 K1eit_U14 InzA_U01 K1eit_W07 K1eit_W08 K1eit_W15 K1eit_K03 K1eit_K03 K1eit_K04	45	120	4	2.8	T	Z		P	K	Ob
21.	ETD004083W	Micro- and nano- technologies	3					K1eit_W08 InzA_W05	45	120	4	2.4	T	E			K	Ob
22.	ETD005074W	Analog and digital electronic circuits II	2					K1eit_W03 InzA_W02	30	60	2	1.2	T	E			K	Ob

23.	ETD005074L	Analog and digital electronic circuits II			2			K1eit_U01 K1eit_U14 InzA_U06 K1eit_K02 K1eit_K04 K1eit_K03 K1eit_K08	30	90	3	1.4	T	Z		P	K	Ob
24.	ETD005075L	Microelectronics laboratory			4			K1eit_W08 K1eit_U01 InzA_U07 K1eit_K02 K1eit_K03	60	120	4	2.8	T	Z		P	K	Ob
25.	ETD005076W	Metrology of optoelectronic elements	1					K1eit_W05 K1eit_W07 K1eit_W09	15	30	1	0.6	T	Z			K	Ob
26.	ETD005076L	Metrology of optoelectronic elements			2			K1eit_U09 K1eit_U13 K1eit_U14 InzA_U01 K1eit_K03	30	60	2	1.4	T	Z		P	K	Ob
27.	ETD005080W	Microprocessors and microcontrollers	2					K1eit_W17 K1eit_W30 InzA_W02 K1eit_U18 InzA_U06 K1eit_K04	30	60	2	1.2	T	Z			K	Ob
28.	ETD005080L	Microprocessors and microcontrollers			2			K1eit_W17 K1eit_W30 InzA_W02 K1eit_U18 InzA_U06 K1eit_K04	30	60	2	1.4	T	Z		P	K	Ob
29.	ETD005081W	Packaging in electronics and microsystems I	2					K1eit_W02 K1eit_W21 InzA_W05 K1eit_U15 K1eit_K04	30	60	2	1.2	T	E			K	Ob
30.	ETD005082W	Signal processing	2					K1eit_W14 K1eit_K02	30	60	2	1.2	T	Z			K	Ob
31.	ETD005082L	Signal processing			1			K1eit_U17 InzA_U02 K1eit_K02	15	30	1	0.7	T	Z		P	K	Ob
32.	ETD005083W	Optical fibers I	2					K1eit_W05 K1eit_W09 InzA_W02	30	60	2	1.2	T	E			K	Ob

33.	ETD006076L	Packaging in electronics and microsystems II			2			K1eit_W02 K1eit_U15 K1eit_K03 InzA_U08	30	60	2	1.4	T	Z		P	K	Ob
34.	ETD006077W	Basics of system operating	1					K1eit_W11 InzA_W01 K1eit_K01	15	30	1	0.6	T	Z			K	Ob
35.	ETD006077C	Basics of system operating		1				K1eit_U05 K1eit_U05 InzA_U05 K1eit_K01	15	30	1	0.7	T	Z		P	K	Ob
36.	ETD006078W	Microwave techniques	1					K1eit_W02, K1eit_W12 InzA_W02	15	30	1	0.6	T	Z			K	Ob
37.	ETD006078P	Microwave techniques				2		K1eit_U06 InzA_U08 K1eit_K02 K1eit_K03	30	60	2	1.4	T	Z		P	K	Ob
38.	ETD007068W	Manufacturing engineering	2					K1eit_K05 K1eit_K06 K1eit_U01 K1eit_W25 K1eit_W27	30	30	1	0.6	T	Z			K	Ob
		Total	40	3	26	5	0		1110	2460	82	52.5						

Altogether for main-field-of-study modules:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				
40	3	26	5	0	1110	2460	82	52.5

4.1.4. List of specialization modules

4.1.3.1. *Obligatory specialization subjects* modules

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD004952W	Algorithms of data processing	2					S1ec_W01	30	90	3	1.2	T	Z			S	Ob
2.	ETD004952L	Algorithms of data processing			1			S1ec_U01 InzA_U02 K1eit_K02	15	60	2	1.4	T	Z		P	S	Ob
3.	ETD005203W	ASIC technology	2					K1ec_W05 InzA_W05	30	60	2	1.2	T	Z			S	Ob
4.	ETD005202W	VLSI circuits design	2					S1ec_W04 InzA_W05	30	90	3	1.8	T	Z			S	Ob
5.	ETD005202L	VLSI circuits design			2			S1ec_U03 S1ec_U06 InzA_U02 K1eit_K05	30	60	2	1.4	T	Z		P	S	Ob
6.	ETD006201W	Signal processors	2					S1ec_W06 InzA_W02	30	90	3	1.8	T	E			S	Ob
7.	ETD006201L	Signal processors			1			S1ec_U03 InzA_U08 K1eit_K03	15	60	2	1.4	T	Z		P	S	Ob
8.	ETD006202W	Object oriented programming	2					S1ec_W02 S1ec_W09 InzA_W02	30	30	1	0.6	T	Z			S	Ob
9.	ETD006202P	Object oriented programming				2		S1ec_U02 S1ec_U07 InzA_U02 K1eit_K03	30	30	1	0.7	T	Z		P	S	Ob
10.	ETD006203W	Programming of logical circuits	2					S1ec_W04 InzA_W02	30	60	2	1.2	T	Z			S	Ob
11.	ETD006203P	Programming of logical circuits				2		S1ec_U04 S1ec_U03 InzA_U08 K1eit_K02	30	30	1	0.7	T	Z		P	S	Ob

12.	ETD006204S	Protocols and interfaces					1	K1eit_W17 K1eit_W18 K1eit_W30 S1ec_W10 K1eit_U10 K1eit_U21, S1ec_U08 InzA_U07 K1eit_K03 K1eit_K04	15	60	2	1.4	T	Z		P	S	Ob
13.	ETD006205W	Verification of digital systems	1					S1ec_W07	15	30	1	0.6	T	Z			S	Ob
14.	ETD006205P	Verification of digital systems				1		S1ec_U06 InzA_U01 K1eit_K02 K1eit_K03	15	30	1	0.7	T	Z		P	S	Ob
15.	ETD006206W	Embedded operating systems	2					S1ec_W09 InzA_W05	30	60	2	1.2	T	E			S	Ob
16.	ETD006206P	Embedded operating systems				2		S1ec_U07 InzA_U02 K1eit_K02 K1eit_K03	30	60	2	1.4	T	Z		P	S	Ob
17.	ETD007211W	Embedded processors	2					S1ec_W03 S1ec_W10	30	30	1	0.6	T	Z			S	Ob
18.	ETD007211L	Embedded processors			1			S1ec_U05 S1ec_U10 InzA_U07 K1eit_K03	15	60	2	1.4	T	Z		P	S	Ob
19.	ETD007212W	Wireless systems	1					S1ec_W08	15	30	1	0.6	T	Z			S	Ob
20.	ETD007212P	Wireless systems				1		S1ec_U08 InzA_U08 K1eit_K02	15	60	2	1.4	T	Z		P	S	Ob
		Total	18	0	5	8	1		480	1080	36	22.7						

Altogether for specialization modules:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				
18	0	5	8	1	480	1080	36	22.7

4.2. List of optional modules

4.2.1. List of general education modules

4.2.1.1. *Liberal-managerial subjects* modules

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
	ZMD100001BK	Management course	1						15	30	1	0.6	T	Z	O	P	KO	W
		Total	1	0	0	0	0		15	30	1	0.6						

4.2.1.2. *Foreign languages* module

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	JZL100707BK	Foreign language		4					60	60	2	1.4	T	Z	O	P	KO	W
2.	JZL100708BK	Foreign language B2		4					60	90	3	2.1	T	E	O	P	KO	W
		Total	0	8	0	0	0		120	150	5	3.5						

4.2.1.3. *Sporting classes* module

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	WFW010000BK	Sport		2					30	0	0	0	T	Z	O	P	KO	W
		Total	0	2	0	0	0		30	0	0	0						

4.2.1.4. *Information Technologies module*

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

Altogether for general education modules:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				
1	10	0	0	0	165	180	6	4,1

4.2.2. List of basic sciences modules

4.2.2.1. *Mathematics* module

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

4.2.2.2. *Physics* module

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

4.2.2.3. Chemistry module

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

Altogether for basic sciences modules:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				

4.2.3. List of main-field of science modules

4.2.3.1. *Optional main-field-of-study* modules

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD006075L	Open laboratory (electronics)			2			K1eit_U14 InzA_U07 K1eit_K03	30	120	4	2.8	T	Z		P	K	W
	ETD100012BK	BLOCK A	2			2			60	150	5	3.3						
2.	ETD003084W	Low level programming in C language	2					K1eit_W17 InzA_W02	30	60	2	1.2	T	Z			K	W
3.	ETD003084P	Low level programming in C language				2		InzA_W02 K1eit_U08 K1eit_U18 InzA_U06 K1eit_K03 InzA_K01	30	90	3	2.1	T	Z		P	K	W
4.	ETD003085W	Application programming	2					K1eit_W28 InzA_W02	30	60	2	1.2	T	Z			K	W
5.	ETD003085P	Application programming				2		InzA_W02 K1eit_U20 InzA_U02 K1eit_K02 K1eit_K03 InzA_K01	30	90	3	2.1	T	Z		P	K	W
	ETD100013BK	BLOCK B				1			15	30	1	0.7						
6.	ETD006079P	Application of information techniques and numerical methods				1		K1eit_U06 K1eit_U07 InzA_U02 K1eit_K02	15	30	1	0.7		Z		P	K	W
7.	ETD006080P	Computer aided modeling of semiconductor devices				1		K1eit_U07 InzA_U01 K1eit_K02	15	30	1	0.7		Z		P	K	W
8.	ETD006081P	Computer aided design				1		K1eit_U07 InzA_U02 K1eit_K03	15	30	1	0.7		Z		P	K	W
		Total	2	0	2	3	0		105	300	10	6.8						

4.2.3.2. *Practice* module

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD007069Q	Training						K1eit_U01 K1eit_U09 InzA_U03 K1eit_K03 K1eit_K06 InzA_K02	160	180	6	4.2	T	Z		P	K	W
		Total							160	180	6	4.2						

Altogether for main-field-of-study modules:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				
2	0	2	3	0	265	480	16	11

4.2.4 List of specialization modules

4.2.4.1. *Optional specialization subjects modules*

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

4.2.4.2. *Diploma dissertation* module

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD007215S	Diploma seminar					2	K1eit_K03 InzA_K01 K1eit_W01 - K1eit_W30, S1ec_W01 - S1ec_W10 K1eit_U01 - K1eit_U22, S1ec_U01 - S1ec_U11	30	60	2	1.4	T	Z		P	S	Ob
2.	ETD007214D	Diploma thesis						K1eit_W01- K1eit_W30 S1ec_W01- S1ec_W10 K1eit_U01- K1eit_U22 S1ec_U01- S1ec_U11 K1eit_K03	30	450	15	10.5	T	Z		P	S	W
		Total	0	0	0	0	2		60	510	17	11.9						

Altogether for specialization modules:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				
0	0	0	0	2	60	510	17	11.9

4.2 Training module

Name of training		Training	
Number of ECTS points	**Number of ECTS points for BK classes1**	**Training crediting mode**	**Code**
6	**4,2**	Training is a course included in education programme and programme of study, obligatory for the first level of study. Duration of the training is at least 160 hours, i.e. not less than 4 weeks. Training may take place in one or more companies (in such case the time of duration is added). The training is realized on the motion made by a student on the basis of an agreement between the Faculty Dean. and the Institution where the training is to be realized. The pattern of the agreement is the attachment of the Internal Instruction No 24/2006, edited by the Rector of WUT. Signing of the agreement is possible after prior arrangement the term and location of the training and the approval of the frame programme of training by the Faculty Coordinator for Student's Trainings. In the agreement there is information where and when the training should be made. After finishing the training, the student is obliged to deliver to the Faculty Coordinator for Student's Trainings: - the certificate from the Institution on accomplishing the training (who, when and where has made the training) - additional certificate containing the student's assessment - short, max 2-page report. In case when a student was employed in a firm, then his/her paid work (also done abroad) may be considered by the Faculty Coordinator for Student's Trainings as a student's training provided that its character fulfills the requirements of training programme. There is then no need to make an agreement between the Faculty Dean and the Institution, and only certification of employment and short report are required to credit the course . The fact of accomplishing student's training by a student is registered in the Edukacja.CL system.	**ETD007069Q**

Training duration	**Training objective**
4 weeks	The objective of student's training is to make a student familiar with the way of operation, organization of work and tasks performed in a company dealing with electronics and telecommunications and applying in their activity wide understood electronics. The student should have a possibility to confront the knowledge acquired during the education in the Faculty. He/she should learn, during the training, to work by himself/herself and in a team on realization of tasks.

4.3 Diploma dissertation module

Type of diploma dissertation	engineering	
Number of semesters of diploma dissertation	**Number of ECTS points**	**Code**
1	**15**	**ETD007214D**
Character of diploma dissertation		
The Faculty students may, in the collection of topics of diploma dissertations, choose a diploma dissertation of different characters: - analytical, (analysis, e.g. numerical, properties) - technological (Technology of epitaxial growth) - project (Project of a sensor) - design (Laboratory stand for annealing by RTS method) - application (Assessment of applicability) - usage (Application of a heterostructure in construction) - research (Testing, characterization) - survey (Current state of knowledge concerning the growth mechanisms)		
Number of BK1 ECTS points	**10.5**	

5. Ways of verifying assumed educational effects

Type of classes	Ways of verifying assumed educational effects
lecture	examination, progress/final test
class	oral answer progress/final test
laboratory	oral answer, pre-test, realization of laboratory exercise, report from laboratory
project	partial assessment, project defense
seminar	participation in discussion, multimedia topic presentation
training	employer assessment, report from training
diploma dissertation	prepared diploma dissertation, review, defense of diploma dissertation

6. **Total number of ECTS points, which student has to obtain from classes requiring direct academic teacher-student contact** (enter total of ECTS points for courses/groups of courses denoted with code BK1)

   137.7 ECTS

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

Number of ECTS points for obligatory subjects	47
Number of ECTS points for optional subjects	0
Total number of ECTS points	47

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

Number of ECTS points for obligatory subjects	79
Number of ECTS points for optional subjects	34
Total number of ECTS points	113

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

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

11. Range of diploma examination

EiT (I level studies) – field of study exam questions

1. Construction of the currently used system of units (SI). Classification of measurement errors.
2. Defects in the crystallographic network, their systematics and influence on the properties of materials (examples).
3. Definition of epitaxy, classification of epitaxial methods applied for manufacturing of optoelectronic structures.
4. Impedance matching in an electrical circuit. Active and reactive power in the electrical circuit.
5. The experimental basis of quantum mechanics. Photoelectric effect.
6. Passive components made of LTCC technology - construction and characteristics of resistors, inductors and capacitors.
7. Active filters.
8. Generators of sinusoidal waveforms.
9. The importance and goals of logistics in production engineering.
10. What types of waves can occur in wave guides? Classify the waveguide into two groups depending on the type of the wave. What criterion should be used for this purpose?
11. Linear and nonlinear applications of operational amplifiers.
12. Optical logic: basic circuits of optical logic, optoelectronic gates.
13. Conduction mechanisms describing R = f(T) characteristic of thick-film cermet resistors.
14. Digital measurement method of frequency and period of electric signal; influence of important factors on measurement error.
15. Calculation methods of error in complex measurements.
16. Measurement methods of piezoelectrics.
17. Measurement methods of basic passive elements (RLC).
18. Measurement methods of root mean square value of periodic voltage signals.
19. DC and AC measurements methods applied for investigation of properties of electronic materials and elements.
20. Learning methods of neural networks.
21. Movable microsystems: methods of actuation in microscale, basic microconstructions and their applications.
22. Modification of properties of surface layers – systematics and manufacturing methods.
23. The principles of light modulation by microwaves. Give an example construction of an electrooptical modulator.
24. The most important applications of elements, circuits and devices operating in the microwave frequency range (300 MHz-300 GHz).
25. Electrical charge carriers and mechanisms of the current flow in semiconductors.
26. Series RLC circuit – voltage resonance. Parallel RLC circuit – current resonance.
27. Parameters and characteristics of reliability and the relations between them.
28. Piezoresistive detection of force and deflection in MEMS.

29. Basic transistor amplifier circuits.
30. Measurement of hysteresis loop, determination of magnetic materials parameters.
31. Comparison of properties and parameters of bipolar and field effect transistors.
32. Basic application of Schroedinger equation. Electron tunneling through the potential barrier.
33. Flip-flops and comparators.
34. Conditions for the application of ISO 9000 norm series.
35. Analog to digital and digital to analog converters.
36. Semiconductor devices with p-n junction; describe the basic applications.
37. Transient state in DC RL and RC circuit. Time constant.
38. Applicability of different thin-film materials for precise resistors, thermistors, capacitors, microwave microstrips, conductive paths and transparent conductive electrodes etc.
39. Systematics of microsystems concerning the aspects connected with the specifics of materials and technology.
40. Replication techniques with the application of micromechnical matrices for microoptics
41. Development trends in novel semiconductor technology, review of basic micro- and nanotechnological processes.
42. Bipolar transistors – explain the amplification properties of the device. Comparison of the basic parameters and applications of bipolar and field effect transistors.
43. Field effect transistors – systematics, constructions and applications. Comparison of the basic parameters and applications of bipolar and field effect transistors.
44. Types of neural networks and their applications.
45. MMIC circuits – architecture, semiconductor devices applied in their construction, applications.
46. Integrated circuits – objectives and advantages of circuit integration, types of the integrated circuit technologies.
47. Electrical properties of metal in the function of temperature.
48. Influence of the measurement device on the value of the measured parameter (demonstrate the problem on the chosen example of measurement of a basic electrical parameter).
49. Influence of the temperature on the semiconductor material and the application of the effect in semiconductor devices.
50. Properties of the p-n junction; explain on the basis of different types of semiconductor diodes.
51. List example electronic elements and semiconductor devices and explain what parameters have influence on their parameters.
52. Power amplifiers.
53. High frequency selective amplifiers.
54. Impulsive and broad-band amplifiers.
55. Advantages of surface mount technology in comparison with the through-hole technology.
56. The relationship between the electrical properties and the temperature of the materials applied in electronics.

57. Operating principle of piezoresistive tuning-fork.
58. External and internal photoelectric effect. Conditions of occurrence and examples of application.
59. Microwave power sources – classification, comparison of parameters and application areas.
60. Voltage and current sources. Terms of sources equivalence.

EiT (I level studies) – exam questions for EC specialization

1. Characteristics of a properly designed digital circuit.
2. Characteristics and elements of the architecture that differentiate the signal processors from classic microcontrollers.
3. Characteristics of the file system in the UNIX system.
4. What properties differentiate the fixed-point processors from the floating-point processors, what application consequences results from the fact?
5. XML language for data description. Characteristics, applications and limits.
6. Programming languages of programmable controllers.
7. Fragmentation of address space in IP protocol. Describe on an example.
8. Draw the schematic of DSP signal processor and briefly describe its elements.
9. Explain the difference between the TCP and UDP protocols.
10. Parameters of PID regulator.
11. Basic mechanisms and architecture elements of signal processor that increase its processing capability..
12. Compare sorting algorithms: bubble sort, swap sort, quick-sort. Complexity, memory allocation and when they are applied?
13. Compare multithread programming in Java and C/C++. Mechanism of critical section creation in both languages.
14. Comparison of von Neumann and Harvard architecture. Application areas.
15. Characteristic of basic PLD circuits.
16. Polymorphism in object oriented programming on the example of C++ language.
17. Analog to digital and digital to analog converters.
18. Recurrence: applications and limits. Sample algorithm in recurrence and iterative version.
19. Role of the DMA circuit in a computer system, explain operation modes of the circuit.
20. Fuzzy data processing.
21. Differences between object oriented programming and structural programming.
22. Differences between synthesizable and non- synthesizable VHDL code. Examples.
23. Coding specifics in hardware description language – differences between VHDL code and code of a typical computer program code.
24. Coding systems of integer and float-point numbers in C language. Problems connected with data transfer.
25. The major application areas of modern signal processors and what differentiate the processors from others in these applications?
26. List and describe basic number codes applied in fixed-point arithmetics.

27. Construction and properties of asynchronic and synchronic counters.
28. Construction and properties of basic arithmetic circuits.
29. Construction of registers and typical applications.
30. Pipeline processing of the program, explain basic differences between CISR and RISC processors.

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

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

13. Plan of studies (attachment no. 1)

Opinion of the Student Council of the Faculty

....
Date

....
Name, surname and signature of the student's representative

....
Date

....
Dean's signature

Attachment no. 1 to Programme of Studies

PLAN OF STUDIES

FACULTY: ***Microsystem Electronics and Photonics***

MAIN FIELD OF STUDY: ***Electronics and Telecommunications***

EDUCATION LEVEL: ***1-st level engineering study***

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

PROFILE: ***general academic***

SPECIALIZATION: ***Digital Electronics***

LANGUAGE OF STUDY: ***Polish***

Microsystem Electronics and Photonics Faculty Council resolution no. ***118/11/2016-2020 of May 17, 2017***

In effect since ***01.10.2017***

Faculty:	**Microsystem Electronics and Photonics**	Faculty Council resolution from:	**17.05.2017**
Field of study:	**Electronics and Telecommunications**	In effect from:	**01.10.2017**
Specialization:	**Digital Electronics**		
Study:	**1-st level, full-time**		

POINT AND HOUR LAYOUT OF THE PLAN OF STUDIES

	23 **I** 30	24 **II** 30	27 **III** 30	27 **IV** 30	28 **V** 30	28 **VI** 30	11 **VII** 30	
28						**Block B ETD100013BK 1P** 00010		28
27				ETD4952 **3W+2L** 20100	ETD5202 **3W+2L** 20200	ETD6075 **4L** 00200		27
26			**Block A ETD100012BK**	Algorithms of data	VLSI circuits design	Open laboratory (electronic)		26
25			20020 **2W+3P**	processing				25
24		ETD2070 **2W** 20000		ETD4077 **2W** 20000**E**	ETD5203 **2W** 20000	ETD6206 **2W+2P** 20020**E**		24
23	ETD1066 **2W** 20000	Introduction to digital and microprocessors systems I	ETD3079 **1W+1L** 10100	Microsystems I	ASIC technology			23
22	Introduction to electronics	ETD2072 **2W** 20000	Scripting Language	ETD4076 **2W+2P** 20010	ETD5081 **2W** 20000**E**	Embedded operating systems		22
21	ETD1070 **2W** 20000	Metrology I	ETD3078 **1W+2L** 10200	Analog and digital electronics circuits I	Packaging in electronics and microsystems I	ETD6204 **2S** 00001 Protocols and interfaces		21
20	Materials engineering		Introduction to digital		ETD5076 **1W+2L** 10200	ETD6205 **1W+1P** 10010		20
19	ETD1269 **1W+1L** 10100	ETD2074 **2W+3C** 22000**E**	and microprocessor systems II	ETD4079 **2W** 20000	Metrology of optoelectronic	Verification of digital systems		19
18	The basics of computer networks	Analog Technique		Foundations of electronic apparatus construction.	elements			18
17	ETD1068 **1W + 1L** 10100		ETD3077 **3W+4L** 20300**E**	ETD4081 **4L** 00300	ETD5083 **2W** 20000**E**	ETD6203 **2W+1P** 20020		17
16	Information technologies	ETD2073 **1W +2C** 11000	Semiconductor devices I	Semiconductor devices II	Optical fibers I	Programming of logical circuits		16
15	ETD1067 **1W+2P** 10020	Probabilistics			ETD5075 **4L** 00400			15
14	Engineering graphics			ETD4078 **2W** 20000**E**	Microelectronics laboratory	ETD6202 **1W+1P** 20020		14
13		ETD2071 **2W+2L** 20200	ETD3089 **1W** 10000 Wave optics	Optoelectronics I				13
12		Informatics	ETD3083 **2W** 20000	ETD4080 **4L** 00300		Object oriented programming		12
11	FZP1057 **4W + 1C** 21000**E**		Principles of solid state	Semiconductor, dielectric	ETD5080 **2W+2L** 20200		ETD7214D **15 p**	11
10	Physics 1.1		ETD3081 **2L** 00200	and magnetic materials	Microprocessors	ETD6201 **3W+2L** 20100**E**	Diploma thesis	10
9		ETD2069 **2W+2C** 22000**E**	Metrology II	ETD4083 **4W** 30000**E**	and microcontrollers	Signal processors	ETD7215 **2S** 00002	9
8	MAT1412 **5W+3C** 22000**E**	Electricity and magnetism	ETD3080 **3W** 20000**E**				Diploma seminar	8
7	Mathematical Analysis 1.1A		Dielectrics and magnetic materials	Micro- and nano- technologies	ETD5082 **2W+1L** 20100	ETD6076 **2L** 00200	ETD7212 **1W+2P** 10010	7
6		FZP2079 **2L** 00100 Physics **3.1**	Management 10000 **1W**	JZL **3C** 04000	Signal processing	Packaging in electronics and microsystems II	Wireless system	6
5	MAT1402 **2W+2C** 21000**E**		PKH120411 **2W** 10000 Social communication	Foreign Language		ETD6077 **1W+1C** 11000	ETD7211 **1W+2L** 20100	5
4	Algebra and Analytic geometry	MAT1424 **5W+3C** 32000**E**	JZL **2C** 04000	(60 hours)	ETD5074 **2W+3L** 20200**E**	Basics of system operating	Embedded processors	4
3		Mathematical Analysis 2.2A	Foreign Language		Analog and digital electronics circuits II	ETD6078 **1W+2P** 10020		3
2	FLH121611 **2W** 20000		(60 hours)	Sport 02000 **0C**		Microwave technique	ETD7068 **1W** 20000	2
1	Ethics in Business						Manufacturing engineering	1
	d_I=15	d_{II}=16	d_{III}=12	d_{IV}=8	d_V=8	d_{VI}=5	d_{VII}=0	

OPTIONAL BLOCKS

A – ETD100012BK

COURSE CODE	COURSE NAME	NUMBER OF HOURS	POINTS	SUPERVISOR
ETD003084	Low level programming in C language	20020	2W+3P	dr inż. K. Urbański
ETD003085	Application programming	20020	2W+3P	dr inż. K. Urbański

B – ETD100013BK

COURSE CODE	COURSE NAME	NUMBER OF HOURS	POINTS	SUPERVISOR
ETD006079	Application of information techniques and numerical methods	00010	1P	dr hab. inż. A. Wymysłowski
ETD006080	Computer aided modeling of semiconductor devices	00010	1P	dr inż. W. Panek
ETD006081	Computer Aided Design	00010	1P	dr inż. W. Drzazga

D (MANAGEMENT) – ZMD100001BK

COURSE CODE	COURSE NAME	NUMBER OF HOURS	POINTS	SUPERVISOR
ZMZ000382	Novel management trends	10000	1P	W-8
ZMZ001274	Basics of management	10000	1P	W-8
ZMZ000144	Quality management	10000	1P	W-8

Legend

Basic science courses	
University-wide courses	
Main field of study courses	
Specialization courses	
Obligatory courses	
Optional courses	ETD

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

Semester 1

Obligatory courses

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD001066W	Introduction to electronics	2					K1eit_W01 K1eit_W02 InzA_W02 InzA_K01	30	60	2	1.2	T	Z			K	Ob
2.	ETD001067W	Engineering graphics	1					K1eit_W02 InzA_W02 InzA_K01	15	30	1	0.6	T	Z			K	Ob
3.	ETD001067P	Engineering graphics				2		K1eit_U01 K1eit_K07	30	60	2	1.4	T	Z		P	K	Ob
4.	ETD001068W	Information technologies	1					K1eit_W13 InzA_W02 K1eit_W24 K1eit_W17	15	30	1	0.6	T	Z			KO	Ob
5.	ETD001068L	Information technologies			1			K1eit_U21 K1eit_K02 InzA_U02 K1eit_U20 K1eit_U08 K1eit_K03 InzA_K02	15	30	1	0.7	T	Z		P	KO	Ob
6.	ETD001269W	The basics of computer networks	1					K1eit_W22 InzA_W02 InzA_W05	15	30	1	0.6	T	Z			PD	Ob
7.	ETD001269L	The basics of computer networks			1			K1eit_U10 K1eit_U19 InzA_U08	15	30	1	0.7	T	Z		P	PD	Ob
8.	ETD001070W	Material engineering	2					K1eit_W01 InzA_W02	30	60	2	1.2	T	Z			PD	Ob
9.	FLH121611W	Ethics in business	2						30	60	2	1.2	T	Z	O		KO	Ob
10.	MAT001402W	Algebra and analytic geometry	2					K1eit_W03	30	60	2	1.2	T	E	O		PD	Ob
11.	MAT001402C	Algebra and analytic geometry		1				K1eit_U02	15	60	2	1.4	T	Z	O	P	PD	Ob
12.	MAT001412W	Mathematical analysis 1.1 A	2					K1eit_W03	30	150	5	3.0	T	E	O		PD	Ob
13.	MAT001412C	Mathematical analysis 1.1 A		2				K1eit_U02 K1eit_K01	30	90	3	2.1	T	Z	O	P	PD	Ob

14.	FZP001057W	Physics 1.1	2					K1eit_W04 InzA_W02 InzA_K01	30	120	4	2.4	T	E	O		PD	Ob
15.	FZP001057C	Physics 1.1		1				K1eit_U03 K1eit_U04	15	30	1	0.7	T	Z	O	P	PD	Ob
		Total	15	4	2	2	0		345	900	30	19						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				
15	4	2	2	0	345	900	30	19

Semester 2

Obligatory courses

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	MAT001424W	Mathematical analysis 2.2 A	3					K1eit_W03	45	150	5	3.0	T	E	O		PD	Ob
2.	MAT001424C	Mathematical analysis 2.2 A		2				K1eit_U02 K1eit_K01	30	90	3	2.1	T	Z	O	P	PD	Ob
3.	FZP002079L	Physics 3.1			1			K1eit_W20 K1eit_W29 K1eit_U04 K1eit_U13 K1eit_U19 K1eit_K03	15	60	2	1.4	T	Z	O	P	PD	Ob
4.	ETD002069W	Electricity and magnetism	2					K1eit_W04 K1eit_W06 InzA_W02 K1eit_K03 K1eit_K07	30	60	2	1.2	T	E			PD	Ob
5.	ETD002069C	Electricity and magnetism		2				K1eit_K03 K1eit_K07 K1eit_U04 K1eit_U19	30	60	2	1.4	T	Z		P	PD	Ob
6.	ETD002071W	Informatics	2					K1eit_W24 InzA_W02	30	60	2	1.2	T	Z			PD	Ob
7.	ETD002071L	Informatics			2			K1eit_U08 K1eit_U20 InzA_U07 K1eit_K03 InzA_K01	30	60	2	1.4	T	Z		P	PD	Ob
8.	ETD002073W	Probabilistics	1					K1eit_W03 InzA_W02 K1eit_K01 InzA_K01	15	30	1	0.6	T	Z			PD	Ob
9.	ETD002073C	Probabilistics		1				K1eit_U02 InzA_U02 K1eit_K01 InzA_K01	15	60	2	1.4	T	Z		P	PD	Ob
10.	ETD002070W	Introduction to digital and microprocessors systems I	2					K1eit_W16 K1eit_W15 InzA_W02	30	60	2	1.2	T	Z			K	Ob

11.	ETD002072W	Metrology I	2					K1eit_W20 InzA_W02 InzA_U01	30	60	2	1.2	T	Z			K	Ob
12.	ETD002074W	Analog technique	2					K1eit_W23 InzA_W02	30	60	2	1.2	T	E			K	Ob
13.	ETD002074C	Analog technique		2				InzA_W02 K1eit_U01 K1eit_ U09 K1eit_U17 InzA_U03 Keit_K02 InzA_K01	30	90	3	2.1	T	Z		P	K	Ob
		Total	14	7	3	0	0		360	900	30	19,4						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				
14	7	3	0	0	360	900	30	19.4

Semester 3

Obligatory courses

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	PKH120411W	Social communication	1						15	60	2	1.2	T	Z	O		KO	Ob
2.	ETD003079W	Scripting language	1					K1eit_W28 InzA_W02	15	30	1	0.6	T	Z			PD	Ob
3.	ETD003079L	Scripting language			1			K1eit_U20 InzA_U01 K1eit_K03 InzA_K01	15	30	1	0.7	T	Z		P	PD	Ob
4.	ETD003083W	Principles of solid state	2					K1eit _W05 K1eit _W04 InzA_W02	30	60	2	1.2	T	Z			PD	Ob
5.	ETD003089W	Wave optics	1					K1eit_W04 K1eit_W07 K1eit_W09 InzA_W02	15	30	1	0.6	T	Z			PD	Ob
6.	ETD003077W	Semiconductor devices I	2					K1eit_W07 K1eit_W08 K1eit_W15 InzA_W02	30	90	3	1.8	T	E			K	Ob
7.	ETD003077L	Semiconductor devices I			3			K1eit_K03 InzA_K01 K1eit_U13 K1eit_U14 InzA_U01	45	120	4	2.8	T	Z		P	K	Ob
8.	ETD003078W	Introduction to digital and microprocessors systems II	1					K1eit_W17 InzA_W02 K1eit_K03 InzA_K01	15	30	1	0.6	T	Z			K	Ob
9.	ETD003078L	Introduction to digital and microprocessors systems II			2			K1eit_U11 InzA_U01 K1eit_K03 InzA_K01	30	60	2	1.4	T	Z		P	K	Ob
10.	ETD003080W	Dielectric and magnetic materials	2					K1eit_W06 InzA_W02	30	90	3	1.8	T	E			K	Ob
11.	ETD003081L	Metrology II			2			K1eit_U13 InzA_U01 Kleit_K03 InzA_K01	30	60	2	1.4	T	Z		P	K	Ob
		Total	10	0	8	0	0		270	660	22	14.1						

Optional courses

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours lec	c	lab	p	s	Field of study educational effect symbol	Number of hours ZZU	CNPS	Number of ECTS total	BK[1] classes	Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses university-wide[4]	practical[5]	kind[6]	type[7]
1.	JZL100707BK	Foreign language		4					60	60	2	1.4	T	Z	O	P	KO	W
2.	ZMD100001BK	Optional block D - Management	1						15	30	1	0.6	T	Z	O	P	KO	W
	ETD100012BK	Optional block A	2			2			60	150	5	3.3						
3.	ETD003084W	Low level programming in C language	2					K1eit_W17 InzA_W02	30	60	2	1.2	T	Z			K	W
4.	ETD003084P	Low level programming in C language				2		InzA_W02 K1eit_U08 K1eit_U18 InzA_U06 K1eit_K03 InzA_K01	30	90	3	2.1	T	Z		P	K	W
5.	ETD003085W	Application programming	2					K1eit_W28 InzA_W02	30	60	2	1.2	T	Z			K	W
6.	ETD003085P	Application programming				2		InzA_W02 K1eit_U20 InzA_U02 K1eit_K02 K1eit_K03 InzA_K01	30	90	3	2.1	T	Z		P	K	W
		Total	3	4	0	2	0		135	240	8	5.3						

Altogether in semester

Total number of hours lec	c	lab	p	s	Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
13	4	8	2	0	405	900	30	19.4

Semester 4

Obligatory courses

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD004076W	Analog and digital electronic circuits I	2					K1eit_W03 InzA_W02	30	60	2	1.2	T	Z			K	Ob
2.	ETD004076P	Analog and digital electronic circuits I				1		K1eit_U01, K1eit_U14 InzA_U06 K1eit_K02- K1eit_K04	15	60	2	1.4	T	Z		P	K	Ob
3.	ETD004077W	Microsystems I	2					K1eit_W05 InzA_W05	30	60	2	1.2	T	E			K	Ob
4.	ETD004078W	Optoelectronics I	2					K1eit_W01 K1eit_W04 K1eit_W19 InzA_W02	30	60	2	1.2	T	E			K	Ob
5.	ETD004079W	Foundations of electronic apparatus construction.	2					K1eit_W02 K1eit_W11 K1eit_K04 K1eit_K05 K1eit_U01 InzA_W05	30	60	2	1.2	T	Z			K	Ob
6.	ETD004080L	Semiconductor, dielectric and magnetic materials			3			Kleit_K03 Kleit_U04 InzA_U01	45	120	4	2.8	T	Z		P	K	Ob
7.	ETD004081L	Semiconductor devices II			3			K1eit_U13 K1eit_U14 InzA_U01 K1eit_W07 K1eit_W08 K1eit_W15 K1eit_K03 K1eit_K03 K1eit_K04	45	120	4	2.8	T	Z		P	K	Ob
8.	ETD004083W	Micro- and nanotechnologies	3					K1eit_W08 InzA_W05	45	120	4	2.4	T	E			K	Ob
9.	ETD004952W	Algorithms of data processing	2					S1ec_W01	30	90	3	1.8	T	Z			S	Ob
10.	ETD004952L	Algorithms of data processing			1			S1ec_U01 InzA_U02 K1eit_K02	15	60	2	1.4	T	Z		P	S	Ob
		Total	13	0	7	1	0		315	810	27	17.4						

Optional courses

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	JZL100708BK	Foreign language B2		4					60	90	3	2.1	T	Z	O	P	KO	W
2.	WFW010000BK	Sport		2					30				T	Z	O	P	KO	W
		Total	0	6	0	0	0		90	90	3	2.1						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				
13	6	7	1	0	405	900	30	19.5

Semester 5

Obligatory courses

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD005074W	Analog and digital circuits II	2					K1eit_W03 InzA_W02	30	60	2	1.2	T	E			K	Ob
2.	ETD005074L	Analog and digital circuits II			2			K1eit_U01 K1eit_U14 InzA_U06 K1eit_K02 K1eit_K04 K1eit_K03 K1eit_K08	30	90	3	2.1	T	Z		P	K	Ob
3.	ETD005075L	Microelectronics laboratory			4			K1eit_W08 K1eit_U01 InzA_U07 K1eit_K02 K1eit_K03	60	120	4	2.8	T	Z		P	K	Ob
4.	ETD005076W	Metrology of optoelectronic elements	1					K1eit_W05 K1eit_W07 K1eit_W09	15	30	1	0.6	T	Z			K	Ob
5.	ETD005076L	Metrology of optoelectronic elements			2			K1eit_U09 K1eit_U13 K1eit_U14 InzA_U01 K1eit_K03	30	60	2	1.4	T	Z		P	K	Ob
6.	ETD005080W	Microprocessors and microcontrollers	2					K1eit_W17 K1eit_W30 InzA_W02 K1eit_U18 InzA_U06 K1eit_K04	30	60	2	1.2	T	Z			K	Ob
7.	ETD005080L	Microprocessors and microcontrollers			2			K1eit_W17 K1eit_W30 InzA_W02 K1eit_U18 InzA_U06 K1eit_K04	30	60	2	1.4	T	Z		P	K	Ob

8.	ETD005081W	Packaging in electronics and microsystems I	2					K1eit_W02 K1eit_W21 InzA_W05 K1eit_U15 K1eit_K04	30	60	2	1.2	T	E			K	Ob
9.	ETD005082W	Signal processing	2					K1eit_W14 K1eit_K02	30	60	2	1.2	T	Z			K	Ob
10.	ETD005082L	Signal processing			1			K1eit_U17 InzA_U02 K1eit_K02	15	30	1	0.7	T	Z		P	K	Ob
11.	ETD005083W	Optical fibers I	2					K1eit_W05 K1eit_W09 InzA_W02	30	60	2	1.2	T	E			K	Ob
12.	ETD005203W	ASIC technology	2					K1ec_W05 InzA_W05	30	60	2	1.2	T	Z			S	Ob
13.	ETD005202W	VLSI circuits design	2					S1ec_W04 InzA_W05	30	90	3	1.8	T	Z			S	Ob
14.	ETD005202L	VLSI circuits design			2			S1ec_U03 S1ec_U06 InzA_U02 K1eit_K05	30	60	2	1.4	T	Z		P	S	Ob
		Total	15	0	13	0	0		420	900	30	19.4						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				
15	0	13	0	0	420	900	30	19.4

Semester 6

Obligatory courses

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD006076L	Packaging in electronics and microsystems II			2			K1eit_W02 K1eit_U15 K1eit_K03 InzA_U08	30	60	2	1.4	T	Z		P	K	Ob
2.	ETD006077W	Basics of system operating	1					K1eit_W11 InzA_W01 K1eit_K01	15	30	1	0.6	T	Z			K	Ob
3.	ETD006077C	Basics of system operating		1				K1eit_U05 K1eit_U05 InzA_U05 K1eit_K01	15	30	1	0.7	T	Z		P	K	Ob
4.	ETD006078W	Microwave technique	1					K1eit_W02, K1eit_W12 InzA_W02	15	30	1	0.6	T	Z			K	Ob
5.	ETD006078P	Microwave technique				2		K1eit_U06 InzA_U08 K1eit_K02 K1eit_K03	30	60	2	1.4	T	Z		P	K	Ob
6.	ETD006201W	Signal processors	2					S1ec_W06 InzA_W02	30	90	3	1.8	T	E			S	Ob
7.	ETD006201L	Signal processors			1			S1ec_U03 InzA_U08 K1eit_K03	15	60	2	1.4	T	Z		P	S	Ob
8.	ETD006202W	Object oriented programming	2					S1ec_W02 S1ec_W09 InzA_W02	30	30	1	0.6	T	Z			S	Ob
9.	ETD006202P	Object oriented programming				2		S1ec_U02 S1ec_U07 InzA_U02 K1eit_K03	30	30	1	0.7	T	Z		P	S	Ob
10.	ETD006203W	Programming of logical circuits	2					S1ec_W04 InzA_W02	30	60	2	1.2	T	Z			S	Ob
11.	ETD006203P	Programming of logical circuits				2		S1ec_U04 S1ec_U03 InzA_U08 K1eit_K02	30	30	1	0.7	T	Z		P	S	Ob

12.	ETD006204S	Protocols and interfaces					1	K1eit_W17 K1eit_W18 K1eit_W30 S1ec_W10 K1eit_U10 K1eit_U21, S1ec_U08 InzA_U07 K1eit_K03 K1eit_K04	15	60	2	1.4	T	Z		P	S	Ob
13.	ETD006205W	Verification of digital systems	1					S1ec_W07	15	30	1	0.6	T	Z			S	Ob
14.	ETD006205P	Verification of digital systems				1		S1ec_U06 InzA_U01 K1eit_K02 K1eit_K03	15	30	1	0.7	T	Z		P	S	Ob
15.	ETD006206W	Embedded operating systems	2					S1ec_W09 InzA_W05	30	60	2	1.2	T	E			S	Ob
16.	ETD006206P	Embedded operating systems				2		S1ec_U07 InzA_U02 K1eit_K02 K1eit_K03	30	60	2	1.4	T	Z		P	S	Ob
		Total	11	1	3	9	1		375	750	25	16.4						

Optional courses

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD006075L	Open Laboratory (electronic)			2			K1eit_U14 InzA_U07 K1eit_K03	30	120	4	2.8	T	Z		P	K	W
	ETD100013BK	Optional block B				1			15	30	1	0.7						
2.	ETD006079P	Application of information techniques and numerical methods				1		K1eit_U06 K1eit_U07 InzA_U02 K1eit_K02	15	30	1	0.7	T	Z		P	K	W
3.	ETD006080P	Computer aided modeling of semiconductor devices				1		K1eit_U07 InzA_U01 K1eit_K02	15	30	1	0.7	T	Z		P	K	W
4.	ETD006081P	Computer Aided Design				1		K1eit_U07 InzA_U02 K1eit_K03	15	30	1	0.7	T	Z		P	K	W
		Total	0	0	2	1	0		45	150	5	3,5						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				
11	1	5	10	1	420	900	30	19.9

Semester 7

Obligatory courses

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD007068W	Manufacturing engineering	2					K1eit_K05 K1eit_K06 K1eit_U01 K1eit_W25 K1eit_W27	30	30	1	0.6	T	Z			K	Ob
2.	ETD007211W	Embedded processors	2					S1ec_W03 S1ec_W10	30	30	1	0.6	T	Z			S	Ob
3.	ETD007211L	Embedded processors			1			S1ec_U05 S1ec_U10 InzA_U07 K1eit_K03	15	60	2	1.4	T	Z		P	S	Ob
4.	ETD007212W	Wireless systems	1					S1ec_W08	15	30	1	0.6	T	Z			S	Ob
5.	ETD007212P	Wireless systems				1		S1ec_U08 InzA_U08 K1eit_K02	15	60	2	1.4	T	Z		P	S	Ob
6.	ETD007215S	Diploma seminar					2	K1eit_K03 InzA_K01 K1eit_W01 - K1eit_W30, S1ec_W01 - S1ec_W10 K1eit_U01 - K1eit_U22, S1ec_U01 - S1ec_U11	30	60	2	1.4	T	Z		P	S	Ob
		Total	5	0	1	1	2		135	270	9	6						

Optional courses

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD007069Q	Practice						K1eit_U01 K1eit_U09 InzA_U03 K1eit_K03 K1eit_K06 InzA_K02	160	180	6	4.2	T	Z		P	K	W
2.	ETD007214D	Diploma thesis						K1eit_W01-K1eit_W30 S1ec_W01-S1ec_W10 K1eit_U01-K1eit_U22 S1ec_U01-S1ec_U11 K1eit_K03	30	450	15	10.5	T	Z		P	S	W
		Total	0	0	0	0	0		190	630	21	14.7						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				
5	0	1	1	2	325	900	30	20.7

2. Set of exams in semestral arrangement

Course code	Name of course credited by examination	Semester
FZP001057W MAT001402W MAT001412W	1. Physics 1.1 2. Algebra and analytic geometry 3. Mathematical analysis 1.1A	1
ETD002069W ETD002074W MAT001424W	1. Electricity and magnetism 2. Analog technique 3. Mathematical analysis 2.2A	2
ETD003077W ETD003080W	1. Semiconductor devices I 2. Dielectric and magnetic materials	3
ETD004077W ETD004078W ETD004083W	1. Microsystems I 2. Optoelektronics I 3. Micro- and nanotechnologies	4
ETD005074W ETD005081W ETD005083W	1. Analog and digital electronic circuits I 2. Packaging in electronics and microsystems I 3. Optical fibers I	5
ETD006201W ETD006206W	1. Signal processors 2. Embedded operating systems	6

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

Semester	Allowable deficit of ECTS points after semester
1	15
2	16
3	12
4	8
5	8
6	5

Opinion of the Student Council of the Faculty

....	....
Date	Name, surname and signature of the student's representative

....	....
Date	Dean's signature

PROGRAMME OF EDUCATION

FACULTY: ***Microsystem Electronics and Photonics***

MAIN FIELD OF STUDY: ***Electronics and Telecommunications***

in area of technical science

EDUCATION LEVEL: ***1-st level engineering study***

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

PROFILE: ***general academic***

SPECIALIZATION: ***Electronic and Photonic Engineering***

LANGUAGE OF STUDY: ***Polish***

Content:

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

Microsystem Electronics and Photonics Faculty Council resolution no. ***119/11/2016-2020 of 17.05.2017***

In effect since ***01.10.2017***

Attachment no. 1 to Programme of Education

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

Faculty: Microsystem Electronics and Photonics
Field of study: Electronics and Telecommunications
Level of studies: first level, full time study

<u>Legend:</u>

K (before line/dash) – field-of-study educational effects
W – category of knowledge
U – category skills
K (after line/dash) – category of social competences
T1A – educational effects in the area of technical sciences for the first level study
01, 02, 03 and further – number of educational effects

Field of study educational effects for the 1st level studies in *Electronics and Telecommunications*	**DESCRIPTION OF FIELD OF STUDY EDUCATIONAL EFFECTS** **Upon completion of the first level study in the field of *Electronics and Telecommunications* the graduate:**	**Correlation with educational effects for 1st level study in area of technical sciences (T) and engineering competences (I)**
	KNOWLEDGE	
K1eit_W01	has elemental knowledge concerning materials used in electronic industry	T1A_W02 T1A_W04 T1A_W06 T1A_W07 InzA_W01 InzA_W02
K1eit_W02	knows and understands the processes of design and fabrication of electronic devices	T1A_W07 InzA_W02 InzA_W05
K1eit_W03	has knowledge in the field of mathematics comprising calculus of probability, algebra, analysis and the elements of discrete and applied mathematics, including mathematical and numerical methods necessary to describe and analyze the operation of electronic circuits, electronic devices, analog and digital electronic circuits as well fundamental physical phenomena occurring in these circuits and devices, description and analysis of operation of electronic systems, including the systems containing programmable units, description and analysis of the algorithms of signal processing systems, including sound and image, synthesis of electronic elements, circuits and systems	T1A_W01
K1eit_W04	has knowledge in the field of physics comprising mechanics, thermodynamics, optics, electricity and magnetism, nuclear physics and solid state physics, including the knowledge necessary to understand the fundamental physical phenomena occurring in electronic systems and devices as well as their surroundings	T1A_W01 T1A_W02 T1A_W04
K1eit_W05	has knowledge concerning theoretical and experimental bases from the field of solid state electronics and photonics	T1A_W01

K1eit_W06	has knowledge on the phenomena of electric and magnetic polarization and electrical conductivity for solving technical problems	T1A_W01
K1eit_W07	understands optical phenomena and processes occurring in semiconductors; understands physical basis of operation of typical optoelectronic devices and circuits used in telecommunication, medicine; has knowledge on advanced technologies of fabrication and mechanical treatment, measurement techniques and sensors	T1A_W04 InzA_W05
K1eit_W08	knows and understands the processes of fabrication of electronic devices, integrated circuits and microsystems	T1A_W04 T1A_W07 InzA_W02 InzA_W05
K1eit_W09	has ordered and theoretically grounded knowledge from the field of photonics, including the knowledge necessary to understand physical basis of operation of optical communication systems	T1A_W01 T1A_W03 T1A_W04
K1eit_W10	knows physical and chemical processes for microsystem manufacturing	T1A_W04 T1A_W07 InzA_W02 InzA_W05
K1eit_W11	knows the issues concerning exploitation and reliability of electronic devices	T1A_W03 T1A_W06 T1A_W08 InzA_W01 InzA_W03
K1eit_W12	has general knowledge on microwave technologies and basic methods of designing and analysis of microwave circuits	T1A_W01 T1A_W04
K1eit_W13	has knowledge on specific tools and informatics technologies useful during the course of technical studies, including operating systems, office facilities, mathematical packages, databases and basics of programming	T1A_W02 InzA_W05
K1eit_W14	has knowledge on the methods of analyzing and processing signals in time and frequency domains	T1A_W01 T1A_W04

K1eit_W15	has knowledge on available integrated circuits, their parameters and application	T1A_W03 T1A_W04 T1A_W07 InzA_W02
K1eit_W16	has knowledge on logic circuits	T1A_W02 T1A_W03 T1A_W04 T1A_W07 InzA_W02
K1eit_W17	has knowledge on the architecture of microprocessor systems and their programming	T1A_W03 T1A_W04 T1A_W07 InzA_W02
K1eit_W18	is familiar with analog and digital technologies of data transmission	T1A_W02 T1A_W03 T1A_W05 T1A_W07 T1A_W08 InzA_W02 InzA_W03
K1eit_W19	understands the physical basis of functioning semiconductor devices and the meaning of their parameters	T1A_W02
K1eit_W20	knows basic concepts of metrology and the methods of measurement of electrical quantities	T1A_W03 T1A_W07 InzA_W02
K1eit_W21	is familiar with basic techniques of packaging in electronics	T1A_W04 T1A_W06 T1A_W07 InzA_W01 InzA_W02 InzA_W05

K1eit_W22	is familiar with the principles of computer networks functioning	T1A_W02 T1A_W05 T1A_W08 InzA_W03
K1eit_W23	knows the fundamentals of the theory of circuits with passive elements	T1A_W01 T1A_W02
K1eit_W24	knows the principles of computer programming in C/C++ language	T1A_W02 T1A_W07 InzA_W02
K1eit_W25	has basic knowledge concerning management, quality management and running business	T1A_W09 InzA_W04
K1eit_W26	knows and understands basic rules and concepts concerning industrial property protection and copyright laws; can use the resources of patent information	T1A_W10
K1eit_W27	knows general rules on establishing and developing the forms of individual entrepreneurship, using the knowledge from the field of science and scientific disciplines relevant to the field of study	T1A_W11
K1eit_W28	knows the principles and methods of object-oriented programming	T1A_W02 T1A_W07 InzA_W02
K1eit_W29	knows and understands industrial safety rules	T1A_W08 InzA_W03
K1eit_W30	achieves results in the category of KNOWLEDGE in one of the following specializations: • Electronic and Photonic Engineering – IEF • Digital Electronics – EC	
K1eit_W31	knows rules concerning the principles of construction documentation (sections, views, cross-sections), dimensioning and normalization in technical documentation	T1A_W03
SKILLS		
K1eit_U01	is able to choose materials, components and design of devices according to technical requirements and exploitation conditions	T1A_U16 InzA_U08
K1eit_U02	is able, by himself/herself to solve the tasks from the field of algebra, mathematical analysis, calculus of probability and mathematical statistics	T1A_U09 InzA_U02

K1eit_U03	is able to estimate parameters of wave motion	T1A_U14 InzA_U06
K1eit_U04	is able to measure basic properties of dielectrics, magnetics and semiconductors, understands the mechanisms of physical phenomena occurring in the materials	T1A_U07 T1A_U02
K1eit_U05	is able, by himself/herself, to solve the problems concerning relations between reliability parameters, methods of device testing, characteristics of repairable systems, reliability prediction	T1A_U15 InzA_U07
K1eit_U06	is able, by himself/herself, to realize a project of a simple microwave filter, resonator, coupler, detector, mixer, motion sensor etc. using available CAD software and literature	T1A_U01 T1A_U06
K1eit_U07	is able, by himself/herself to develop an own project (from computer aided modeling, analysis of feasibility to economic analysis of undertaken activity) of a chosen device	T1A_U16 InzA_U08
K1eit_U08	is able to develop a computer program in C/C++ language	T1A_U07
K1eit_U09	knows and applies industrial safety rules	T1A_U11
K1eit_U10	is able to configure and diagnose connections between computers	T1A_U01 T1A_U10 InzA_U03
K1eit_U11	is able to design, implement and test simple logic circuits	T1A_U08 InzA_U01
K1eit_U12	is able to model electronic circuits with passive elements	T1A_U09 InzA_U02
K1eit_U13	is able to handle measuring equipment and design measurement systems	T1A_U01 T1A_U08 T1A_U11 InzA_U01
K1eit_U14	is able to deal with semiconductor devices in static and dynamic systems	T1A_U08 T1A_U11 InzA_U01
K1eit_U15	is able to deal with the techniques and equipment for surface and wire bonding	T1A_U10 T1A_U12 InzA_U03 InzA_U04

K1eit_U16	is able to design, build, implement and test electronic circuits	T1A_U05 T1A_U15 T1A_U16 InzA_U07 InzA_U08
K1eit_U17	is able to perform signal analysis using Fourier methods, can design filters, can handle the hardware and DSP software	T1A_U14 T1A_U15 InzA_U06 InzA_U07
K1eit_U18	is able to program microprocessor, microcontroller and assess its functional capability	T1A_U01 T1A_U05 T1A_U16 InzA_U08
K1eit_U19	is able to prepare and give in Polish and foreign language, an oral presentation concerning detailed tasks relevant to the studied discipline	T1A_U04
K1eit_U20	is able to write computer software	T1A_U07
K1eit_U21	achieves results in the category of SKILLS in one of the following specializations: • Electronic and Photonic Engineering – IEF • Digital Electronics – EC	
K1eit_U22	is able to draw simple 3-dimensional geometric elements with the traditional drawing technique and is able to create and read technical documentation	T1A_U02 T1A_U03
COMPETENCES		
K1eit_K01	perceives the necessity of using statistical methods for description of collected data	T1A_K01
K1eit_K02	understands the necessity to use new techniques and technologies in engineering activity, can define objectives and predict results of undertaken experimental works	T1A_K02 T1A_K05 InzA_K01
K1eit_K03	is able to work individually and in a team	T1A_K03
K1eit_K04	is able to correctly define the priorities for realization of a particular task	T1A_K04
K1eit_K05	is conscious of the importance and understands beyond technical aspects and consequences of engineering activity, including the environmental aspects and responsibility for undertaken decisions	T1A_K02 InzA_K01

K1eit_K06	is able to think and act in a creative and entrepreneurial way	T1A_K06 InzA_K02
K1eit_K07	is conscious of the social role of technical university graduates, understands the need of sharing in society, in an understandable way, the information and opinions concerning the achievements in technique	T1A_K07
K1eit_K08	knows basic rules from the field of ethics, has a basic knowledge, necessary to understand the aspects of engineering activity, correctly identifies and recognizes ethical dilemmas	T1A_K05
K1eit_K09	thinks that the conscious and systematic physical activity during studies and after graduation, helps in improvement of life quality	T1A_K01 T1A_K03
K1eit_K10	can working in a team, according to the specified rules and fair play rules, during participation in different forms of physical activity	T1A_K03

Where:
K1yyy – symbol for the field of study at the first level
K2yyy – symbol for the field of study at the second level
_W01, _W02, … – symbols for educational effects concerning KNOWLEDGE
_U01, _U02, … – symbols for educational effects concerning SKILLS
_K01, _K02, … – symbols for educational effects concerning COMPETENCES
T – educational area in the field of technical sciences
1 – first level study,
2 – second level study
A – general academic profile, P – practical profile

EDUCATIONAL EFFECTS FOR IEF SPECIALIZATION

Faculty: Microsystem Electronics and Photonics
Field of study: Electronics and Telecommunications
Level of studies: first level, full time study
Specialization: Electronic and Photonic Engineering (IEF)

Specialization educational effects at the 1st level study in *Electronic and Photonic Engineering*	**DESCRIPTION OF EDUCATIONAL EFFECTS** **Upon completion of the first level study in the field of *Electronics and Telecommunications* within the *Electronic and Photonic Engineering* specialization the graduate:**	**Correlation with educational effects for 1st level study in area of technical sciences (T) and engineering competences (I)**
KNOWLEDGE		
S1ief_W01	knows mechanisms of amplification and generation of electromagnetic radiation, its modulation and detection; has knowledge on the applications of laser technology	T1A_W01 T1A_W03 T1A_W04
S1ief_W02	knows the functioning principles of devices for optoelectronic image processing	T1A_W01 T1A_W03
S1ief_W03	has knowledge on the structure and functioning of specific microsystems and the possibilities of their application in biology and medicine; knows how to choose suitable microsystem device and/or and equipment to realize particular tasks in professional practice, basing on the acquired knowledge, catalogues or Internet	T1A_W05
S1ief_W04	understands the structure, operating principle and application of sensor systems in microsystems and automotive technologies	T1A_W04
S1ief_W05	has knowledge concerning micromechanical sensors and actuators and microsystems: their structure, operation, basic phenomena, performance and application in technology	T1A_W04

S1ief_W06	has knowledge on classification, methods of vacuum production and methods of vacuum measurement	T1A_W04 InzA_W05
S1ief_W07	has knowledge on wireless techniques of information transmission, knows classification and mechanisms of radio waves propagation, knows classification and specific kinds of wireless communication systems	T1A_W02
S1ief_W08	has ordered and theoretically grounded knowledge concerning phenomena occurring in gaseous plasma discharge and their use in technological processes applied in widely understood thin-film micro- and nano-electronics and semiconductor device technologies	T1A_W01 InzA_W05
S1ief_W09	has knowledge on building access and security systems	T1A_W04 T1A_W07 InzA_W02
S1ief_W10	has knowledge on using multimedia techniques for realization of educational and technical tasks	T1A_W05
SKILLS		
S1ief_U01	is able, by himself/herself to develop a project in the field of microelectronic technologies for fabrication of a specific component or device; can design, build and use microsystems in practice	T1A_U14 T1A_U10 InzA_U03 InzA_U06
S1ief_U02	is able to use the knowledge concerning basic structures of electronic and optoelectronic devices and components and basis of telecommunication; is able to explain the structure and principles of operation of optoelectronic devices, is able by himself/herself to realize the design and technological projects in the fields of optoelectronics and telecommunication, with special emphasis on the specific properties and requirements of AIIIBV semiconductor compounds; uses proper simulation programs for computer aided design and engineering work and for processing and documentation of calculation and simulation results	T1A_U01 T1A_U02
S1ief_U03	is able, by himself/herself, to perform investigation of basic properties of laser beams and basic techniques of modulation and detection of laser radiation	T1A_U09 InzA_U02
S1ief_U04	performs measurements of basic parameters of the equipment for optoelectronic image processing and is able to handle the equipment	T1A_U09 T1A_U13 InzA_U02 InzA_U05

S1ief_U05	is able to analyze physical phenomena occurring in different types of microsystems; is able to model the properties and operation of microsystems	T1A_U08 T1A_U05 T1A_U07 T1A_U13 InzA_U01 InzA_U05
S1ief_U06	performs measurements of simple sensor systems used in automotive technology	T1A_U13 T1A_U14 InzA_U05 InzA_U06
S1ief_U07	performs measurements of basic properties of optical fibers and fiber bundles	T1A_U09 InzA_U02
S1ief_U08	performs measurement of basic parameters of vacuum	T1A_U08 InzA_U01
S1ief_U09	is able, by himself/herself, to put together and run a communication system for specific standards of wireless data transmission	T1A_U07
S1ief_U10	is able to propose and design, a relevant to desired properties of realized structure (thin-film, semiconductor), flow of a plasma-added technological process (PVD, CVD) and assess the results of interactions in the ion-film-structure	T1A_U08 InzA_U01
S1ief_U11	is able to prepare a presentation with the use of multimedia aids, also in a foreign langue regarded as a basic one in the studied discipline	T1A_U07
S1ief_U12	is able to design a protecting and monitoring alarm system	T1A_U13 T1A_U16 InzA_U05 InzA_U08
S1ief_U13	is able to program microprocessor, microcontroller and assess its functional capability	T1A_U16
S1ief_U14	is able to identify and formulate specification of complex engineering tasks (characteristic of the studied discipline), including the unusual ones, considering also their beyond technical aspects	T1A_U14
S1ief_U15	is able, by himself/herself, to solve the problems connected with reliability, methods of investigation, characteristics of repairable systems	T1A_U15

Where:
S1yyy – symbol for specialization at the first level study
S2yyy – symbol for specialization at the second level study
_W01, _W02, … – symbols for educational effects concerning KNOWLEDGE
_U01, _U02, … – symbols for educational effects concerning SKILLS
_K01, _K02, … – symbols for educational effects concerning COMPETENCES
T – educational area in the field of technical sciences
1 – first level study,
2 – second level study
A – general academic profile, P – practical profile

Attachment no. 2 to Programme of Education

PROGRAMME OF STUDIES

1. Description

Number of semesters: ***7***	*Number of ECTS points necessary to obtain qualifications:* ***210***
Prerequisites: ***The decision of enrollment is based on the RECRUITMENT INDICATOR. Its value is determined by the selected results of the matura exam. RECRUITMENT INDICATOR is the sum of the points from the qualification courses (mathematics, physics, Polish, a modern foreign language), calculated in accordance with the principles of the candidates admissions adopted by the Senate.*** ***The threshold value of the recruitment rate is determined depending on the number of candidates.***	*Upon completion of studies graduate obtains* *professional degree of:* ***engineer*** *1-st level qualifications*
Possibility of continuing of the studies: ***The graduate is prepared to undertake study at the second level***	*Graduate profile, employability:* ***The graduate has knowledge and skills to implement and operate electronic circuits, devices and systems and the systems of telecommunication networks and services. Is prepared to work in the enterprises producing electronic and telecommunication equipment as well as in the network operating companies and telecommunication services providers. Knows a foreign language at B2 level of the Common European Framework for Languages and has the ability to use a specialist language in the field of electronics and telecommunications***
Indication of the connection with University's mission and its development strategy: *Wrocław University of Science and Technology is a pubic academy with a status of technical university, acting on the basis of the Act of July 27, 2005 "Law on Higher Education" and University Statute. In the plan of development of Wrocław University of Science and Technology there is a statement "The expression of mission underlines the role of university in maintaining and developing the competences associated with the culture of experimentation. The competences are the foundations of contemporary civilization, they determine its existence and are the main factor of its development. At the time when experimentations tend to be replaced by procedures and when pretences are considered as more important than facts, the mission is of fundamental importance.*	

Stress on creativity which changes the trajectories of future

Stress on professionalism and real skills which are the condition of technosphere functioning

Stress on partnership and cooperation with local and external partners, which enhances the effects of activities and facilitates their achievement."

This expression has been directly transferred to the Plan of Development of the Faculty of Electronic Microsystems and Photonics, but there, the word "University" has been replaced by "Faculty". It means that if an academic unit is to play the role of an intellectual center, it must understand the contemporary world and have a vision of the future. As an important technical university, Wrocław University of Science and Technology "links high theoretical, research and expert competences with the educational and didactic activities". For this reason, the main feature of the Faculty of Microsystem Electronics and Photonics of Wrocław University of Science and Technology" is its high external usefulness" The already mentioned plan of Faculty development says that "at the Faculty, the dominant role play design and technological research works associated with micro- and nanoelectronics, micro- and nanosystems and micro- and nanophotonics. This research subject is transferred into the educational profile, especially at the 2-nd and 3-rd levels. The educational profile is supplemented with the university-wide subjects, encompassing liberal-managerial subjects which create the basis of engineer's cultural education, and are available for the whole students' community". So outlined mission and vision of University/Faculty has been incorporated into the educational model, proposed by the Faculty, i.e. "interactive, discursive and experimental shaping of students' skills". Currently, the Faculty of Microsystem Electronics and Photonics educates B. Sc. engineers and M.Sc. engineers, the specialists in the field of electronics, photonics, informatics and telecommunications. The Faculty graduate is able to design and apply electronic integrated circuits - both analog and digital. Knows how to design and apply lasers, optical fibers and photovoltaic cells in solar power plants. Is able to design and operate telecommunication and teleinformatic networks. Is able to design, manufacture and apply micro- and nanosystems, i.e. microrobots used in medicine, automotive and aircraft industry, pharmacy, environment protection, building security systems and armaments industry. In the perspective of 2020, the Faculty is planning to lead or co-lead with other units of Wrocław University of Science and Technology, the following fields of study: "Electronics – 1-st and 2-nd levels (the 2-nd level oriented to Micro- and Nanoengineering), Optoelectronics (and possibly Photonics) - 1-st and 2-nd level, Materials Engineering – 1-st level." This is associated with interdisciplinary character of conducted in the Faculty research and development works. We are going to lead, "within our competences, post-graduate study and the studies of II and III age." In the currently prepared and developed concept there is included the education of specialists and innovators, which takes into account individual student's abilities. We would like to stimulate the skills enhancing competitiveness on the labor market and teach cooperation as well as provide international contacts. The way to realize this goal is, among the others, to follow the development of faculties which lead similar subjects in the world and adapt the reasonable solutions to our specificity. Student, who fulfill particular conditions may get an individual tutor and study according to interdisciplinary paths, shaped in accordance with their individual interests (the idea is possible to realize in the Faculty due to the favorable ratio of the number of students and the number of academic teachers). We are doing our best to balance our educational programme so as it contained, in suitable proportion, the knowledge enabling further professional adaptation and the knowledge building a rational image of the world.

2. **Fields of science and scientific disciplines to which educational effects apply:**
   Area: technical sciences
   Discipline: electronics
3. **Concise analysis of consistency between assumed educational effects and labor market needs**

The resources of knowledge, skills and social competences of the students/graduates of the Faculty in the field "Electronics and Telecommunication" result from assigning the educational effects at a particular field of study to the provided courses. The educational effects associated with specialization, related to the educational effects in the area of technical sciences, should provide the students/graduates (at the particular educational level) with elemental knowledge (1-st level) and theoretically grounded detailed knowledge (2-nd level) in the range of engineering areas connected with the Electronics and Telecommunication field of study or other disciplines. The applied solutions concerning "enhanced" competences upon achieving a higher qualification level and, at the same time, securing "accessibility" of the 1-st and 2-nd level studies, make possible to acquire at the higher level, more advanced knowledge and skills (at specified social competences) but in a narrower subject range. The potential prospective employers should be aware of the students/graduates of the 1-st and 2-nd level studies level of knowledge, skills and social competences.

The basic and detailed knowledge, acquired by a student/graduate in a particular area should be wide enough to enable him/her self-study within the lifetime learning process to adapt his/her competences to the changing conditions and challenges which may emerge during a long-lasting professional career. Such expectations have the employers who implement modern work organization and innovative technologies in their enterprises. The assigned to courses effects, achieved during the educational process, enable, according to the expectations of prospective employers, acquiring by the graduate the knowledge about trends in development and novel, currently implemented achievements not only in the field of electronics and telecommunications, optoelectronics, photonics and informatics but also in medicine or environment protection.

The assumed effect concerning knowledge in the educational process is acquiring by the graduate the basic knowledge about technology transfer as well as the knowledge associated with management (including quality management) and running business. As educational effect should also be concerned the general knowledge used in engineering practice, necessary to understand, social, economic, legal and other beyond technical aspects of engineering activities. The effects are attained by realization of university-wide courses, Such knowledge will enable the graduates to understand the realities concerning organization of production processes and conditions in which they are conducted. It would enable them to take into account these conditions in individual and team job, which they would be able to take up as a result of achieving these goals. Such resources of knowledge are expected to be acquired by an university graduate in the contemporary labour market. The educational effects, included in the subject cards of the courses realized in the field of study, assure additionally achieving by the graduate the ability to integrate the knowledge from various areas and disciplines with the application of system approach in formulating and solving engineering tasks. The labor market expects that the effects achieved by the graduates as a result of the educational process, will prepare them to the work in an industrial environment, with the knowledge of industrial safety rules connected with the work, especially with the work at a particular stand/apparatus. In this respect, the effects achieved during realization of laboratory courses and the courses such as Students' practice, are especially important. Student/graduate should perceive the need of improvement and modification of production process or the solutions existing on the working place. Upon achieving the assumed educational effects, they should be able, taking into account beyond technical aspects, according to the given specification, to design and complete (using suitable methods, techniques and tools) a complex device, system or process.

Having in mind that the objective of the assumed and achieved educational effects in the specialization field of study is to fulfill, at possibly high level, the expectations of entrepreneurs who employ our graduates, an important aspect of evaluation of educational process are hospitations conducted during each semester and faculty polls addressed to graduates. Verification of conformity of the assumed educational effects and the market expectations and needs takes place during numerous meetings of our graduates with the Faculty staff.

4. List of education modules

4.1. List of obligatory modules

4.1.1. List of general education modules

4.1.1.1. *Liberal-managerial subjects* module

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	FLH121611W	Ethics in business	2						30	60	2	1.2	T	Z	O		KO	Ob
2.	PKH120411W	Social communication	1						15	30	2	1.2	T	Z	O		KO	Ob
		Total	3	0	0	0	0		45	90	4	2.4						

4.1.1.2. *Foreign languages* module

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

4.1.1.3. *Sporting classes* module

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

4.1.1.4. *Information Technologies* module

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD001068W	Information technologies	1					K1eit_W13 InzA_W02 K1eit_W24 K1eit_W17	15	30	1	0.6	T	Z			KO	Ob
2.	ETD001068L	Information technologies			1			K1eit_U21 K1eit_K02 InzA_U02 K1eit_U20 K1eit_U08 K1eit_K03 InzA_K02	15	30	1	0.7	T	Z		P	KO	Ob
		Total	1	0	1	0	0		30	60	2	1.3						

Altogether for general education modules:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				
4	0	1	0	0	75	150	6	3.7

4.1.2. List of basic sciences modules

4.1.2.1. *Mathematics* module

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	MAT001402W	Algebra and analytic geometry	2					K1eit_W03	30	60	2	1.2	T	E	O		PD	Ob
2.	MAT001402C	Algebra and analytic geometry		1				K1eit_U02	15	60	2	1.4	T	Z	O	P	PD	Ob
3.	MAT001412W	Mathematical analysis 1.1 A	2					K1eit_W03	30	150	5	3.0	T	E	O		PD	Ob
4.	MAT001412C	Mathematical analysis 1.1 A		2				K1eit_U02 K1eit_K01	30	90	3	2.1	T	Z	O	P	PD	Ob
5.	MAT001424W	Mathematical analysis 2.2 A	3					K1eit_W03	45	150	5	3.0	T	E	O		PD	Ob
6.	MAT001424C	Mathematical analysis 2.2 A		2				K1eit_U02 K1eit_K01	30	90	3	2.1	T	Z	O	P	PD	Ob
7.	ETD002073W	Probabilistics	1					K1eit_W03 InzA_W02 K1eit_K01 InzA_K01	15	30	1	0.6	T	Z			PD	Ob
8.	ETD002073C	Probabilistics		1				K1eit_U02 InzA_U02 K1eit_K01 InzA_K01	15	60	2	1.4	T	Z		P	PD	Ob
		Total	8	6	0	0	0		210	690	23	14.8						

4.1.2.2. *Physics* module

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	FZP001057W	Physics 1.1	2					K1eit_W04 InzA_W02 InzA_K01	30	120	4	1.2	T	E	O		PD	Ob
2.	FZP001057C	Physics 1.1		1				K1eit_U03 K1eit_U04	15	30	1	0.7	T	Z	O	P	PD	Ob

3.	FZP002079L	Physics 3.1			1			K1eit_W20 K1eit_W29 K1eit_U04 K1eit_U13 K1eit_U19 K1eit_K03	15	60	2	1.4	T	Z	O	P	PD	Ob
4.	ETD002069W	Electricity and magnetism	2					K1eit_W04 K1eit_W06 InzA_W02 K1eit_K03 K1eit_K07	30	60	2	1.2	T	E			PD	Ob
5.	ETD002069C	Electricity and magnetism		2				K1eit_K03 K1eit_K07 K1eit_U04 K1eit_U19	30	60	2	1.4	T	Z		P	PD	Ob
6.	ETD003083W	Principles of solid state electronics	2					K1eit _W05 K1eit _W04 InzA_W02	30	60	2	1.2	T	Z			PD	Ob
7.	ETD003089W	Wave optics	1					K1eit_W04 K1eit_W07 K1eit_W09 InzA_W02	15	30	1	0.6	T	Z			PD	Ob
		Total	7	3	1	0	0		165	420	14	7.7						

4.1.2.3. *Chemistry* module

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD001070W	Materials engineering	2					K1eit_W01 InzA_W02	30	60	2	1.2	T	Z			PD	Ob
		Total	2	0	0	0	0		30	60	2	1.2						

4.1.2.4. *Informatics* module

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD001269W	The basics of computer networks	1					K1eit_W22 InzA_W02 InzA_W05	15	30	1	0.6	T	Z			PD	Ob
2.	ETD001269L	The basics of computer networks			1			K1eit_U10 K1eit_U19 InzA_U08	15	30	1	0.7	T	Z		P	PD	Ob
3.	ETD002071W	Informatics	2					K1eit_W24 InzA_W02	30	60	2	1.2	T	Z			PD	Ob
4.	ETD002071L	Informatics			2			K1eit_U08 K1eit_U20 InzA_U07 K1eit_K03 InzA_K01	30	60	2	1.4	T	Z		P	PD	Ob
5.	ETD003079W	Scripting language	1					K1eit_W28 InzA_W02	15	30	1	0.6	T	Z			PD	Ob
6.	ETD003079L	Scripting language			1			K1eit_U20 InzA_U01 K1eit_K03 InzA_K01	15	30	1	0.7	T	Z		P	PD	Ob
		Total	4	0	4	0	0		120	240	8	5.2						

Altogether for basic sciences modules:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				
21	9	5	0	0	525	1410	47	28.7

4.1.3. List of main-field-of-study modules

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

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD001066W	Introduction to electronics	2					K1eit_W01 K1eit_W02 InzA_W02 InzA_K01	30	60	2	1.2	T	Z			K	Ob
2.	ETD001067W	Engineering graphics	1					K1eit_W02 InzA_W02 InzA_K01	15	30	1	0.6	T	Z			K	Ob
3.	ETD001067P	Engineering graphics				2		K1eit_U01 K1eit_K07	30	60	2	1.4	T	Z		P	K	Ob
4.	ETD002070W	Introduction to digital and microprocessor systems I	2					K1eit_W16 K1eit_W15 InzA_W02	30	60	2	1.2	T	Z			K	Ob
5.	ETD002072W	Metrology I	2					K1eit_W20 InzA_W02 InzA_U01	30	60	2	1.2	T	Z			K	Ob
6.	ETD002074W	Analog technique	2					K1eit_W23 InzA_W02	30	60	2	1.2	T	E			K	Ob
7.	ETD002074C	Analog technique		2				InzA_W02 K1eit_U01 K1eit_ U09 K1eit_U17 InzA_U03 Keit_K02 InzA_K01	30	90	3	2.1	T	Z		P	K	Ob
8.	ETD003077W	Semiconductor devices I	2					K1eit_W07 K1eit_W08 K1eit_W15 InzA_W02	30	90	3	1.8	T	E			K	Ob
9.	ETD003077L	Semiconductor devices I			3			K1eit_K03 InzA_K01 K1eit_U13 K1eit_U14 InzA_U01	45	120	4	2.8	T	Z		P	K	Ob
10.	ETD003078W	Introduction to digital and microprocessor systems II	1					K1eit_W17 InzA_W02 K1eit_K03 InzA_K01	15	30	1	0.6	T	Z			K	Ob

11.	ETD003078L	Introduction to digital and microprocessor systems I			2			K1eit_U11 InzA_U01 K1eit_K03 InzA_K01	30	60	2	1.4	T	Z		P	K	Ob
12.	ETD003080W	Dielectric and magnetic materials	2					K1eit_W06 InzA_W02	30	90	3	1.8	T	E			K	Ob
13.	ETD003081L	Metrology II			2			K1eit_U13 InzA_U01 Kleit_K03 InzA_K01	30	60	2	1.4	T	Z		P	K	Ob
14.	ETD004076W	Analog and digital electronic circuits I	2					K1eit_W03 InzA_W02	30	60	2	1.2	T	Z			K	Ob
15.	ETD004076P	Analog and digital electronic circuits I				1		K1eit_U01, K1eit_U14 InzA_U06 K1eit_K02- K1eit_K04	15	60	2	1.4	T	Z		P	K	Ob
16.	ETD004077W	Microsystems I	2					K1eit_W05 InzA_W05	30	60	2	1.2	T	E			K	Ob
17.	ETD004078W	Optoelectronics I	2					K1eit_W01 K1eit_W04 K1eit_W19 InzA_W02	30	60	2	1.2	T	E			K	Ob
18.	ETD004079W	Foundations of electronic apparatus construction	2					K1eit_W02 K1eit_W11 K1eit_K04 K1eit_K05 K1eit_U01 InzA_W05	30	60	2	1.2	T	Z			K	Ob
19.	ETD004080L	Semiconductor, dielectric and magnetic materials			3			Kleit_K03 Kleit_U04 InzA_U01	45	120	4	2.8	T	Z		P	K	Ob
20.	ETD004081L	Semiconductor devices II			3			K1eit_U13 K1eit_U14 InzA_U01 K1eit_W07 K1eit_W08 K1eit_W15 K1eit_K03 K1eit_K03 K1eit_K04	45	120	4	2.8	T	Z		P	K	Ob
21.	ETD004083W	Micro- and nano- technologies	3					K1eit_W08 InzA_W05	45	120	4	2.4	T	E			K	Ob
22.	ETD005074W	Analog and digital electronic circuits II	2					K1eit_W03 InzA_W02	30	60	2	1.2	T	E			K	Ob

23.	ETD005074L	Analog and digital electronic circuits II			2			K1eit_U01 K1eit_U14 InzA_U06 K1eit_K02 K1eit_K04 K1eit_K03 K1eit_K08	30	90	3	1.4	T	Z		P	K	Ob
24.	ETD005075L	Microelectronics laboratory			4			K1eit_W08 K1eit_U01 InzA_U07 K1eit_K02 K1eit_K03	60	120	4	2.8	T	Z		P	K	Ob
25.	ETD005076W	Metrology of optoelectronic elements	1					K1eit_W05 K1eit_W07 K1eit_W09	15	30	1	0.6	T	Z			K	Ob
26.	ETD005076L	Metrology of optoelectronic elements			2			K1eit_U09 K1eit_U13 K1eit_U14 InzA_U01 K1eit_K03	30	60	2	1.4	T	Z		P	K	Ob
27.	ETD005080W	Microprocessors and microcontrollers	2					K1eit_W17 K1eit_W30 InzA_W02 K1eit_U18 InzA_U06 K1eit_K04	30	60	2	1.2	T	Z			K	Ob
28.	ETD005080L	Microprocessors and microcontrollers			2			K1eit_W17 K1eit_W30 InzA_W02 K1eit_U18 InzA_U06 K1eit_K04	30	60	2	1.4	T	Z		P	K	Ob
29.	ETD005081W	Packaging in electronics and microsystems I	2					K1eit_W02 K1eit_W21 InzA_W05 K1eit_U15 K1eit_K04	30	60	2	1.2	T	E			K	Ob
30.	ETD005082W	Signal processing	2					K1eit_W14 K1eit_K02	30	60	2	1.2	T	Z			K	Ob
31.	ETD005082L	Signal processing			1			K1eit_U17 InzA_U02 K1eit_K02	15	30	1	0.7	T	Z		P	K	Ob
32.	ETD005083W	Optical fibers I	2					K1eit_W05 K1eit_W09 InzA_W02	30	60	2	1.2	T	E			K	Ob

33.	ETD006076L	Packaging in electronics and microsystems II			2			K1eit_W02 K1eit_U15 K1eit_K03 InzA_U08	30	60	2	1.4	T	Z		P	K	Ob
34.	ETD006077W	Basics of system operating	1					K1eit_W11 InzA_W01 K1eit_K01	15	30	1	0.6	T	Z			K	Ob
35.	ETD006077C	Basics of system operating		1				K1eit_U05 K1eit_U05 InzA_U05 K1eit_K01	15	30	1	0.7	T	Z		P	K	Ob
36.	ETD006078W	Microwave techniques	1					K1eit_W02, K1eit_W12 InzA_W02	15	30	1	0.6	T	Z			K	Ob
37.	ETD006078P	Microwave techniques				2		K1eit_U06 InzA_U08 K1eit_K02 K1eit_K03	30	60	2	1.4	T	Z		P	K	Ob
38.	ETD007068W	Manufacturing engineering	2					K1eit_K05 K1eit_K06 K1eit_U01 K1eit_W25 K1eit_W27	30	30	1	0.6	T	Z			K	Ob
		Total	40	3	26	5	0		1110	2460	82	52.5						

Altogether for main-field-of-study modules:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				
40	3	26	5	0	1110	2460	82	52.5

4.1.4. List of specialization modules

4.1.3.1. *Obligatory specialization subjects* modules

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD004102W	Vacuum technique	2					S1ief_W06 InzA_W02	30	90	3	1.8	T	Z			S	Ob
2.	ETD004102L	Vacuum technique			1			S1ief_U08 InzA_U01 K1eit_K02 K1eit_K03	15	60	2	1.4	T	Z		P	S	Ob
3.	ETD005101P	Optoelektronics II				2		S1ief_U02 InzA_U02 K1eit_K03	30	60	2	1.4	T	Z		P	S	Ob
4.	ETD005102L	Microsystem modelling			2			S1ief_U05 InzA_U02 K1eit_K02	30	90	3	1.8	T	Z		P	S	Ob
5.	ETD005103W	Microsystems modelling	2					S1ief_W03 InzA_W03	30	60	2	1.2	T	Z			S	Ob
6.	ETD006101W	Automotive microsystems	1					K1eit_W30, S1ief_W04	15	30	1	0.6	T	Z			S	Ob
7.	ETD006101L	Automotive microsystems			1			K1eit_U21 S1ief_U06 InzA_U01 K1eit_K03	15	30	1	0.7	T	Z		P	S	Ob
8.	ETD006102W	Imaging optoelectronics	2					S1ief_W02	30	60	2	1.2	T	E			S	Ob
9.	ETD006102L	Imaging optoelectronics			1			S1ief_U04 InzA_U01 K1eit_K03	15	30	1	0.7	T	Z		P	S	Ob
10.	ETD006103L	Optical fibers II			2			S1eit_U07 InzA_U06 K1eit_K03	30	60	2	1.4	T	Z		P	S	Ob
11.	ETD006104W	Ion and plasma techniques	2					S1ief_W08 InzA_W02	30	60	2	1.2	T	E			S	Ob
12.	ETD006104L	Ion and plasma techniques			1			S1ief_U10 PEK_U02 K1eit_K02 K1eit_K03 InzA_K0	30	60	2	1.4	T	Z		P	S	Ob
13.	ETD006105W	Building Access Control and Security Systems	1					S1ief_W09 InzA_W01	15	30	1	0.6	T	Z			S	Ob

14.	ETD006105L	Building Access Control and Security Systems			2			S1ief_U12 InzA_U03 K1eit_K03	30	60	2	1.4	T	Z		P	S	Ob
15.	ETD006106W	Microsystems II	2					S1ief_W05 InzA_W02	30	60	2	1.2	T	E			S	Ob
16.	ETD006106P	Microsystems II				2		S1ief_U01 K1eit_K03 InzA_U07	30	60	2	1.4	T	Z		P	S	Ob
17.	ETD007101W	Laser technique	1					S1ief_W01	15	30	1	0.6	T	Z			S	Ob
18.	ETD007101L	Laser technique			2			S1ief_U03 InzA_U01	30	60	2	1.4	T	Z		P	S	Ob
		Total	13	0	12	4	0		450	990	33	21,4						

Altogether for specialization modules:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				
13	0	12	4	0	450	990	33	21.4

4.2. List of optional modules

4.2.1. List of general education modules

4.2.1.1. *Liberal-managerial subjects* modules

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
	ZMD100001BK	Optional Block D – Management	1						15	30	1	0.6	T	Z	O	P	KO	W
		Total	1	0	0	0	0		15	30	1	0.6						

4.2.1.2. *Foreign languages* module

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	JZL100707BK	Foreign language		4					60	60	2	1.4	T	Z	O	P	KO	W
2.	JZL100708BK	Foreign language B2		4					60	90	3	2.1	T	E	O	P	KO	W
		Total	0	8	0	0	0		120	150	5	3.5						

4.2.1.3. *Sporting classes* module

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	WFW010000BK	Sport		2					30	0	0	0	T	Z	O	P	KO	W
		Total	0	2	0	0	0		30	0	0	0						

4.2.1.4. *Information Technologies module*

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

Altogether for general education modules:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				
1	10	0	0	0	165	180	6	4.1

4.2.2. List of basic sciences modules

4.2.2.1. *Mathematics* module

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

4.2.2.2. *Physics* module

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

4.2.2.3. *Chemistry* module

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

Altogether for basic sciences modules:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				

4.2.3. List of main-field of science modules

4.2.3.1. *Optional main-field-of-study* modules

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol**)**	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD006075L	Open laboratory (electronics)			2			K1eit_U14 InzA_U07 K1eit_K03	30	120	4	2.8	T	Z		P	K	W
	ETD100012BK	BLOCK A	2			2			60	150	5	3.3						
2.	ETD003084W	Low level programming in C language	2					K1eit_W17 InzA_W02	30	60	2	1.2	T	Z			K	W
3.	ETD003084P	Low level programming in C language				2		InzA_W02 K1eit_U08 K1eit_U18 InzA_U06 K1eit_K03 InzA_K01	30	90	3	2.1	T	Z		P	K	W
4.	ETD003085W	Application programming	2					K1eit_W28 InzA_W02	30	60	2	1.2	T	Z			K	W
5.	ETD003085P	Application programming				2		InzA_W02 K1eit_U20 InzA_U02 K1eit_K02 K1eit_K03 InzA_K01	30	90	3	2.1	T	Z		P	K	W
	ETD100013BK	BLOCK B				1			15	30	1	0.7						
6.	ETD006079P	Application of information techniques and numerical methods				1		K1eit_U06 K1eit_U07 InzA_U02 K1eit_K02	15	30	1	0.7		Z		P	K	W
7.	ETD006080P	Computer aided modeling of semiconductor devices				1		K1eit_U07 InzA_U01 K1eit_K02	15	30	1	0.7		Z		P	K	W
8.	ETD006081P	Computer aided design				1		K1eit_U07 InzA_U02 K1eit_K03	15	30	1	0.7		Z		P	K	W
		Total	2	0	2	3	0		105	300	10	6.8						

4.2.3.2. *Practice* module

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD007069Q	Training						K1eit_U01 K1eit_U09 InzA_U03 K1eit_K03 K1eit_K06 InzA_K02	160	180	6	4.2	T	Z		P	K	W
		Total							160	180	6	4.2						

Altogether for main-field-of-study modules:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				
2	0	2	3	0	265	480	16	11

4.2.4. List of specialization modules

4.2.4.1. *Optional specialization subjects modules*

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
	ETD100014BK	BLOCK C	1		1				30	90	3	2						
1.	ETD007102W	Application of multimedia techniques	1					S1ief_W10 InzA_W02	15	30	1	0.6	T	Z			S	W
2.	ETD007102P	Application of multimedia techniques				1		S1ief_U11 K1ief_K02 InzA_K01	15	60	2	1.4	T	Z		P	S	W
3.	ETD007103W	Wireless techniques	1					S1ief_W07	15	30	1	0.6	T	Z			S	W
4.	ETD007103P	Wireless techniques				1		S1ief_U09 InzA_U08 Keit_K03	15	60	2	1.4	T	Z		P	S	W
		Total	1	0	0	1	0		30	90	3	2						

4.2.4.2. *Diploma dissertation* module

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD007104S	Diploma seminar					2	K1eit_K03 InzA_K01 K1eit_W01 - K1eit_W30, S1ec_W01 - S1ec_W10 K1eit_U01 - K1eit_U22, S1ec_U01 - S1ec_U11	30	60	2	1.4	T	Z		P	S	Ob
2.	ETD007105D	Diploma thesis						K1eit_W01- K1eit_W30 S1ec_W01- S1ec_W10 K1eit_U01- K1eit_U22 S1ec_U01- S1ec_U11 K1eit_K03	30	450	15	10.5	T	Z		P	S	W
		Total	0	0	0	0	2		60	510	17	11.9						

Altogether for specialization modules:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				
1	0	0	1	2	90	600	20	13.9

4.2 Training module

Name of training		Training	
Number of ECTS points	Number of ECTS points for BK classes1	Training crediting mode	Code
6	4.2	Training is a course included in education programme and programme of study, obligatory for the first level of study. Duration of the training is at least 160 hours, i.e. not less than 4 weeks. Training may take place in one or more companies (in such case the time of duration is added). The training is realized on the motion made by a student on the basis of an agreement between the Faculty Dean. and the Institution where the training is to be realized. The pattern of the agreement is the attachment of the Internal Instruction No 24/2006, edited by the Rector of WUT. Signing of the agreement is possible after prior arrangement the term and location of the training and the approval of the frame programme of training by the Faculty Coordinator for Student's Trainings. In the agreement there is information where and when the training should be made. After finishing the training, the student is obliged to deliver to the Faculty Coordinator for Student's Trainings: - the certificate from the Institution on accomplishing the training (who, when and where has made the training) - additional certificate containing the student's assessment - short, max 2-page report. In case when a student was employed in a firm, then his/her paid work (also done abroad) may be considered by the Faculty Coordinator for Student's Trainings as a student's training provided that its character fulfills the requirements of training programme. There is then no need to make an agreement between the Faculty Dean and the Institution, and only certification of employment and short report are required to credit the course . The fact of accomplishing student's training by a student is registered in the Edukacja.CL system.	ETD007069Q

Training duration	Training objective
4 weeks	The objective of student's training is to make a student familiar with the way of operation, organization of work and tasks performed in a company dealing with electronics and telecommunications and applying in their activity wide understood electronics. The student should have a possibility to confront the knowledge acquired during the education in the Faculty. He/she should learn, during the training, to work by himself/herself and in a team on realization of tasks.

4.3 Diploma dissertation module

Type of diploma dissertation	**engineering**	
Number of semesters of diploma dissertation	**Number of ECTS points**	**Code**
1	**15**	**ETD007105D**
Character of diploma dissertation		
The Faculty students may, in the collection of topics of diploma dissertations, choose a diploma dissertation of different characters: - analytical, (analysis, e.g. numerical, properties) - technological (Technology of epitaxial growth) - project (Project of a sensor) - design (Laboratory stand for annealing by RTS method) - application (Assessment of applicability) - usage (Application of a heterostructure in construction) - research (Testing, characterization) - survey (Current state of knowledge concerning the growth mechanisms)		
Number of BK1 ECTS points	**10.5**	

5. Ways of verifying assumed educational effects

Type of classes	**Ways of verifying assumed educational effects**
lecture	examination, progress/final test
class	oral answer progress/final test
laboratory	oral answer, pre-test, realization of laboratory exercise, report from laboratory
project	partial assessment, project defense
seminar	participation in discussion, multimedia topic presentation
training	employer assessment, report from training
diploma dissertation	prepared diploma dissertation, review, defense of diploma dissertation

6. **Total number of ECTS points, which student has to obtain from classes requiring direct academic teacher-student contact** (enter total of ECTS points for courses/groups of courses denoted with code BK1)

137.1 ECTS

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

Number of ECTS points for obligatory subjects	47
Number of ECTS points for optional subjects	0
Total number of ECTS points	47

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

Number of ECTS points for obligatory subjects	79
Number of ECTS points for optional subjects	34
Total number of ECTS points	113

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

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

11. Range of diploma examination

EiT (I level studies) – field of study exam questions

1. Construction of the currently used system of units (SI). Classification of measurement errors.
2. Defects in the crystallographic network, their systematics and influence on the properties of materials (examples).
3. Definition of epitaxy, classification of epitaxial methods applied for manufacturing of optoelectronic structures.
4. Impedance matching in an electrical circuit. Active and reactive power in the electrical circuit.
5. The experimental basis of quantum mechanics. Photoelectric effect.
6. Passive components made of LTCC technology - construction and characteristics of resistors, inductors and capacitors.
7. Active filters.
8. Generators of sinusoidal waveforms.
9. The importance and goals of logistics in production engineering.
10. What types of waves can occur in wave guides? Classify the waveguide into two groups depending on the type of the wave. What criterion should be used for this purpose?
11. Linear and nonlinear applications of operational amplifiers.
12. Optical logic: basic circuits of optical logic, optoelectronic gates.
13. Conduction mechanisms describing $R = f(T)$ characteristic of thick-film cermet resistors.
14. Digital measurement method of frequency and period of electric signal; influence of important factors on measurement error.
15. Calculation methods of error in complex measurements.
16. Measurement methods of piezoelectrics.
17. Measurement methods of basic passive elements (RLC).
18. Measurement methods of root mean square value of periodic voltage signals.
19. DC and AC measurements methods applied for investigation of properties of electronic materials and elements.
20. Learning methods of neural networks.
21. Movable microsystems: methods of actuation in microscale, basic microconstructions and their applications.
22. Modification of properties of surface layers – systematics and manufacturing methods.
23. The principles of light modulation by microwaves. Give an example construction of an electrooptical modulator.
24. The most important applications of elements, circuits and devices operating in the microwave frequency range (300 MHz-300 GHz).
25. Electrical charge carriers and mechanisms of the current flow in semiconductors.
26. Series RLC circuit – voltage resonance. Parallel RLC circuit – current resonance.
27. Parameters and characteristics of reliability and the relations between them.
28. Piezoresistive detection of force and deflection in MEMS.
29. Basic transistor amplifier circuits.

30. Measurement of hysteresis loop, determination of magnetic materials parameters.
31. Comparison of properties and parameters of bipolar and field effect transistors.
32. Basic application of Schroedinger equation. Electron tunneling through the potential barrier.
33. Flip-flops and comparators.
34. Conditions for the application of ISO 9000 norm series.
35. Analog to digital and digital to analog converters.
36. Semiconductor devices with p-n junction; describe the basic applications.
37. Transient state in DC RL and RC circuit. Time constant.
38. Applicability of different thin-film materials for precise resistors, thermistors, capacitors, microwave microstrips, conductive paths and transparent conductive electrodes etc.
39. Systematics of microsystems concerning the aspects connected with the specifics of materials and technology.
40. Replication techniques with the application of micromechnical matrices for microoptics
41. Development trends in novel semiconductor technology, review of basic micro- and nanotechnological processes.
42. Bipolar transistors – explain the amplification properties of the device. Comparison of the basic parameters and applications of bipolar and field effect transistors.
43. Field effect transistors – systematics, constructions and applications. Comparison of the basic parameters and applications of bipolar and field effect transistors.
44. Types of neural networks and their applications.
45. MMIC circuits – architecture, semiconductor devices applied in their construction, applications.
46. Integrated circuits – objectives and advantages of circuit integration, types of the integrated circuit technologies.
47. Electrical properties of metal in the function of temperature.
48. Influence of the measurement device on the value of the measured parameter (demonstrate the problem on the chosen example of measurement of a basic electrical parameter).
49. Influence of the temperature on the semiconductor material and the application of the effect in semiconductor devices.
50. Properties of the p-n junction; explain on the basis of different types of semiconductor diodes.
51. List example electronic elements and semiconductor devices and explain what parameters have influence on their parameters.
52. Power amplifiers.
53. High frequency selective amplifiers.
54. Impulsive and broad-band amplifiers.
55. Advantages of surface mount technology in comparison with the through-hole technology.
56. The relationship between the electrical properties and the temperature of the materials applied in electronics.
57. Operating principle of piezoresistive tuning-fork.

58. External and internal photoelectric effect. Conditions of occurrence and examples of application.
59. Microwave power sources – classification, comparison of parameters and application areas.
60. Voltage and current sources. Terms of sources equivalence.

EiT (I level studies) – exam questions for DE specialization

1. Electrostatic bonding (anodic): glasses, cleaning and activation, types of bonding, procedures, carrier transport, physicochemistry of bonding, application in microsystems technology.
2. Doping of films: diffusions, ion implantation, annealing (RTA).
3. Optical fiber dispersion – definition, classification, typical values, influence on quality of optical fiber transmission.
4. Liquid crystal screen – principle of operation of LCD cell (orientation layer), relationship between parameters and temperature, viewing angle, reaction time, screen control, explain acronyms: TN, STN, IPS, VA and MDVA, color screens.
5. Plasma screens – I-V characteristics of a gas discharge, principle of operation of DC PDP, ACM PDP and ACC PDP, basic parameters.
6. Passive elements made by LTCC technique (Low Temperature Cofired Ceramics) – resistors, inductors, capacitors (constructions and properties)
7. Manufacturing of basic micromechanical construction by deep anisotropic and isotropic wet etching of silicon.
8. Video camera – additive and subtractive optical filter, principle of operation of camera with green checkerboard DFO and double transducer camera.
9. Classification of light detectors (including semiconductor detectors), mechanisms of detection, applications.
10. Classification of light detectors. Give examples of constructions and compare the parameters.
11. Classification of semiconductor lasers, properties and basic parameters.
12. Classification of lasers, properties, basic parameters, applications.
13. Classification of optical fibers – examples.
14. Classification of light emitters, properties and basic parameters.
15. LIGA: processes and procedures, application in microengineering, microsystems and microoptics.
16. Destruction mechanisms in thin films.
17. Deposition methods of thin films. Analysis of the control possibility of the technological parameters in different methods.
18. Ion micromachining; BOSCH and DRIE process, constructions, microsystems applications, micromachines and integrated optics.
19. The most commonly applied vision screens and their properties. Practical aspects of luminosity efficiency.
20. Optoelectronics: definition, areas, basic properties of optoelectronics.
21. Parameters of optical fibers – classification and examples.
22. Basic energy and photometric parameters of light (names, definitions and units).
23. Basic optical effects in semiconductor material.
24. Projectors: luminescence and projection parameters, division of RGB streams in LCD projector, color projector with one DMD converter.

25. Classification and parameters of gas discharge and its application in technological processes.
26. Connection of optical fibers – classification, comparison, parameters.
27. Precise manufacturing of electrical paths in thick-film technology (precise ink-jet, FODEL method, etching, offset method, application of laser)
28. List and characterize basic parameters of optical fiber transmission.
29. Advanced micro- and nanolitography methods (photolithography, electron beam lithography, roentgen lithography, ion beam lithography, nanostamping, interference lithography, scanning probe lithography).
30. External and internal photoelectric effect. Conditions of occurrence and examples of application.

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

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

13. Plan of studies (attachment no. 1)

Opinion of the Student Council of the Faculty

....
Date Name, surname and signature of the student's representative

....
Date Dean's signature

Attachment no. 1 to Programme of Studies

PLAN OF STUDIES

FACULTY: ***Microsystem Electronics and Photonics***

MAIN FIELD OF STUDY: ***Electronics and Telecommunications***

EDUCATION LEVEL: ***1-st level engineering study***

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

PROFILE: ***general academic***

SPECIALIZATION: ***Electronic and Photonic Engineering***

LANGUAGE OF STUDY: ***Polish***

Microsystem Electronics and Photonics Faculty Council resolution no. ***119/11/2016-2020 of May 17, 2017***

In effect since ***01.10.2017***

Faculty: **Microsystem Electronics and Photonics**
Field of study: **Electronics and Telecommunications**
Specialization: **Electronic and Photonic Engineering**
Study: **1-st level, full-time**

Faculty Council resolution from: **17.05.2017**
In effect from: **01.10.2017**

POINT AND HOUR LAYOUT OF THE PLAN OF STUDIES

	23 I 30	24 II 30	27 III 30	27 IV 30	28 V 30	28 VI 30	11 VII 30	
28					ETD5103 2W 20000	Block B ETD100013BK 1P 00010		28
27				ETD4102 3W+2L 20100	Microsystems in biology and medicine	ETD6075 4L 00200		27
26			Block A ETD100012BK	Vacuum technique	ETD5102 3L 00200	Open laboratory (electronic)		26
25			20020 2W+3P		Microsystem modelling			25
24		ETD2070 2W 20000		ETD4077 2W 20000E	ETD5101 2P 00020	ETD6106 2W+2P 20020E		24
23	ETD1066 2W 20000	Introduction to digital and microprocessors systems I	ETD3079 1W+1L 10100	Microsystems I	Optoelectronics II	Microsystems II		23
22	Introduction to electronics	ETD2072 2W 20000	Scripting Language	ETD4076 2W+2P 20010	ETD5081 2W 20000E			22
21	ETD1070 2W 20000	Metrology I	ETD3078 1W+2L 10200	Analog and digital electronics circuits I	Packaging in electronics and microsystems I	ETD6105 1W+2L 10200		21
20	Materials engineering		Introduction to digital		ETD5076 1W+2L 10200	Building Access Control and Security Systems		20
19	ETD1269 1W+1L 10100	ETD2074 2W+3C 22000E	and microprocessor systems II	ETD4079 2W 20000	Metrology of optoelectronic			19
18	The basics of computer networks	Analog Technique	ETD3077 3W+4L 20300E	Foundations of electronic apparatus construction.	elements			18
17	ETD1068 1W + 1L 10100			ETD4081 4L 00300	ETD5083 2W 20000E	ETD6104 2W+2L 20200E		17
16	Information technologies	ETD2073 1W +2C 11000	Semiconductor devices I	Semiconductor devices II	Optical fibers I	Ion and plasma techniques		16
15	ETD1067 1W+2P 10020	Probabilistics			ETD5075 4L 00400			15
14	Engineering graphics			ETD4078 2W 20000E	Microelectronics laboratory	ETD6103 2L 00200		14
13		ETD2071 2W+2L 20200	ETD3089 1W 10000 Wave optics	Optoelectronics I		Optical fibers II		13
12		Informatics	ETD3083 2W 20000	ETD4080 4L 00300		ETD6102 2W+1L 20100E		12
11	FZP1057 4W + 1C 21000E		Principles of solid state	Semiconductor, dielectric	ETD5080 2W+2L 20200	Imaging optoelectronics	ETD7105D 15 p	11
10	Physics 1.1		ETD3081 2L 00200	and magnetic materials	Microprocessors		Diploma thesis	10
9		ETD2069 2W+2C 22000E	Metrology II	ETD4083 4W 30000E	and microcontrollers	ETD6101 1W+1L 10100	ETD7104 2S 00002	9
8	MAT1412 5W+3C 22000E	Electricity and magnetism	ETD3080 3W 20000E	Micro- and nano- technologies		Automotive microsystems	Diploma seminar	8
7	Mathematical Analysis 1.1A		Dielectrics and magnetic materials		ETD5082 2W+1L 20100	ETD6076 2L 00200	Block C ETD100014BK 10010 1W+2P	7
6		FZP2079 2L 00100 Physics 3.1	Management 10000 1W	JZL 3C 04000	Signal processing	Packaging in electronics and microsystems II		6
5	MAT1402 2W+2C 21000E		PKH120411 2W 10000 Social communication	Foreign Language		ETD6077 1W+1C 11000	ETD7101 1W+2L 10200	5
4	Algebra and Analytic geometry	MAT1424 5W+3C 32000E	JZL 2C 04000	(60 hours)	ETD5074 2W+3L 20200E	Basics of system operating	Laser technique	4
3		Mathematical Analysis 2.2A	Foreign Language		Analog and digital electronics circuits II	ETD6078 1W+2P 10020		3
2	FLH121611 2W 20000		(60 hours)	Sport 02000 0C		Microwave technique	ETD7068 1W 20000	2
1	Ethics in Business						Manufacturing engineering	1
	$d_{I}=15$	$d_{II}=16$	$d_{III}=12$	$d_{IV}=8$	$d_{V}=8$	$d_{VI}=5$	$d_{VII}=0$	

OPTIONAL BLOCKS

A – ETD100012BK

COURSE CODE	COURSE NAME	NUMBER OF HOURS	POINTS	SUPERVISOR
ETD003084	Low level programming in C language	20020	2W+3P	dr inż. K. Urbański
ETD003085	Application programming	20020	2W+3P	dr inż. K. Urbański

B – ETD100013BK

COURSE CODE	COURSE NAME	NUMBER OF HOURS	POINTS	SUPERVISOR
ETD006079	Application of information techniques and numerical methods	00010	1P	dr hab. inż. A. Wymysłowski
ETD006080	Computer aided modeling of semiconductor devices	00010	1P	dr inż. W. Panek
ETD006081	Computer Aided Design	00010	1P	dr inż. W. Drzazga

C – ETD100014BK

COURSE CODE	COURSE NAME	NUMBER OF HOURS	POINTS	SUPERVISOR
ETD007103	Wireless techniques	10010	1W+2P	dr hab. inż. J. Domaradzki
ETD007102	Application of multimedia techniques	10010	1W+2P	prof. dr hab. inż. D. Kaczmarek

D (MANAGEMENT) – ZMD100001BK

COURSE CODE	COURSE NAME	NUMBER OF HOURS	POINTS	SUPERVISOR
ZMZ000382	Novel management trends	10000	1P	W-8
ZMZ001274	Basics of management	10000	1P	W-8
ZMZ000144	Quality management	10000	1P	W-8

Legend

Basic science courses	
University-wide courses	
Main field of study courses	
Specialization courses	
Obligatory courses	
Optional courses	ETD

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

Semester 1

Obligatory courses

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD001066W	Introduction to electronics	2					K1eit_W01 K1eit_W02 InzA_W02 InzA_K01	30	60	2	1.2	T	Z			K	Ob
2.	ETD001067W	Engineering graphics	1					K1eit_W02 InzA_W02 InzA_K01	15	30	1	0.6	T	Z			K	Ob
3.	ETD001067P	Engineering graphics				2		K1eit_U01 K1eit_K07	30	60	2	1.4	T	Z		P	K	Ob
4.	ETD001068W	Information technologies	1					K1eit_W13 InzA_W02 K1eit_W24 K1eit_W17	15	30	1	0.6	T	Z			KO	Ob
5.	ETD001068L	Information technologies			1			K1eit_U21 K1eit_K02 InzA_U02 K1eit_U20 K1eit_U08 K1eit_K03 InzA_K02	15	30	1	0.7	T	Z		P	KO	Ob
6.	ETD001269W	The basics of computer networks	1					K1eit_W22 InzA_W02 InzA_W05	15	30	1	0.6	T	Z			PD	Ob
7.	ETD001269L	The basics of computer networks			1			K1eit_U10 K1eit_U19 InzA_U08	15	30	1	0.7	T	Z		P	PD	Ob
8.	ETD001070W	Material engineering	2					K1eit_W01 InzA_W02	30	60	2	1.2	T	Z			PD	Ob
9.	FLH121611W	Ethics in business	2						30	60	2	1.2	T	Z	O		KO	Ob
10.	MAT001402W	Algebra and analytic geometry	2					K1eit_W03	30	60	2	1.2	T	E	O		PD	Ob
11.	MAT001402C	Algebra and analytic geometry		1				K1eit_U02	15	60	2	1.4	T	Z	O	P	PD	Ob
12.	MAT001412W	Mathematical analysis 1.1 A	2					K1eit_W03	30	150	5	3.0	T	E	O		PD	Ob
13.	MAT001412C	Mathematical analysis 1.1 A		2				K1eit_U02 K1eit_K01	30	90	3	2.1	T	Z	O	P	PD	Ob

14.	FZP001057W	Physics 1.1	2					K1eit_W04 InzA_W02 InzA_K01	30	120	4	1.2	T	E	O		PD	Ob
15.	FZP001057C	Physics 1.1		1				K1eit_U03 K1eit_U04	15	30	1	0.7	T	Z	O	P	PD	Ob
		Total	15	4	2	2	0		345	900	30	17.8						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				
15	4	2	2	0	345	900	30	17.8

Semester 2

Obligatory courses

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	MAT001424W	Mathematical analysis 2.2 A	3					K1eit_W03	45	150	5	3.0	T	E	O		PD	Ob
2.	MAT001424C	Mathematical analysis 2.2 A		2				K1eit_U02 K1eit_K01	30	90	3	2.1	T	Z	O	P	PD	Ob
3.	FZP002079L	Physics 3.1			1			K1eit_W20 K1eit_W29 K1eit_U04 K1eit_U13 K1eit_U19 K1eit_K03	15	60	2	1.4	T	Z	O	P	PD	Ob
4.	ETD002069W	Electricity and magnetism	2					K1eit_W04 K1eit_W06 InzA_W02 K1eit_K03 K1eit_K07	30	60	2	1.2	T	E			PD	Ob
5.	ETD002069C	Electricity and magnetism		2				K1eit_K03 K1eit_K07 K1eit_U04 K1eit_U19	30	60	2	1.4	T	Z		P	PD	Ob
6.	ETD002071W	Informatics	2					K1eit_W24 InzA_W02	30	60	2	1.2	T	Z			PD	Ob
7.	ETD002071L	Informatics			2			K1eit_U08 K1eit_U20 InzA_U07 K1eit_K03 InzA_K01	30	60	2	1.4	T	Z		P	PD	Ob
8.	ETD002073W	Probabilistics	1					K1eit_W03 InzA_W02 K1eit_K01 InzA_K01	15	30	1	0.6	T	Z			PD	Ob
9.	ETD002073C	Probabilistics		1				K1eit_U02 InzA_U02 K1eit_K01 InzA_K01	15	60	2	1.4	T	Z		P	PD	Ob
10.	ETD002070W	Introduction to digital and microprocessors systems I	2					K1eit_W16 K1eit_W15 InzA_W02	30	60	2	1.2	T	Z			K	Ob

11.	ETD002072W	Metrology I	2					K1eit_W20 InzA_W02 InzA_U01	30	60	2	1.2	T	Z			K	Ob
12.	ETD002074W	Analog technique	2					K1eit_W23 InzA_W02	30	60	2	1.2	T	E			K	Ob
13.	ETD002074C	Analog technique		2				InzA_W02 K1eit_U01 K1eit_ U09 K1eit_U17 InzA_U03 Keit_K02 InzA_K01	30	90	3	2.1	T	Z		P	K	Ob
		Total	14	7	3	0	0		360	900	30	19.4						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				
14	7	3	0	0	360	900	30	19.4

Semester 3

Obligatory courses

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	PKH120411W	Social communication	1						15	60	2	1.2	T	Z	O		KO	Ob
2.	ETD003079W	Scripting language	1					K1eit_W28 InzA_W02	15	30	1	0.6	T	Z			PD	Ob
3.	ETD003079L	Scripting language			1			K1eit_U20 InzA_U01 K1eit_K03 InzA_K01	15	30	1	0.7	T	Z		P	PD	Ob
4.	ETD003083W	Principles of solid state	2					K1eit _W05 K1eit _W04 InzA_W02	30	60	2	1.2	T	Z			PD	Ob
5.	ETD003089W	Wave optics	1					K1eit_W04 K1eit_W07 K1eit_W09 InzA_W02	15	30	1	0.6	T	Z			PD	Ob
6.	ETD003077W	Semiconductor devices I	2					K1eit_W07 K1eit_W08 K1eit_W15 InzA_W02	30	90	3	1.8	T	E			K	Ob
7.	ETD003077L	Semiconductor devices I			3			K1eit_K03 InzA_K01 K1eit_U13 K1eit_U14 InzA_U01	45	120	4	2.8	T	Z		P	K	Ob
8.	ETD003078W	Introduction to digital and microprocessors systems II	1					K1eit_W17 InzA_W02 K1eit_K03 InzA_K01	15	30	1	0.6	T	Z			K	Ob
9.	ETD003078L	Introduction to digital and microprocessors systems II			2			K1eit_U11 InzA_U01 K1eit_K03 InzA_K01	30	60	2	1.4	T	Z		P	K	Ob
10.	ETD003080W	Dielectric and magnetic materials	2					K1eit_W06 InzA_W02	30	90	3	1.8	T	E			K	Ob

11.	ETD003081L	Metrology II			2			K1eit_U13 InzA_U01 Kleit_K03 InzA_K01	30	60	2	1.4	T	Z		P	K	Ob
		Total	10	0	8	0	0		270	660	22	14.1						

Optional courses

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	JZL100707BK	Foreign language		4					60	60	2	1.4	T	Z	O	P	KO	W
2.	ZMD100001BK	Optional block D – Management	1						15	30	1	0.6	T	Z	O	P	KO	W
	ETD100012BK	Optional block A	2			2			60	150	5	3.3						
3.	ETD003084W	Low level programming in C language	2					K1eit_W17 InzA_W02	30	60	2	1.2	T	Z			K	W
4.	ETD003084P	Low level programming in C language				2		InzA_W02 K1eit_U08 K1eit_U18 InzA_U06 K1eit_K03 InzA_K01	30	90	3	2.1	T	Z		P	K	W
5.	ETD003085W	Application programming	2					K1eit_W28 InzA_W02	30	60	2	1.2	T	Z			K	W
6.	ETD003085P	Application programming				2		InzA_W02 K1eit_U20 InzA_U02 K1eit_K02 K1eit_K03 InzA_K01	30	90	3	2.1	T	Z		P	K	W
		Total	3	4	0	2	0		135	240	8	5.3						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				
13	4	8	2	0	405	900	30	19.4

Semester 4

Obligatory courses

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD004076W	Analog and digital electronic circuits I	2					K1eit_W03 InzA_W02	30	60	2	1.2	T	Z			K	Ob
2.	ETD004076P	Analog and digital electronic circuits I				1		K1eit_U01, K1eit_U14 InzA_U06 K1eit_K02- K1eit_K04	15	60	2	1.4	T	Z		P	K	Ob
3.	ETD004077W	Microsystems I	2					K1eit_W05 InzA_W05	30	60	2	1.2	T	E			K	Ob
4.	ETD004078W	Optoelectronics I	2					K1eit_W01 K1eit_W04 K1eit_W19 InzA_W02	30	60	2	1.2	T	E			K	Ob
5.	ETD004079W	Foundations of electronic apparatus construction.	2					K1eit_W02 K1eit_W11 K1eit_K04 K1eit_K05 K1eit_U01 InzA_W05	30	60	2	1.2	T	Z			K	Ob
6.	ETD004080L	Semiconductor, dielectric and magnetic materials			3			Kleit_K03 Kleit_U04 InzA_U01	45	120	4	2.8	T	Z		P	K	Ob
7.	ETD004081L	Semiconductor devices II			3			K1eit_U13 K1eit_U14 InzA_U01 K1eit_W07 K1eit_W08 K1eit_W15 K1eit_K03 K1eit_K03 K1eit_K04	45	120	4	2.8	T	Z		P	K	Ob
8.	ETD004083W	Micro- and nanotechnologies	3					K1eit_W08 InzA_W05	45	120	4	2.4	T	E			K	Ob
9.	ETD004102W	Vacuum techniques	2					S1ief_W06 InzA_W02	30	90	3	1.8	T	Z			S	Ob

10.	ETD004102L	Vacuum techniques			1			S1ief_U08 InzA_U01 K1eit_K02 K1eit_K03	15	60	2	1.4	T	Z		P	S	Ob
		Total	13	0	7	1	0		315	810	27	17.4						

Optional courses

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1	JZL100708BK	Foreign language B2		4					60	90	3	2.1	T	Z	O	P	KO	W
2	WFW010000BK	Sport		2					30				T	Z	O	P	KO	W
		Total	0	6	0	0	0		90	90	3	2.1						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				
13	6	7	1	0	405	900	30	19.5

Semester 5

Obligatory courses

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD005074W	Analog and digital circuits II	2					K1eit_W03 InzA_W02	30	60	2	1.2	T	E			K	Ob
2.	ETD005074L	Analog and digital circuits II			2			K1eit_U01 K1eit_U14 InzA_U06 K1eit_K02 K1eit_K04 K1eit_K03 K1eit_K08	30	90	3	1.4	T	Z		P	K	Ob
3.	ETD005075L	Microelectronics laboratory			4			K1eit_W08 K1eit_U01 InzA_U07 K1eit_K02 K1eit_K03	60	120	4	2.8	T	Z		P	K	Ob
4.	ETD005076W	Metrology of optoelectronic elements	1					K1eit_W05 K1eit_W07 K1eit_W09	15	30	1	0.6	T	Z			K	Ob
5.	ETD005076L	Metrology of optoelectronic elements			2			K1eit_U09 K1eit_U13 K1eit_U14 InzA_U01 K1eit_K03	30	60	2	1.4	T	Z		P	K	Ob
6.	ETD005080W	Microprocessors and microcontrollers	2					K1eit_W17 K1eit_W30 InzA_W02 K1eit_U18 InzA_U06 K1eit_K04	30	60	2	1.2	T	Z			K	Ob
7.	ETD005080L	Microprocessors and microcontrollers			2			K1eit_W17 K1eit_W30 InzA_W02 K1eit_U18 InzA_U06 K1eit_K04	30	60	2	1.4	T	Z		P	K	Ob

8.	ETD005081W	Packaging in electronics and microsystems I	2					K1eit_W02 K1eit_W21 InzA_W05 K1eit_U15 K1eit_K04	30	60	2	1.2	T	E			K	Ob
9.	ETD005082W	Signal processing	2					K1eit_W14 K1eit_K02	30	60	2	1.2	T	Z			K	Ob
10.	ETD005082L	Signal processing			1			K1eit_U17 InzA_U02 K1eit_K02	15	30	1	0.7	T	Z		P	K	Ob
11.	ETD005083W	Optical fibers I	2					K1eit_W05 K1eit_W09 InzA_W02	30	60	2	1.2	T	E			K	Ob
12.	ETD005101P	Optoelectronics II				2		S1ief_U02 InzA_U02 K1eit_K03	30	60	2	1.4	T	Z		P	S	Ob
13.	ETD005102L	Microsystem modelling			2			S1ief_U05 InzA_U02 K1eit_K02	30	90	3	1.8	T	Z		P	S	Ob
14.	ETD005103W	Microsystems in biology and medicine	2					S1ief_W03 InzA_W03	30	60	2	1.2	T	Z			S	Ob
		Total	13	0	13	2	0		420	900	30	18.7						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				
13	0	13	2	0	420	900	30	18.7

Semester 6

Obligatory courses

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours: lec	c	lab	p	s	Field of study educational effect symbol	Number of hours: ZZU	CNPS	Number of ECTS: total	BK[1] classes	Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses: university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD006076L	Packaging in electronics and microsystems II			2			K1eit_W02 K1eit_U15 K1eit_K03 InzA_U08	30	60	2	1.4	T	Z		P	K	Ob
2.	ETD006077W	Basics of system operating	1					K1eit_W11 InzA_W01 K1eit_K01	15	30	1	0.6	T	Z			K	Ob
3.	ETD006077C	Basics of system operating		1				K1eit_U05 K1eit_U05 InzA_U05 K1eit_K01	15	30	1	0.7	T	Z		P	K	Ob
4.	ETD006078W	Microwave technique	1					K1eit_W02, K1eit_W12 InzA_W02	15	30	1	0.6	T	Z			K	Ob
5.	ETD006078P	Microwave technique				2		K1eit_U06 InzA_U08 K1eit_K02 K1eit_K03	30	60	2	1.4	T	Z		P	K	Ob
6.	ETD006101W	Automotive microsystems	1					K1eit_W30, S1ief_W04	15	30	1	0.6	T	Z			S	Ob
7.	ETD006101L	Automotive microsystems			1			K1eit_U21 S1ief_U06 InzA_U01 K1eit_K03	15	30	1	0.7	T	Z		P	S	Ob
8.	ETD006102W	Imaging optoelectronics	2					S1ief_W02	30	60	2	1.2	T	E			S	Ob
9.	ETD006102L	Imaging optoelectronics			1			S1ief_U04 InzA_U01 K1eit_K03	15	30	1	0.7	T	Z		P	S	Ob
10.	ETD006103L	Optical fibers II			2			S1eit_U07 InzA_U06 K1eit_K03	30	60	2	1.4	T	Z		P	S	Ob
11.	ETD006104W	Ion and plasma techniques	2					S1ief_W08 InzA_W02	30	60	2	1.2	T	E			S	Ob

12.	ETD006104L	Ion and plasma techniques			1			S1ief_U10 PEK_U02 K1eit_K02 K1eit_K03 InzA_K0	30	60	2	1.4	T	Z		P	S	Ob
13.	ETD006105W	Building Access Control and Security Systems	1					S1ief_W09 InzA_W01	15	30	1	0.6	T	Z			S	Ob
14.	ETD006105L	Building Access Control and Security Systems			2			S1ief_U12 InzA_U03 K1eit_K03	30	60	2	1.4	T	Z		P	S	Ob
15.	ETD006106W	Microsystems II	2					S1ief_W05 InzA_W02	30	60	2	1.2	T	E			S	Ob
16.	ETD006106P	Microsystems II				2		S1ief_U01 K1eit_K03 InzA_U07	30	60	2	1.4	T	Z		P	S	Ob
		Total	10	1	9	4	0		375	750	25	16.5						

Optional courses

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD006075L	Open Laboratory (electronic)			2			K1eit_U14 InzA_U07 K1eit_K03	30	120	4	2.8	T	Z		P	K	W
	ETD100013BK	Optional block B				1			15	30	1	0.7						
2.	ETD006079P	Application of information techniques and numerical methods				1		K1eit_U06 K1eit_U07 InzA_U02 K1eit_K02	15	30	1	0.7		Z		P	K	W
3.	ETD006080P	Computer aided modeling of semiconductor devices				1		K1eit_U07 InzA_U01 K1eit_K02	15	30	1	0.7		Z		P	K	W
4.	ETD006081P	Computer Aided Design				1		K1eit_U07 InzA_U02 K1eit_K03	15	30	1	0.7		Z		P	K	W
		Total	0	0	2	1	0		45	150	5	3.5						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				
10	1	11	5	0	420	900	30	20

Semester 7

Obligatory courses

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD007068W	Manufacturing engineering	2					K1eit_K05 K1eit_K06 K1eit_U01 K1eit_W25 K1eit_W27	30	30	1	0.6	T	Z			K	Ob
2.	ETD007101W	Laser technique	1					S1ief_W01	15	30	1	0.6	T	Z			S	Ob
3.	ETD007101L	Laser technique			2			S1ief_U03 InzA_U01	30	60	2	1.4	T	Z		P	S	Ob
4.	ETD007104S	Diploma seminar					2	K1eit_W01- K1eit_W30 S1ief_W01- S1ief_W10 K1eit_U01- K1eit_U22 S1ief_U01- S1ief_U15 K1eit_K03 InzA_K01	30	60	2	1.4	T	Z		P	S	Ob
		Total	3	0	2	0	2		105	180	6	4						

Optional courses

No.	Course/group of courses code	Name of course/group of courses (denote the group of courses with **GK** symbol)	Weekly number of hours					Field of study educational effect symbol	Number of hours		Number of ECTS		Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	c	lab	p	s		ZZU	CNPS	total	BK[1] classes			university-wide[4]	practical[5]	kind[6]	type[7]
1.	ETD007069Q	Practice						K1eit_U01 K1eit_U09 InzA_U03 K1eit_K03 K1eit_K06 InzA_K02	160	180	6	4.2	T	Z		P	K	W

2.	ETD007214D	Diploma thesis						K1eit_W01-K1eit_W30 S1ec_W01-S1ec_W10 K1eit_U01-K1eit_U22 S1ec_U01-S1ec_U11 K1eit_K03	30	450	15	10.5	T	Z		P	S	W
	ETD100014BK	BLOCK C	1			1			30	90	3	2						
3.	ETD007102W	Application of multimedia techniques	1					S1ief_W10 InzA_W02	15	30	1	0.6	T	Z			S	W
4.	ETD007102P	Application of multimedia techniques				1		S1ief_U11 K1ief_K02 InzA_K01	15	60	2	1.4	T	Z		P	S	W
5.	ETD007103W	Wireless techniques	1					S1ief_W07	15	30	1	0.6	T	Z			S	W
6.	ETD007103P	Wireless techniques				1		S1ief_U09 InzA_U08 Keit_K03	15	60	2	1.4	T	Z		P	S	W
		Total	1	0	0	1	0		220	720	24	16.7						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK[1] classes
lec	c	lab	p	s				
4	0	2	1	2	325	900	30	20.7

2. Set of exams in semestral arrangement

Course code	Name of course credited by examination	Semester
FZP001057W MAT001402W MAT001412W	1. Physics 1.1 2. Algebra and analytic geometry 3. Mathematical analysis 1.1A	1
ETD002069W ETD002074W MAT001424W	1. Electricity and magnetism 2. Analog technique 3. Mathematical analysis 2.2A	2
ETD003077W ETD003080W	1. Semiconductor devices I 2. Dielectric and magnetic materials	3
ETD004077W ETD004078W ETD004083W	1. Microsystems I 2. Optoelektronics I 3. Micro- and nanotechnologies	4
ETD005074W ETD005081W ETD005083W	1. Analog and digital electronic circuits II 2. Packaging in electronics and microsystems I 3. Optical fibers I	5
ETD006102W ETD006104W ETD006106W	1. Imaging optoelectronics 2. Ion and plasma techniques 3. Microsystems II	6

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

Semester	Allowable deficit of ECTS points after semester
1	15
2	16
3	12
4	8
5	8
6	5

Opinion of the Student Council of the Faculty

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Date Name, surname and signature of the student's representative

....

Date Dean's signature

Faculty:	**Microsystem Electronics and Photonics**	**Faculty Council resolution from:**	**17.05.2017**
Field of study:	**Electronics and Telecommunications**	**In effect from:**	**01.10.2017**
Studies:	**1st level, full-time**		

COURSE CATALOG

Subject cards for humanities, management, sport and language courses are posted on the Wrocław University of Science and Technology ECTS information catalog (http://www.portal.pwr.wroc.pl/syllabus,241.dhtml).

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Wprowadzenie do elektroniki**	
Name in English:	**Introduction to electronics**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD001066**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic skills and knowledge in electronics
2. The course is designed for students of the first year (semester 1)

SUBJECT OBJECTIVES

C01 To familiarize students with basic materials, components and electronic and optoelectronic circuits, technological and design processes of electronics and optoelectronics circuits

C02 To prepare students to conduct scientific research in the field of electronics

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Basic knowledge and understanding of the basic concepts of electronics and optoelectronics, learning the basic processes in electronics, construction systems and electronic devices and optoelectronic

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

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

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Some organizational lecture: to determine the scope of the course and the requirements for inclusion, discussion of the lecture material, provide a list of literature. Lecture: near-field microscopy AFM. Open discussion on the topic	2
Le_02	Microscopy STM, SThM and related methods	2
Le_03	Introduction to optoelectronics. Open discussion on the topic	2
Le_04	Optoelectronics - components, devices. Open discussion on the topic	2
Le_05	Technology and vacuum technology in electronics. Open discussion on the topic	2
Le_06	Microsystems in the automotive industry. Electronic security systems. Open discussion on the topic	2
Le_07	Transparent electronics. Open discussion on the topic	2
Le_08	Defects in semiconductor materials. Open discussion on the topic	2
Le_09	Basics of modern electronic assembly	2
Le_10	The use of information technology and numerical methods in electronics	2
Le_11	The use of ceramics in microelectronics	2
Le_12	Fiber optics	2
Le_13	MEMS and their applications. Lab on chip. Discussion	2
Le_14	Vacuum Nanoelectronics. Green energy and its use	2
Le_15	Summary of the lecture. Prospects for the development in the electronics. Knowledge test	2
	TOTAL	30

TEACHING TOOLS USED	
ND_01	Traditional lecture with multimedia presentations
ND_02	Lecture materials on-line
ND_03	Self-study and preparation for test

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (lecture)	PEK_W01, PEK_W02, PEK_K01	Activity in discussions during the lectures
F2	PEK_W01, PEK_W02, PEK_K01	Mark from the written test
P1 = 0,1*F1 + 0,9*F2		

PRIMARY AND SECONDARY LITERATURE
Primary literature 1. Herner A., Elektronika w samochodzie, WKŁ Warszawa, 2001 2. B. Ziętek, Optoelektronika, Wydawnictwo Uniwersytetu Mikołaja Kopernika, Toruń, 2004 3. J. Dziuban, Technologia i zastosowanie mikromechanicznych struktur krzemowych i krzemowo-szklanych w technice mikrosystemów, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław, 2002 4. L. Golonka, Zastosowanie ceramiki LTCC w mikroelektronice, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław, 2001 5. M. Rusin, Wizyjne przetworniki optoelektroniczne, WKŁ, 1990 6. M. Szustakowski, Elementy techniki światłowodowej, WNT, Cykl wydawniczy: „Fizyka dla przemysłu”, 1992 7. R. Kisiel, Podstawy technologii dla elektroników – poradnik praktyczny, Wyd. BTC, 2005 8. W. Marciniak, Przyrządy półprzewodnikowe i układy scalone, WNT Warszawa, 1979 **Secondary literature** 1. Mikroelektronika w pojazdach, technical informator, Bosch, 2002 2. Magazines: Elektronika praktyczna, Elektronizacja, Przegląd Telekomunikacyjny itp. and catalogues

SUBJECT SUPERVISOR
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Introduction to electronics

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W01, K1eit_W02	C01	Le_01-Le_15	ND_01-ND_03
PEK_W02	InzA_W02	C01, C02	Le_01-Le_15	ND_01-ND_03
PEK_K01 (competences)	InzA_K01	C01, C02	Le_01-Le_15	ND_01-ND_03

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Grafika inżynierska**	
Name in English:	**Engineering Graphics**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD001067**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge on ways of depicting the simple elements, necessary in the development of design documentation

SUBJECT OBJECTIVES

C01 Getting acquainted with the principles of construction documentation, including construction documentation of devices developed for scientific and research purposes

C02 Gaining the ability to perform basic engineering drawings and engineering documentation simple mechanical devices encountered in engineering practice

C03 Ability to perform given tasks as a member of team carrying out a specific task design

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 The student has a basic understanding of the role of engineering documentation in the process of creating a simple device

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

Relating to skills
PEK_U01 Able to perform technical drawings-sketches and simple design documentation
Relating to social competences
PEK_K01 Able to communicate technical information in an understandable way for other team members.
PEK_K02 The student is aware of the importance and understands the non-technical aspects and results of engineering activity, including its impact on the environment, and the associated responsibility for made decisions

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Methods of graphic representation of components and assemblies with axonometric and rectangular projections. The selection policy views	2
Le_02	Dimensioning - definitions, methods	1
Le_03	Dimensioning - rules, symbols, shortened dimensioning	2
Le_04	The views and cross-sections - European projection	2
Le_05	The views and cross-sections - shifted, partial, rotated, developed, half-views, half-sections	3
Le_06	State of the surface - roughness of materials. Tolerating and fitting dimensions	2
Le_07	Drawing and dimensioning of standard components (permanent joining and detachable). Ready drawings, design documentation	2
Le_08	Credit - test	1
	TOTAL	15

Form of classes - Project		Quantity
Pr_01	The rules for creating engineering documentation. Dimensioning by calipers. Dimensional formats. The scale of the drawing. Organization of technical drawing-sketch.	2
Pr_02	Basic forms of writing construction - cast. Choosing throw from the known view. Assessment of the skills of projection.	2
Pr_03	The first model - technical drawing model using elements of structural description	2
Pr_04	The first model - the choice of the main projection (view)	2
Pr_05	The first model - the principles and methods of dimensioning of the model (in the form of a top view, side views, table). Grading of the drawing-sketch model	2
Pr_06	The second model - the choice of the main projection (view - cross section)	2
Pr_07	The second model - dimensioning (detachable connection - tapping). Grading of the drawing-sketch model	2
Pr_08	The third model - the choice of the main projection (cross section view). Use of half-view, half-view-half-section, partial view, partial cross-section (breakout)	2
Pr_09	The third model - dimensioning (dimensioning rules, a brief record in dimensioning)	2
Pr_10	The third model - the descriptions (as surface markings, tolerance, size and shape, fitting dimensions table). Grading of the drawing-sketch model.	2
Pr_11	The fourth model - the creation of engineering documentation assembly or component unit	2
Pr_12	The fourth model - the design documentation, forms, descriptions	2
Pr_13	The fourth model - arrangement drawing (dimensioning rules)	2
Pr_14	The fourth model - arrangement drawing. Grading done documentation	2
Pr_15	Check and credit with a grade models made ??drawings and documentation	2
	Total	30

TEACHING TOOLS USED	
ND_01	Lecture traditional assisted presentations and interactive elements of the evaluation
ND_02	Short tests
ND_03	Own work - repetition of the material as a base for the implementation of a sketch-technical drawing
ND_04	Rating sketches-drawings (models) and made - technical documentation
ND_05	Consultation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02, PEK_K02	Knowledge test (tests, final test) + activity during the lecture
P2 = F2 (project)	PEK_U01, PEK_K01	Evaluation of completed projects-technical sketches

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. T. Dobrzański – Rysunek Techniczny Maszynowy, W N-T, Warszawa, 2005
2. W. Posadowski – lecture notes, 2012

Secondary literature

1. J. Houszka, Podstawy konstrukcji mechanicznych w elektronice, Wyd. PWr, 1974
2. Group work, Poradnik inżyniera mechanika, WNT, Warszawa, 1985
3. Group work, Polish Norms

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Engineering Graphics

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W02	C01	Le_01-Le_08	ND_01-ND_03
PEK_W02	InzA_W02	C01	Le_01-Le_08	ND_01-ND_03
PEK_U01 (skills)	K1eit_U01	C02	Pr_01-Pr_15	ND_03-ND_05

PEK_K01 (competences)	K1eit_K07	C01, C03	Pr_01-Pr_15	ND_03-ND_05
PEK_K02	InzA_K01	C01, C03	Le_01-Le_08	ND_01-ND_03

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Technologie informacyjne**	
Name in English:	**Information Technologies**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD001068**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. An elementary knowledge of mathematics and computer science required by the school curriculum

SUBJECT OBJECTIVES

C01 Gaining theoretical knowledge referred to in Le_01-Le_07
C02 Gaining practical skills through laboratory tasks La_01-La_07
C03 The ability to select and use the right computer tools for solving engineering tasks and for the purpose of conducting scientific research

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Ordered knowledge of the principles and practical use of software to support the work of engineers
PEK_W02 The skills to design and implement basic computer algorithms
PEK_W03 A basic knowledge about the functioning of a computer system, the representation of data of selected types and their digital processing

Relating to skills

PEK_U01 Able to effectively use basic computer tools useful in engineering practice
PEK_U02 Ability to describe an algorithm as a flowchart and source code

Relating to social competences

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

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Virtualization - simultaneous and secure use of multiple operating systems	2
Le_02	The structure of a text document. Templates and style sheets. Comparison of HTML and CSS	2
Le_03	The basics of relational databases and SQL	2
Le_04	CAD software in engineering practice as an example application to support the design of printed circuit boards	2
Le_05	Mathematical foundations and practical applications of cryptography. Certificates, secure login to a remote system	2
Le_06	Algorithm. Loops and conditional statements. PHP scripting language	2
Le_07	Introduction to structural - turtle graphics in C	2
Le_08	Final test	1
	TOTAL	15

Form of classes - Laboratory		Quantity
La_01	Configuration of VirtualBox. Use of Linux, Winscp, PuTTY. Operations on files and directories: compression, encryption, ownership and rights	2
La_02	Text processing in OpenOffice. The structure of text documents - use of headings, paragraphs, styles. Automation of document processing	2
La_03	Designing a simple database and its implementation using selected SQL engine. Import and export of a data	2
La_04	PHP as a scripting language. Presentation of the results of the algorithm in the form of dynamically generated HTML pages	2
La_05	KiCAD or EAGLE as an example of a computer aided design tool to support PCB design	2
La_06	Octave or Matlab as a tool to solve some mathematical problems	2
La_07	Turtle graphics and algorithms - implementation of the basic algorithms in C	2
La_08	Additional (spare) classes	1
	Total	15

TEACHING TOOLS USED

ND_01 The traditional lecture with presentations and discussion
ND_02 Software tools (VirtualBox, serwer WWW+PHP, KiCAD, Octave, OpenOffice, Visual Studio)
ND_03 Consultation
ND_04 Self study - preparation of selected topics in the lecture
ND_05 Laboratories

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02, PEK_W03	Discussions and final test
P2 = F2 (lab)	PEK_U01, PEK_U02, PEK_K01	Partial tests and quizzes, lab reports

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Bartlet, Jonathan, Programming from the Ground Up, http://www.bartlettpublishing.com (GNU license), 2012
2. Bindner, Donald, A student's guide to the study, practice, and tools of modern mathematics, CRC Press/Taylor & Francis, 2011
3. Czajka, Marek, MATLAB: ćwiczenia: opanuj środowisko programistyczne MATLAB-a, napisz programy obliczeniowe, zilustruj wyniki obliczeń wykresami, Helion, 2005
4. David Jahshan, KiCad Step by Step Tutorial, http://www.kicadlib.org/Fichiers/KiCad_Tutorial.pdf, 2006
5. Dziewoński, Mirosław, OpenOffice 3.x PL : oficjalny podręcznik, Helion, 2010
6. Kuczmarski, Karol, Kurs C++, http://avocado.risp.pl (GNU license), 2012

Secondary literature

1. Karwin, Bill., Antywzorce języka SQL: jak uniknąć pułapek podczas programowania baz danych, Helion, 2012

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Information Technologies

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W13, InzA_W02	C01-C03	Le_01-Le_07	ND_01-ND_04
PEK_W02	K1eit_W24,K1eit_W17	C01-C03	Le_01-Le_07	ND_01-ND_04
PEK_W03	K1eit_W17	C01-C03	Le_01-Le_07	ND_01-ND_04
PEK_U01 (skills)	K1eit_U21, K1eit_K02, InzA_U02	C01-C03	La_01-La_07	ND_01-ND_05

PEK_U02	K1eit_U20,K1eit_U08	C01-C03	La_01-La_07	ND_01-ND_05
PEK_K01 (competences)	K1eit_K03, InzA_K02	C01-C03	La_01-La_07	ND_05

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Inżynieria materiałowa**	
Name in English:	**Materials Engineering**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD001070**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of chemistry required at high school level
2. Knowledge of mathematics required at high school level
3. Knowledge of physics required at high school level
4. Ability to enhance knowledge through independent learning

SUBJECT OBJECTIVES

C01 To acquaint students with the basis of Materials Engineering in the field of study, particularly in a materials classification, basic parameters of materials, criteria in materials selection

C02 To prepare students to conduct scientific research in the field of materials engineering

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Student has knowledge in basis of Materials Engineering, particularly in crystallography and physicochemical properties of metals, ceramics, glass, super-ionic conductors, polymer composites and biomaterials with regard to the relationship between their properties, crystal structure and microstructure from the perspective of materials science

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

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Introduction, classification and basis parameters of materials, criteria in materials selection	2
Le_02	Chemical elements, molecules, types of bonds and their properties	2
Le_03	Crystal structures, methods of description and classification, elements	2
Le_04	Crystal defects and it influence on physicochemical parameters of materials	2
Le_05	Monocrystals, methods of producing, fields of applications	2
Le_06	Anisotropy of physical and chemical properties	2
Le_07	Metal properties	2
Le_08	Ceramic, producing methods, impact of construction on the physicochemical properties	2
Le_09	Glass - general characteristics of the glassy state, mechanical, optical, thermal and chemical properties	2
Le_10	Super-ionic conductors, synthesis method, structure and their electrical parameters	2
Le_11	Nanomaterials, synthesis method, properties	2
Le_12	Polymers, properties, application in microelectronics	2
Le_13	Composites, methods of producing, construction and physical properties	2
Le_14	Biomaterials, definition and requirements for biomaterials, applications	2
Le_15	Test	2
	TOTAL	30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Test - positive mark

PRIMARY AND SECONDARY LITERATURE
Primary literature 1. Leszek A. Dobrzański, Wprowadzenie do nauki o materiałach, Wydawnictwo Politechniki Śląskiej, 2007 2. Leszek A. Dobrzański, Metalowe materiały inżynierskie, WNT , 2004 3. M. Jurczyk, J. Jakubowicz, Biomateriały, Wydawnictwo Politechniki Poznańskiej, 2008 4. Marek Blicharski, Wstęp do inżynierii materiałowej, WNT, Warszawa , 1998 5. Michael F. Ashby, David R. H. Jones, Materiały inżynierskie, właściwości i zastosowanie, WNT, Warszawa, 1998 6. Roman Pampuch, Współczesne materiały ceramiczne, AGH, Kraków, 2005 7. Wacław Jakubowski , Przewodniki superjonowe, właściwości fizyczne i zastosowania, WNT, Warszawa, 1988 **Secondary literature** 1. H. Teterycz, Grubowarstwowe chemiczne czujniki gazów na bazie dwutlenku cyny, Oficyna Wydawnicza Politechniki Wrocławskiej, 2005 2. L. A. Dobrzeński, Podstawy metodologii projektowania materiałowego, Wydawnictwo Politechniki Śląskiej, Gliwice, 2009 3. Leszek A. Dobrzański, Metaloznawstwo z podstawami nauki o materiałach, WNT, Warszawa, 1998 4. Leszek Hozer, Półprzewodnikowe materiały ceramiczne z aktywnymi granicami ziaren, PWN, Warszawa, 1998 5. Władysław Bogusz, Franciszek Krok, Elektrolity stałe, właściwości elektryczne i sposoby ich pomiaru, WNT, Warszawa, 1995

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Materials Engineering

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W01	C01	Le_01-Le_15	ND_01-ND_03
PEK_W02	InzA_W02	C02	Le_01-Le_15	ND_01-ND_03

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Podstawy sieci komputerowych**	
Name in English:	**The basics of computer networks**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD001269**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. An elementary knowledge of mathematics and computer science required by the high school curriculum

SUBJECT OBJECTIVES

C01 Gaining theoretical knowledge of computer networks
C02 Using the knowledge to practical tasks for the design and use of computer networks
C03 Ability to develop and present selected topics in group
C04 Preparation of students to conduct scientific research - potential use of computer networks while conducting scientific research

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Gaining theoretical knowledge of computer networks
PEK_W02 The student knows the typical engineering technologies in the area of studied field of study

Relating to skills

PEK_U01 The ability to use knowledge to practical tasks for the design and use of computer networks
PEK_U02 The student is able to - according to the given specification - design and implement typical computer network, using appropriate methods, techniques and tools

Relating to social competences

PEK_K01 The student is able to identify and formulate issues in the area of network technologies from a variety of source materials and preparing presentations

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Introduction to computer networks. History of computer networks.	2
Le_02	Network classification and topologies. Network devices, standards and addressing.	2
Le_03	ISO/OSI model. Basic diagnostics of computer networks.	2
Le_04	Standardization and networks examples. Protocols, frame construction	2
Le_05	Selected protocols of data link, Internet and transport layers	2
Le_06	Selected application layer protocols. Wireless networks part 1	2
Le_07	Wireless networks part 2. Security: network traffic monitoring, threat detection, data encryption, certificates	2
Le_08	Final test	1
	TOTAL	15

Form of classes - Classes		Quantity
Cl_01	Introduction. BHP, organization and rules of classes	2
Cl_02	Tasks related to the design of the IP network address structure	2
Cl_03	Computer network diagnostics using IP, ICMP and ARP protocols, packet route selection	2
Cl_04	Network traffic monitoring part 1	2
Cl_05	Network traffic monitoring part 2	2
Cl_06	Computer network design part 1 - analysis of TCP, UDP and ARP protocols, packet routes in different network configuration scenarios	2
Cl_07	Computer network design part 2 – DNS server configuration, http, DHCP protocol	2
Cl_08	Additional (spare) classes	1
	Total	15

TEACHING TOOLS USED

ND_01 The traditional lecture with presentations and discussion
ND_02 Consultation
ND_03 Self study - preparation of selected topics in the lecture
ND_04 Self study - preparation of selected topics in the laboratory
ND_05 Solving the list. Practical verification of selected solutions and discussion of results

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Discussions, final test
P2 = F2 (classes)	PEK_U01, PEK_U02, PEK_K01	Presentations of selected topics, quizzes, problem solving from the list

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Tanenbaum, Andrew S. , Sieci komputerowe, Helion, 2012
2. Krysiak K., Sieci komputerowe. Kompendium. Kurs, Helion, 2016
3. Schneier, Bruce, Kryptografia dla praktyków : protokoły i programy źródłowe w języku C, WNT, 2002

Secondary literature

1. Danowski, Bartosz, Wi-Fi : domowe sieci bezprzewodowe, Helion, 2010
2. Józefiok A., CCNA 200-120. Zostań administratorem sieci komputerowych Cisco, Helion, 2015
3. Peczarski, Marcin., Mikrokontrolery STM32 w sieci Ethernet: w przykładach, BTC, 2011

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

The basics of computer networks

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W22, InzA_W02	C01	Le_01-Le_07	ND_01-ND_03
PEK_W02	InzA_W05	C04	Le_01-Le_07	ND_01-ND_03
PEK_U01 (skills)	K1eit_U10, K1eit_U19	C02	La_01-La_07	ND_02, ND_04, ND_05
PEK_U02	InzA_U08	C02	La_01-La_07	ND_02, ND_04, ND_05
PEK_K01 (competences)	K1eit_K03, InzA_K02	C03	La_01-La_07	ND_04

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Elektryczność i magnetyzm**	
Name in English:	**Electricity and Magnetism**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD002069**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Acquisition of knowledge, skills and competences resulting from courses: Physics, Mathematical Analysis and Algebra with Analytical Geometry

SUBJECT OBJECTIVES

C01 Mastering of problems connected with mathematical description and physical interpretation of phenomena attendant upon formation and application of electric, magnetic and electromagnetic fields

C02 Practical application of physical principles dealing with the problems of electricity and magnetism, realization of technical problems, determination and calculation of material parameters

C03 Acquirement and consolidation of social competences including emotional intelligence connected with competences of co-operation and partnership in a student group in order to efficiently realise problems Responsibility, honesty and fairness in compliance with customs obligatory in academic community and society

C04 To prepare students to conduct scientific research in the field of electronics

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01	The student has knowledge within the domain of physics containing electricity and magnetism as well as knowledge necessary for understanding basic physical phenomena existing in electronic devices and their environment
PEK_W02	The student knows the basic methods, techniques, tools and materials used in solving simple engineering problems from the studied field of study

Relating to skills

PEK_U01	The student is able to determine physic-chemical properties & parameters of investigated material

Relating to social competences

PEK_K01	The student is able to properly identify & effectively solve the dilemmas connected with his profession

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Preliminary information, lecture programme, fundamentals of vectors algebra, conditions of credit	2
Le_02	Electrical charges, principle of charge conservation, Coulombs Law, systems of units	2
Le_03	Electrostatic field, electric field intensity, electric field potential, relationship between field intensity and field potential, flux of electric field intensity	2
Le_04	Properties of vector fields, circulation and rotation of electric field, Gauss' law, Poissons' equation, Laplace's equation	2
Le_05	Electric field in dielectrics, electric dipole, dielectric polarization, free and bound charges, electric induction, ferroelectric materials, hysteresis loop	2
Le_06	Conductors in electric field, electric capacity, capacitors, electric field energy	2
Le_07	Direct current, current intensity, current density, current continuity equation, electromotive force, resistivity, conductivity	2
Le_08	Conductors resistance, Ohm's law, resistance vs temperature, superconductivity, current power, Kirchhoff's laws, Joule-Lenz law	2
Le_09	Magnetic field in vacuum, Biot-Savart-Laplace law, vector of magnetic induction, magnetic and Lorenz forces, divergence and rotation of magnetic field, Ampere's law	2
Le_10	Magnetic field in matter, magnetic field intensity, magnetic flux, magnetic materials (diamagnetics, paramagnetics, ferromagnetics), magnetic-mechanical effects	2
Le_11	Magnetic induction flux, Lenz's rule, electromagnetic induction, self induction, mutual induction, methods of magnetic induction measurement, electromotive force of self and mutual induction	2
Le_12	Magnetic field in electric circuits, magnetic circuits, magnetic field energy, magnetism as relativistic phenomenon	2
Le_13	Rotational magnetic field, shift current, Maxwell's equations	2
Le_14	Classic theory of metals conductivity, nature of current carriers in metals, Hall's effect	2
Le_15	Final test - exam	2
	TOTAL	30

Form of classes - Classes		Quantity
Cl_01	Introduction classes. Overview on the thematic range of the classes and terms of credit. Theoretical introduction, basic issues: coordinate diagrams (Cartesian, cylindrical, spherical), scalars and vectors, scalar and vector fields, differential operators	2
Cl_02	Electrostatic field, Coulomb's law, intense of electric field, arrangement of electric charges (punctual, linear, superficial, volumetric)	2
Cl_03	Electric flux, Gauss's law for vacuum	2
Cl_04	Electric potential and voltage, superposition principle	2
Cl_05	Dielectric materials, dielectric polarization, free and bound charges	2
Cl_06	Electric induction, generalized Gauss' law (for all environments)	2
Cl_07	Capacitors, electric capacity, voltage durability and breakdown voltage, capacitor networks (series and parallel circuits)	2
Cl_08	Electric field energy, capacitor energy, electric potential energy of set of charges	2
Cl_09	Electric current, intense and density of current, electromotive force, the principle of charge conservation, Kirchoff's law	2
Cl_10	Resistors, Ohm's law, temperature dependence of resistance, resistor networks (series and parallel circuits), capacitor's insulation resistance	2
Cl_11	Magnetostatic field, magnetic induction, Biot-Savart-Laplace's law, Lorentz force	2
Cl_12	Magnetic materials, magnetization, intense of magnetic field, Ampere's law	2
Cl_13	Magnetic flux, Faraday phenomenon, Lenz's law	2
Cl_14	Inductors (magnetic coils), inductance of magnetic coils	2
Cl_15	Final test	2
	Total	30

TEACHING TOOLS USED
ND_01 Traditional lecture with transparencies, slides and discussion ND_02 Individual work - elaboration of homework solutions ND_03 Individual work - preparation for the following topics of lecture ND_04 Individual work - preparation for tests ND_05 Tutorials ND_06 Individual studies and preparation for the exam

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02, PEK_K01	Final test - exam.
P2 = F2 (classes)	PEK_U01, PEK_K01	Final exam

PRIMARY AND SECONDARY LITERATURE
Primary literature 1. I.W. Sawieliew, Wykłady z fizyki, tom II „Elektryczność i magnetyzm, Fale, Optyka”, Wyd. Naukowe PWN, Warszawa, 2002 2. R.P. Feynmann, R.B. Leighton, M. Sands, Feynmanna wykłady z fizyki, tom II, cz. I, Wyd. Naukowe PWN, Warszawa, 1970 3. W. Michalski, Elektryczność i magnetyzm. Zbiór zagadnień i zadań, cz. I, Elektrostatyka, Oficyna Wydawnicza PWr, Wrocław, 2003 4. W. Michalski, Elektryczność i magnetyzm. Zbiór zagadnień i zadań, cz. II, Prąd elektryczny, pole magnetyczne, Oficyna Wydawnicza PWr, Wrocław, 2004 **Secondary literature** 1. H. Percak, Zbiór zadań z elektryczności i magnetyzmu, skrypt PWr, Wyd. PWr, Wrocław, 1989 2. H. Rawa, Elektryczność i magnetyzm w technologii, Wyd. Naukowe PWN, Warszawa, 1966 3. J.S. Witkowski, Jak rozwiązywać zadania z elektryczności i magnetyzmu, script, Wrocław, 2004

SUBJECT SUPERVISOR
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Electricity and Magnetism

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W04, K1eit_W06	C01-C03	Le_01-Le_15	ND_01, ND_03-ND_06
PEK_W02	InzA_W02	C01, C02, C04	Le_01-Le_15	ND_01, ND_03-ND_06
PEK_U01 (skills)	K1eit_U04, K1eit_U19	C01-C03	Cl_01-Cl_15	ND_02-ND_05
PEK_K01 (competences)	K1eit_K03, K1eit_K07	C03	Le_01-Le_15, Cl_01-Cl_15	ND_01-ND_06

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Podstawy techniki cyfrowej i mikroprocesorowej I**
Name in English:	**Introduction to Digital and Microprocessor Systems I**
Main field of studies:	**Electronics and Telecommunications**
Level and form of studies:	**I level / Full time**
Kind of subject:	**Obligatory / Faculty**
Subject code:	**ETD002070**
Group of courses:	**NO**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic information about electric circuits at the level of basic physics course
2. Completion of the Introduction to Electronics course

SUBJECT OBJECTIVES

C01 Presenting of the principles of digital information representation and its processing and with the methods of description and synthesis of the digital combinatory and sequential logic circuits and basic components used in these circuits

C02 Presenting typical designs and parameters of the digital circuits

C03 To prepare students to conduct scientific research in the field of electronics

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge	
PEK_W01	Student has the basic information about the digital circuits such as: digital data representation, methods of combinatory and sequential logic description and process of the design of simple digital circuit composed of the low scale of integration components
PEK_W02	Student has the knowledge of typical digital components, their electric parameters and the rules of their selecting and connection
PEK_W03	The student knows the basic methods, techniques, tools and materials used in solving simple engineering problems from the studied field of study

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Introduction to the digital systems, definitions	1
Le_02	Electric parameters of the digital circuits	3
Le_03	Binary representation of numeric and non-numeric information	4
Le_04	Binary arithmetics	2
Le_05	Boolean algebra and boolean function	1
Le_06	Combinatory logic, description and synthesis	4
Le_07	Common combinatory logic circuits	2
Le_08	Synchronous sequential logic	4
Le_09	Asynchronous sequential logic	2
Le_10	Programmable Logic Devices	2
Le_11	Digital memories – types, classification, details of construction and operation of SRAM, DRAM, EPROM, EEPROM, FRAM and MRAM	2
Le_12	Quizzes	3
	TOTAL	30

TEACHING TOOLS USED	
ND_01	Lecture with multimedia presentations and discussion
ND_02	Consultations
ND_03	Homework - solving assigned problems
ND_04	Homework - self studies and preparing to the quizzes

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (lecture)	PEK_W01, PEK_W03	Quiz
F2	PEK_W02, PEK_W03	Quiz
P1 = (F1 + F2)/2		

PRIMARY AND SECONDARY LITERATURE
Primary literature 1. Baranowski J., Kalinowski B., Nosal Z., Układy elektroniczne, cz. III. Układy i systemy cyfrowe, WNT 2. Misiurewicz P., Podstawy techniki cyfrowej., WNT 3. Piecha J., Elementy i układy cyfrowe, PWN 4. Pienkos J.,Turczyński J., Układy scalone TTL w systemach cyfrowych, WKiŁ 5. Skorupski A., Podstawy techniki cyfrowej, WKiŁ **Secondary literature** 1. Traczyk W., Układy cyfrowe - Podstawy teoretyczne i metody syntezy, WNT 2. Łakomy M., Zabrodzki J., Układy scalone CMOS, PWN

SUBJECT SUPERVISOR
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Introduction to Digital and Microprocessor Systems

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W16	C01	Le_01, Le_03-Le_12	ND_01-ND_04
PEK_W02	K1eit_W15	C02	Le_02	ND_01-ND_04
PEK_W03	InzA_W02	C01- C03	Le_01-Le_12	ND_01-ND_04

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Informatyka**	
Name in English:	**Informatics**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD002071**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed the course material: Information technology

SUBJECT OBJECTIVES

C01 Gaining theoretical knowledge in the field of informatics
C02 Gaining practical skills through the implementation of the basic tasks in Computer Science
C03 Can implement a computer program both individually and in a team
C04 To prepare students to conduct scientific research in the field of dedicated software development

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge	
PEK_W01	The student knows the basics of C/C++
PEK_W02	The student knows the basic methods, techniques, tools and materials used in solving simple engineering problems from the studied field of study
Relating to skills	
PEK_U01	The student can develop a simple application in C/C++ implementing the selected algorithm
PEK_U02	The student is able to assess the usefulness of routine methods and tools used for solving of a simple and practical engineering task, characteristic for the studied field of study and to select and apply the appropriate method and tools
Relating to social competences	
PEK_K01	Able to interact and work in a group of laboratory, taking in the different roles
PEK_K02	The student is aware of the importance and understands the non-technical aspects and results of engineering activity, including its impact on the environment, and the associated responsibility for made decisions

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

Form of classes - Laboratory		Quantity
La_01	Configuration of the Integrated Development Environment	2
La_02	Basic data types. Standard input-output. Operations on numeric variables	2
La_03	Local, global, static variables. Functions	2

La_04	Conditional statements and multiple-choice instruction	2
La_05	Dynamic allocation of memory and pointer arithmetics	2
La_06	Introduction to classes and objects	2
La_07	Object-oriented I/O in C++	2
La_08	Sorting algorithms and complexity of algorithms	2
La_09	Applications of function pointers	2
La_10	Completion of the final project (application in C)	2
La_11	Debugger. Type conversions.	2
La_12	Strings, arrays, files	2
La_13	Selected algorithms for processing strings in C	2
La_14	Presentation of successful completion of the final project	2
La_15	Additional (spare) classes	2
	Total	30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Discussions and final test
P2 = F2 (lab)	PEK_U01, PEK_U02, PEK_K01, PEK_K02	Partial tests and quizzes, lab reports

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Kerningham B. W., Ritchie D. M., , Język ANSI C, WNT, 2001
2. Kuczmarski, Karol, Kurs C++, http://avocado.risp.pl, 2012

Secondary literature

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

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Informatics

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W24	C01	Le_01-Le_15	ND_01-ND_04
PEK_W02	InzA_W02	C01, C04	Le_01-Le_15	ND_01-ND_04
PEK_U01 (skills)	K1eit_U08, K1eit_U20	C02	La_01-La_14	ND_02, ND_04-ND_06
PEK_U02	InzA_U07	C02, C04	La_01-La_14	ND_02, ND_04-ND_06
PEK_K01 (competences)	K1eit_K03	C03	La_01-La_14	ND_06
PEK_K02	InzA_K01	C02-C04	La_01-La_14	ND_06

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Metrologia I**
Name in English:	**Metrology I**
Main field of studies:	**Electronics and Telecommunications**
Level and form of studies:	**I level / Full time**
Kind of subject:	**Obligatory / Faculty**
Subject code:	**ETD002072**
Group of courses:	**NO**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

There are no prerequisites listed for this course

SUBJECT OBJECTIVES

C01 To familiarize students with basic the knowledge of metrology: account of measurement errors, statistical methods in data analysis, standards of physical quantities and International System of Units

C02 To familiarize students with the basic measuring instruments, methods of measuring electrical quantities, parameters characterizing the components and electrical signals, the basic types of nonelectrical sensors and modern measuring systems and data acquisition

C03 To prepare students to conduct scientific research in the field of electronics

SUBJECT EDUCATIONAL EFFECTS

<u>Relating to knowledge</u>

PEK_W01 He knows the basic problems of metrology and electrical quantities measurement methods

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

Relating to skills	
PEK_U01	The student is able to plan and carry out experiments, including measurements and computer simulations, interpret the acquired results and draw conclusions

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Basic of measurements	2
Le_02	Measurement errors	2
Le_03	Errors of measurement tools	2
Le_04	Statistical analysis of measurement results	2
Le_05	Uncertainty propagation in indirect measurements	2
Le_06	Measures service, instruments legalization, measurement standards	2
Le_07	First test	2
Le_08	A/C and D/C converters	2
Le_09	Currents and voltages measurement methods. Resistance measurement	2
Le_10	Impedance measurements	2
Le_11	Measurements of periodically varying signals	2
Le_12	Non-electrical sensors	2
Le_13	Advanced measuring methods and instruments	2
Le_14	Data acquisition systems	2
Le_15	Final test	2
	TOTAL	30

TEACHING TOOLS USED

ND_01 Traditional lecture with presentations and discussion
ND_02 Consultations
ND_03 Individual work - independent literature studies and prepare for the test

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (lecture)	PEK_W01, PEK_W02, PEK_U01	Tests
P1 (lecture)	PEK_W01, PEK_W02, PEK_U01	Average test score

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Chwaleba A., Poniński M., Siedlecki A., Metrologia elektryczna, WNT Warszawa, 2010
2. Nawrocki W., Wstęp do metrologii kwantowej, WPP Poznań, 2007
3. Piotrowski J., Podstawy miernictwa, WNT Warszawa, 2002
4. Taylor J. R., Wstęp do analizy błędu pomiarowego, PWN Warszawa, 1999

Secondary literature
1. ISO, International vocabulary of basic and general terms in metrology, INTERNATIONAL ORGANIZATION FOR STANDARDIZATION, 2003 2. Tumański S, Technika pomiarowa, WNT Warszawa, 2007

SUBJECT SUPERVISOR
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Metrology I

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W20	C01, C02	Le_01-Le_15	ND_01-ND_03
PEK_W02	InzA_W02	C01-C03	Le_01-Le_15	ND_01-ND_03
PEK_U01 (skills)	InzA_U01	C02, C03	Le_01-Le_15	ND_01-ND_03

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Probabilistyka**	
Name in English:	**Probability and Statistics**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD002073**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of mathematics in the range of mathematical analysis
2. Credit of course: Mathematical analysis 1

SUBJECT OBJECTIVES

C01 To acquaint students with the basic problems of probability and statistics
C02 To gain skills of solving simple problems in the range of probability and statistics
C03 To understand a need of application of probability and statistics in practical engineering
C04 To prepare students to apply theory of probability and mathematical statistics in scientific works

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 The student has theoretical knowledge of probability and statistics
PEK_W02 The student knows the basic methods, techniques, tools and materials used in solving simple engineering problems from the studied field of study

Relating to skills	
PEK_U01	The student is able to solve simple problems in the range of probability and statistics, he is able to use proper analysis methods
PEK_U02	The student is able to use the analytical and simulation methods for solving engineering tasks
Relating to social competences	
PEK_K01	He understands the need of probability and statistics application in technical activity

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Sample space, probability, basic relation	2
Le_02	Random variables, probability distribution	2
Le_03	Moments of random variables, quantiles	2
Le_04	Characteristic function	2
Le_05	Central limit theorems	2
Le_06	Estimation methods	2
Le_07	Statistic tests	2
Le_08	Test	1
	TOTAL	15

Form of classes - Classes		Quantity
Cl_01	Exercises dealing with analysis and calculation on random events	2
Cl_02	Exercises connected with cumulative distribution analysis, probability density function and probability of the discrete random variables	2
Cl_03	Calculation of moments and quantiles	2
Cl_04	Calculation and analysis of characteristic function	2
Cl_05	Calculation of empirical moments	2
Cl_06	Calculation of confidence intervals	2
Cl_07	Exercises connected with hypothesis testing	2
Cl_08	Test	1
	Total	15

TEACHING TOOLS USED

ND_01 Traditional lecture
ND_02 Classes - solving of problems connected with probability and statistics
ND_03 Tutorials
ND_04 Individual work - studies for lecture
ND_05 Individual work - studies of examples and exercises for classes
ND_06 Individual work - individual studies for tests

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Credit test
P2 = F2 (classes)	PEK_U01, PEK_U02, PEK_K01	Discussion, solving of problems

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. W. Kordecki, Rachunek prawdopodobieństwa i statystyka matematyczna, definicje, twierdzenia, wzory, Oficyna Wyd. GiS, 2003
2. H. Jasiulewicz, W. Kordecki, Rachunek prawdopodobieństwa i statystyka matematyczna, przykłady i zadania, Oficyna Wyd. GiS, 2003

Secondary literature

1. L. Gajek, M. Kałuszka, Wnioskowanie statystyczne, WNT, 1996
2. M. Fisz, Rachunek prawdopodobieństwa i statystyka matematyczna, WNT, 1969

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Probability and Statistics

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W03	C01	Le_01-Le_07	ND_01, ND_03, ND_04, ND_06
PEK_W02	InzA_W02	C01, C02, C04	Le_01-Le_07	ND_01, ND_03, ND_04, ND_06
PEK_U01 (skills)	K1eit_U02	C02	Cl_01-Cl_07	ND_02, ND_03, ND_05
PEK_U02	InzA_U02	C02	Cl_01-Cl_07	ND_02, ND_03, ND_05
PEK_K01 (competences)	K1eit_K01, InzA_K01	C03	Le_01-Le_07, Cl_01-Cl_07	ND_01-ND_06

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Technika analogowa**	
Name in English:	**Analog Technique**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD002074**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	30			
Number of hours of total student workload (CNPS)	60	90			
Form of crediting	E	Z			
Number of ECTS points	2	3			
Including number of ECTS points for practical (P) classes	0	3			
Including number of ECTS points for direct teacher-student contact (BK) classes	1.2	2.1			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. A knowledge of fundamentals of physics
2. A knowledge the fundamentals of mathematics (including arithmetic of complex quantities)

SUBJECT OBJECTIVES

C01 Familiarizing students with the analysis of linear and nonlinear, direct (dc) and alternating (ac) current circuits including of using Ohm's and Kirchhoff's laws, loop (mesh) current method and nodal analysis, the superposition theorem, Thevenin's theorem and Norton's theorem and symbolic method

C02 Familiarizing students with the phenomenon of voltage resonances and current resonances and the power of RLC circuits under sinusoidal stimulation

C03 Familiarizing students with the nonlinear RLC circuits analysis

C04 Familiarizing students with the basics theorem of four-port networks, RLC filters, transformers, miscellaneous (nonsinusoidal) waveforms and the phenomenon of sinusoidal harmonic components

C05 To prepare students to conduct scientific research in the field of electronics

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 The student knows the fundamentals of electric circuits with passive discrete components, linear and nonlinear for direct current and alternating current in steady states and instantaneous states

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

Relating to skills

PEK_U01 The student has a skill of use passive components and a skill of device design to meet technical and operation requirements, and also to meet health and safety-at-work legislation

Relating to social competences

PEK_K01 The student understands the need to use new technics in engineer activity, and can predict consequences of undertaken experimental works

PROGRAMME CONTENT

	Form of classes - Lecture	Quantity
Le_01	Equivalent resistances of resistor networks. Ohm’s low. Electrical energy sources, autonomous ideal sources and real sources	2
Le_02	Kirchhoff’s laws. DC network analysis using Kichhoff’s laws (classic method). Concept (idea) of voltage source and current source	2
Le_03	The superposition theorem, Thevenin’s theorem and Norton’s theorem in electric circuits analysis	2
Le_04	Loop equations (mesh equations) method and nodal analysis method in electric circuits analysis	2
Le_05	Nonlinear electric circuits - analysis methods. Instantaneous states in RLC circuits	2
Le_06	Linear circuits under sinusoidal excitation .Voltage - current relations for RLC components	2
Le_07	Ohm’s law and Kirchhoff’s laws in complex form. Analysis of simple RLC circuits under sinusoidal excitation	2
Le_08	Basic analysis techniques and theorems employed to solve linear ac network under sinusoidal excitation	2
Le_09	Power in AC circuits under sinusoidal excitation - balance of power and matching for maximum transfer of power. Power factor and its correction	2
Le_10	Voltage resonance and current resonance in electrical circuits	2
Le_11	Principle of four-port networks. RLC filters	2
Le_12	Magnetically coupled circuits. Basic construction of transformer and principle its operation, types of transformers, efficiency, equivalent circuits, transformation of impedance	2
Le_13	Three-phase AC systems. Symmetrical (balanced load) and unsymmetrical (unbalanced load) networks. □-connections and Y-connections	2
Le_14	Nonsinusoidal waveforms. Harmonic analysis of periodic waveforms	2
Le_15	Basic information on circuits with distributed parameters, elementary information about longue transmission line	2
	TOTAL	30

	Form of classes - Classes	Quantity
Cl_01	Solving the electrical circuits using Ohm’s law	2
Cl_02	Solving the electrical circuits using Kirchhoff’s lows and using method of current source and voltage source conversion	2
Cl_03	Solving the electrical circuits using superposition theorem, loop equation (mesh equation) and nodal analysis	2

Cl_04	Solving the electrical circuits using Thevenin’s theorem and Norton’s theorem	2
Cl_05	Solving the RLC electrical circuits in instantaneous states	2
Cl_06	Solving simple electrical circuits under sinusoidal excitation	2
Cl_07	Calculation the equivalence impedances and the equivalences admittances using complex numbers	2
Cl_08	Solving complex electrical networks under sinusoidal excitation	2
Cl_09	Solving complex electrical networks under sinusoidal excitation	2
Cl_10	Solving problems on voltage resonance and current resonance	2
Cl_11	Calculation the characteristics of RLC filters	2
Cl_12	Solving the electrical circuits with one-phase voltage transformer	2
Cl_13	Calculation three-phase voltage circuits	2
Cl_14	Analysis electrical circuits under nonsinusoidal waveform excitation	2
Cl_15	Test verification - complete semester	2
	Total	30

TEACHING TOOLS USED

ND_01 Traditional lecture with presentation and discussion
ND_02 Consultations
ND_03 Individual work (homework) - studying for class instruction and the examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Exam
P2 = F2 (classes)	PEK_U01	Classroom tests average result

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Lecture notes
2. J. R. Przygodzki, Zbiór zadań z elektrotechniki dla studentów wydziałów nieelektrycznych, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2008
3. K. Cieślicki, A. Syrzycki, Zbiór zadań z elektrotechniki ogólnej, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2003
4. S. Bolkowski, Teoria obwodów elektrycznych, WNT, Warszawa, 2003
5. S. Osowski, K. Siwek, M. Śmiałek, Teoria obwodów, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2006

Secondary literature

1. A. Markiewicz, Zbiór zadań z elektrotechniki, WSiP, Warszawa , 2006
2. H. Lindner, Zbiór zadań z elektrotechniki. Część1 - Prąd stały - obwody, COSIW. SEP. Warszawa, 2004
3. S. Bolkowski, W. Brociek, H. Rawa, Teoria obwodów elektrycznych. Zadania, WNT, Warszawa, 1995

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Analog Technique

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W23	C01-C04	Le_01-Le_15	ND_01
PEK_W02	InzA_W02	C01-C05	Le_01-Le_15, Cl_01-Cl_15	ND_01-ND_03
PEK_U01 (skills)	K1eit_U01, K1eit_ U09, K1eit_U17, InzA_U03	C01-C05	Cl_01-Cl_15	ND_01-ND_03
PEK_K01 (competences)	Keit_K02, InzA_K01	C01-C04	Cl_01-Cl_15	ND_01-ND_03

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Przyrządy półprzewodnikowe I**	
Name in English:	**Semiconductor Devices I**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD003077**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		45		
Number of hours of total student workload (CNPS)	90		120		
Form of crediting	E		Z		
Number of ECTS points	3		4		
Including number of ECTS points for practical (P) classes	0		4		
Including number of ECTS points for direct teacher-student contact (BK) classes	1.8		2.8		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of physic's principles (electricity and magnetism)
2. Completed course - Analog Technique ETD002074

SUBJECT OBJECTIVES

C01 To learn basic physical properties and operation of semiconductor devices
C02 To learn parameters and characteristics of electronic components
C03 To learn how to choose proper electronic device for circuit design
C04 Team work skill development
C05 To prepare students to conduct scientific research in the field of electronics

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Understanding of basic physics of semiconductors, operation of semiconductor devices and their applications
PEK_W02 The student knows the basic techniques, tools and materials used in solving simple engineering problems from the studied field of study

Relating to skills	
PEK_U01	Skill of using semiconductor elements in electronic circuits
PEK_U02	The student is able to plan and carry out experiments, including measurements and computer simulations, interpret the acquired results and draw conclusions
Relating to social competences	
PEK_K01	Independent and team work ability in lab experiments
PEK_K02	The student is aware of the importance and understands the non-technical aspects and results of engineering activity, including its impact on the environment, and the associated responsibility for made decisions

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Introduction. Semiconductor properties	2
Le_02	Semiconductor components and sensors: thermistors, photoresistors, hallotrons	2
Le_03	Basics of semiconductor device design	2
Le_04	The p-n junction. Energy band model. I-V characteristic	2
Le_05	The p-n junction and metal- semiconductor junction. Small signal equivalent models	2
Le_06	Influence of temperature and light on the p-n junction parameters	2
Le_07	Types of diodes and circuit applications 2	2
Le_08	Bipolar transistors; design, principle of operation	2
Le_09	Bipolar transistor characteristics, CE amplifier circuit	2
Le_10	Bipolar transistor small signal parameters	2
Le_11	JFET and MESFET devices	2
Le_12	MOSFET devices	2
Le_13	Switching devices: thyristors, triacs, IGBT	2
Le_14	Basics of monolithic integrated circuits	2
Le_15	Introduction to analog and digital ICs	2
	TOTAL	30

Form of classes - Laboratory		Quantity
La_01	Introduction to the Laboratory	3
La_02	Measurement instrumentation and set-ups circuits	3
La_03	Measuring passive components characteristics	3
La_04	The p-n junction characteristics	3
La_05	Zener diodes. Voltage regulator	3
La_06	Rectifying diodes and circuits	3
La_07	Temperature influence on semiconductors and p-n junction	3
La_08	Light influence on semiconductors and p-n junction	3
La_09	Bipolar transistor characteristics	3
La_10	Bipolar transistor amplifier	3

La_11	JFET characteristics	3
La_12	MOSFET characteristics	3
La_13	Monolithic integrated circuits I	3
La_14	Monolithic integrated circuits II	3
La_15	Make-up lab meeting	3
	Total	45

TEACHING TOOLS USED

ND_01 Lecture with slide presentation and discussion
ND_02 Laboratory – oral introduction to the experiments, 10-minute quizzes
ND_03 Office hours – tutorials
ND_04 Individual study with lecture material
ND_05 Student work – preparation to the lab
ND_06 Student work – preparation to the exam

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Class tests, discussions, final exam
P2 = F2 (lab)	PEK_U01, PEK_U02, PEK_K01, PEK_K02	Quizzes, lab reports, oral answers

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Lecture notes – copy (.pdf files) of the materials given by the subject supervisor, students should write the missing parts in the printed materials during the lecture, 2010
2. A. Świt, J. Pułtorak, Przyrządy półprzewodnikowe, WNT, 1984
3. B. Streetman, Przyrządy półprzewodnikowe, WNT, 1988
4. W. Marciniak, Przyrządy półprzewodnikowe i układy scalone, WNT, 1984

Secondary literature

1. A. Guziński, Liniowe elektroniczne układy analogowe, WNT, 1993
2. G. Rizzoni, Fundamentals of Electrical Engineering, McGraw-Hill, 2010

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Semiconductor Devices I

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W07, K1eit_W08, K1eit_W15	C01-C03	Le_01-Le_15	ND_01, ND_03, ND_04, ND_06
PEK_W02	InzA_W02	C01-C03, C05	Le_01-Le_15	ND_01, ND_03, ND_04, ND_06
PEK_U01 (skills)	K1eit_U13, K1eit_U14	C01-C03	La_01-La_15	ND_02, ND_03, ND_05
PEK_U02	InzA_U01	C01-C03, C05	La_01-La_15	ND_02, ND_03, ND_05
PEK_K01 (competences)	K1eit_K03	C04	La_01-La_15	ND_02, ND_05
PEK_K02	InzA_K01	C04, C05	La_01-La_15	ND_02, ND_05

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Podstawy Techniki Cyfrowej i Mikroprocesorowej II**	
Name in English:	**Introduction to Digital and Microprocessor Systems II**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD003078**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic computer science knowledge
2. Credited Introduction to Digital and Microprocessor Systems I course

SUBJECT OBJECTIVES

C01 Presenting of the construction, principles of operation and connecting of fundamental components of the basic microprocessor systems
C02 Presenting of the elements of modern microprocessors
C03 Practicing of the abilities learned during the Digital and Microprocessor Systems I course
C04 Improving the ability to work as a team member
C05 To prepare students to conduct scientific research in the field of electronics

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Student learned the knowledge about the construction and principles of the operation of basic components of the microprocessor systems: the microprocessor, memories, buses and input-output devices and about the construction of the modern microprocessors

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

Relating to skills

PEK_U01	Student is able to design, connect and test the simple digital circuit composed of low scale of integration components
PEK_U02	The student is able to plan and carry out experiments, including measurements and computer simulations, interpret the acquired results and draw conclusions

Relating to social competences

PEK_K01	Student is able to work in a team during the realization of the tasks
PEK_K02	The student is aware of the importance and understands the non-technical aspects and results of engineering activity, including its impact on the environment, and the associated responsibility for made decisions

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	The architecture of the microprocessor based on the Intel 8086, basic components of the microprocessor, addressing modes, review of the command list, principles of the program processing	4
Le_02	Memories - types, classification, presentation of the construction and principles of the operation of SRAM, DRAM, EPROM, EEPROM and FRAM memories	1
Le_03	Buses - classification, structure of simple local bus, typical buses found in hardware	3
Le_04	Input - output devices: connecting with the local bus, interrupt reporting and handling, DMA	3
Le_05	Modern microprocessors: Moore Law, cache, processing, pipelining, superscalar, multi-core, examples	2
Le_06	Quizzes	2
	TOTAL	15

Form of classes - Laboratory		Quantity
La_01	Introductory class, familiarization with the software and hardware	4
La_02	Combinatory logic - introduction	4
La_03	Arithmetic digital circuits	4
La_04	Computational digital circuits	4
La_05	Synchronous sequential logic - part 1	4
La_06	Synchronous sequential logic - part 2	4
La_07	Asynchronous sequential logic	4
La_08	Retake class, assigning final grades	2
	Total	30

TEACHING TOOLS USED

ND_01 The lecture with multimedia presentations and discussion
ND_02 Lecture supplements
ND_03 Consultations
ND_04 Homework - working on the assigned problems using literature and supplementary materials
ND_05 Laboratory classes - mini quizzes at the start of each class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Quizzes
P2 = F2 (lab)	PEK_U01, PEK_U02 PEK_K01, PEK_K02	Mini quizzes, grades for completing tasks

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Mroziński Zbigniew, Mikroprocesor 8086, WNT
2. Mroziński Zbigniew, Elementy systemu mikroprocesorowego 8086, skrypt PWr
3. Biernat Janusz, Architektura komputerów, PWr
4. Sacha Krzysztof, Mikroprocesor w pytaniach i odpowiedziach WNT

Secondary literature

1. Ron White, Jak działa komputer, PWN

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Introduction to Digital and Microprocessor Systems II

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W17	C01, C02	Le_01-Le_06	ND_01-ND_03
PEK_W02	InzA_W02	C01, C02, C05	Le_01-Le_06	ND_01-ND_03
PEK_U01 (skills)	K1eit_U11	C03	La_01-La_08	ND_03, ND_05
PEK_U02	InzA_U01	C03, C05	La_01-La_08	ND_03, ND_05
PEK_K01 (competences)	K1eit_K03	C04	Le_01-Le_06 La_01-La_08	ND_05
PEK_K02	InzA_K01	C04, C05	Le_01-Le_06 La_01-La_08	ND_05

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Języki skryptowe**	
Name in English:	**Scripting languages**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD003079**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge transferred in the course: Information Technology
2. Knowledge transferred in the course: Computer Science or Introduction to Computer Science

SUBJECT OBJECTIVES

C01 Mastery of theoretical knowledge referred to Le_01-Le_08
C02 Gaining practical skills through laboratory tasks La_01-La_07
C03 Consolidation of teamwork
C04 To prepare students to conduct scientific research in the field of electronics

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Student has expertise in the use of scripting languages on engineering issues
PEK_W02 Student knows the areas of application of scripting languages in scientific and engineering calculations
PEK_W03 Student knows the rules and methods of object-oriented programming using scripting languages

Relating to skills
PEK_U01 Student is able to select and properly use development tools to create script code dedicated to engineering tasks
PEK_U02 Students can write a script to control the application of engineering
Relating to social competences
PEK_K01 Students can interact and work in a group of laboratory, taking in the various roles

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Scripting languages - introduction, features, examples of applications	1
Le_02	The structure of scripting languages - similarities and differences	1
Le_03	Scripting language interpreters, examples	2
Le_04	The data types. Entering and data manipulation	2
Le_05	The control statements	2
Le_06	Functions	2
Le_07	Object-oriented programming	2
Le_08	I/O operations. File operations	2
Le_09	Final test	1
	TOTAL	15

Form of classes - Laboratory		Quantity
La_01	Introduction to laboratory classes. Conditions of the course	1
La_02	Development environments and scripting language interpreters	2
La_03	The data types. Entering and data manipulation	2
La_04	The control statements	2
La_05	Functions - definitions, the use of	2
La_06	Object-oriented programming. Classes and Objects	2
La_07	Input/output operations on the files	2
La_08	The additional period; Completion of the course	2
	Total	15

TEACHING TOOLS USED
ND_01 Traditional lecture with multimedia presentations and discussion
ND_02 Laboratory: short, 10-minute tests at the beginning of classes
ND_03 Consultation
ND_04 Own work - preparation for the lecture selected issues
ND_05 Own work - preparation for laboratory
ND_06 Own work - self-study and preparation for test

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02, PEK_W03	Final test
P2 = F2 (lab)	PEK_U01, PEK_U02, PEK_K01	Short tests, lab reports

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. D. Ascher, M. Lutz, Python. Wprowadzenie., Helion, 2010
2. L. Borkowski, Języki skryptowe, Wydawnictwo Naukowe UAM, 2006
3. P. Norton et al., Python. Od podstaw., Helion, 2007

Secondary literature

1. B. Mrozek, Z. Mrozek, MATLAB i Simulink, Helion, 2010
2. P. Krzyżanowski, Obliczenia inżynierskie i naukowe; Szybkie, skuteczne, efektowne, PWN, 2011
3. Reuven M. Lerner, Perl, Helion, 2003

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Scripting languages

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W28, InzA_W02	C01, C04	Le_01-Le_08	ND_01, ND_03, ND_04, ND_06
PEK_W02	K1eit_W28, InzA_W02	C01, C04	Le_01-Le_08	ND_01, ND_03, ND_04, ND_06
PEK_W03	K1eit_W28, InzA_W02	C01, C04	Le_01-Le_08	ND_01, ND_03, ND_04, ND_06
PEK_U01 (skills)	K1eit_U20, InzA_U01	C02	La_01-La_08	ND_02, ND_05
PEK_U02	K1eit_U20, InzA_U01	C02	La_01-La_08	ND_02, ND_05
PEK_K01 (competences)	K1eit_K03, InzA_K01	C03	La_01-La_08	ND_01-ND_06

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Dielektryki i magnetyki**	
Name in English:	**Dielectrics and Magnetic Materials**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD003080**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	90				
Form of crediting	E				
Number of ECTS points	3				
Including number of ECTS points for practical (P) classes	0				
Including number of ECTS points for direct teacher-student contact (BK) classes	1.8				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completing the course Electricity and magnetism
2. Completing the course Analog technique

SUBJECT OBJECTIVES

C01 To familiarize students with the basic physical phenomena determining the electrical and magnetic properties of matter, dielectric and magnetic materials and their applications in electronics

C02 Application of knowledge that is the content of the lecture to solve technical problems

C03 To prepare students to conduct scientific research in the field of electronics

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 The student has knowledge of the electrical and magnetic polarization and electrical conduction phenomena to solve technical problems

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

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Dielectric and magnetic characteristics. Material constants	2
Le_02	Mechanisms of electrical polarization. Resonant and relaxation phenomena. Conductivity in constant electric fields	2
Le_03	Macroscopic properties of dielectrics	2
Le_04	Dielectric response in alternating electric fields. Description in the time domain and frequency domain	2
Le_05	Dielectric relaxation in solids - the universal response	2
Le_06	Nonlinear dielectrics. Piezoelecrics	2
Le_07	Basic applications of dielectrics. Capacitors	2
Le_08	Polarization phenomena in magnetic materials. Diamagnetic,paramagnetic and ferromagnetic materials	2
Le_09	Macroscopic properties of magnetic materials. Hysteresis loop	2
Le_10	Soft and hard magnetic materials	2
Le_11	Magnetostriction. Villari effect	2
Le_12	Basic application of magnetic materials	2
Le_13	Measurements of electric and magnetic properties of materials using classical methods	2
Le_14	Impedance spectroscopy: measurement and analysis. Electrical equivalent models of RLC elements	2
Le_15	Dielectric and magnetic materials: examples of applications, limitations and perspectives	2
	TOTAL	30

TEACHING TOOLS USED

ND_01 Traditional lecture with presentations and discussion
ND_02 Consultations
ND_03 Self-resolving questions presented in the lecture
ND_04 Individual work - independent literature studies and Exam preparation.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02,	Written Examination

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Z. Celiński, Materiałoznawstwo elektrotechniczne, OW PW Warszawa, 2011
2. A. Chełkowski, Fizyka dielektryków, PWN Warszawa, 1993
3. M. Soiński, Materiały magnetyczne w technice, Wydawnictwo SEP, 2001

Secondary literature

1. A. K. Jonscher, Dielectric relaxation in solids, Chelsea Dielectric Press Ltd, 1983
2. B.D. Cullity, C.D. Graham, Introduction to Magnetics Materials, IEEE Press, J. Wiley&Sons, Inc, 2009
3. J. Martinez-Vega, Dielectric Materials for Electrical Engineering, ISTE Ltd. and J. Wiley&Sons, Inc, 2010

SUBJECT SUPERVISOR
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Dielectrics and Magnetic Materials

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W06	C01, C02, C03	Le_01-Le_15	ND_01-ND_04
PEK_W02	InzA_W02	C01, C02, C03	Le_01-Le_15	ND_01-ND_04

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Metrologia II**	
Name in English:	**Metrology II**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD003081**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completing the course Metrology I ETD002072

SUBJECT OBJECTIVES

C01 Ability to apply basic methods of measurement of physical and electrical quantities. The basis of statistical analysis of measurement data. Operation of measuring instruments
C02 Preparation to work independently and on a team
C03 To prepare students to conduct scientific research in the field of electronics

SUBJECT EDUCATIONAL EFFECTS

Relating to skills

PEK_U01 The student supports measuring equipment
PEK_U02 The student is able to plan and carry out experiments, including measurements and computer simulations, interpret the acquired results and draw conclusions

Relating to social competences PEK_K01 The student works independently and as a team member PEK_K02 The student is aware of the importance and understands the non-technical aspects and results of engineering activity, including its impact on the environment, and the associated responsibility for made decisions

PROGRAMME CONTENT		
Form of classes - Laboratory		Quantity
La_01	Introductory classes, technical training, safety training	3
La_02	Methods for determination measurement uncertainty	3
La_03	The basic measuring instruments for electronics	3
La_04	Influence of the measuring instruments on tested object	3
La_05	Voltage and current sources basic parameters	3
La_06	Resistance measurement	3
La_07	Oscilloscope	3
La_08	Registration and determine parameters of periodic signals	3
La_09	Temperature measurements	3
La_10	Term corrective exercises	3
	Total	30

TEACHING TOOLS USED
ND_01 Own work - preparation for laboratory exercises ND_02 Consultation ND_03 Verification of the degree preparation of students for laboratory exercises

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (lab)	PEK_U01, PEK_U02	A short written test, evaluation reports and the implementation of exercises
F2	PEK_K01, PEK_K02	Observation of the behavior of students during the laboratory

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Chwaleba A, Poniński M, Siedlecki A., Metrologia elektryczna, WNT Warszawa, 2010
2. Piotrowski J., Podstawy miernictwa, WNT Warszawa, 2002
3. Taylor J. R., Wstęp do analizy błędu pomiarowego, PWN Warszawa, 1999

Secondary literature

1. ISO, International vocabulary of basic and general terms in metrology, INTERNATIONAL ORGANIZATION FOR STANDARDIZATION, 2003
2. Sydenham P. H., Podręcznik metrologii, WKŁ Warszawa, 1988
3. Tumański S, Technika pomiarowa, WNT Warszawa, 2007

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Metrology II

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_U01 (skills)	K1eit_U13	C01	La_01-La_10	ND_01-ND_03
PEK_U02	InzA_U01	C01	La_01-La_10	ND_01-ND_03
PEK_K01 (competences)	Kleit_K03	C02	La_01-La_10	ND_01-ND_03
PEK_K02	InzA_K01	C02	La_01-La_10	ND_01-ND_03

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Podstawy elektroniki ciała stałego**	
Name in English:	**Principles of solid state electronics**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD003083**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of basics in higher mathematics at the level enabling understanding the issues in physics and quantum electronics
2. Successful completion of the Physics I course

SUBJECT OBJECTIVES

C01 Acquiring basic knowledge in theoretical and experimental physics and quantum electronics
C02 Understanding the theoretically founded issues related to basics in atom and statistical physics, as well as electrical and thermal properties of metals and semiconductors
C03 To prepare students to conduct scientific research in the field of solid state electronics

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 The student has the knowledge of theoretical and experimental basics in the field of solid state electronics
PEK_W02 The student knows the basic methods, techniques, tools and materials used in solving simple engineering problems from the studied field of study

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Experimental basics in quantum mechanics	2
Le_02	Theoretical basics in quantum mechanics	2
Le_03	Wave function. Schrödinger equation part 1	2
Le_04	Wave function. Schrödinger equation part 2	2
Le_05	Operators, physical interpretation of operational calculus	2
Le_06	Elementary quantum problems part 1	2
Le_07	Elementary quantum problems part 2	2
Le_08	Application of quantum mechanics to atom physics issues	2
Le_09	Gas of free electrons. Statistical distributions part 1	2
Le_10	Gas of free electrons. Statistical distributions part 2	2
Le_11	Crystalline lattice vibrations. Phonons	2
Le_12	Periodic potentials	2
Le_13	Thermal properties of metals and semiconductors	2
Le_14	Electrical properties of metals and semiconductors	2
Le_15	Colloquium	2
	TOTAL	30

TEACHING TOOLS USED

ND_01 Traditional lecture with presentations and discussion
ND_02 Own work of a student
ND_03 Consultations

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

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

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Ginter J., Wstęp do fizyki atomu cząsteczki i ciała stałego, PWN, Warszawa, 1996
2. Kittel C., Wstęp do fizyki ciała stałego, PWN Warszawa , 1999
3. Sukiennicki A. Zagórski A., Fizyka ciała stałego, WNT, Warszawa, 1984

Secondary literature

1. Brandt S., Dahmen H.D., Mechanika kwantowa w obrazach, PAN, Warszawa, 1989
2. Hennel J., Podstawy elektroniki półprzewodnikowej, WNT, Warszawa , 1986
3. Liboff R., Wstęp do mechaniki kwantowej, PWN, Warszawa, 1987
4. Van der Ziel A., Podstawy fizyczne elektroniki ciała stałego, WTN, Warszawa, 1980

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Principles of solid state electronics

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W04, K1eit_W05	C01, C02	Le_01-Le_15	ND_01-ND_03
PEK_W02	InzA_W02	C01-C03	Le_01-Le_15	ND_01-ND_03

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Programowanie niskopoziomowe w C**	
Name in English:	**Low level programming in C language**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Optional**	**/ Faculty**
Subject code:	**ETD003084**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			30	
Number of hours of total student workload (CNPS)	60			90	
Form of crediting	Z			Z	
Number of ECTS points	2			3	
Including number of ECTS points for practical (P) classes	0			3	
Including number of ECTS points for direct teacher-student contact (BK) classes	1.2			2.1	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

C01 Theoretical knowledge in the field of low-level programming in C
C02 The implementation of practical projects in the field of low-level programming in C
C03 Gaining experience working in a development team
C04 To prepare students to conduct scientific research in the field of electronics

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Acquisition of knowledge in the course of lectures on low-level programming in C
PEK_W02 The student knows the basic methods, techniques, tools and materials used in solving simple engineering problems from the studied field of study

Relating to skills

PEK_U01 Ability to program microcontroller based devices in C language

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

Relating to social competences

PEK_K01 Ability to act as a team in the implementation of projects in the field of electronics and computer science

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

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	The implementation of the printf function. Character terminal server software for the microcontroller	2
Le_02	PWM as a means of digital control of analog outputs. Software and hardware solutions. High-power RGB LED, DC motor	2
Le_03	The use of communication interfaces: SPI, I2C, UART	2
Le_04	Boot sequences of selected microcontrollers - from power-on to the main() function	2
Le_05	Selected integrated C-language development environment (IDE) for microcontrollers: CodeWarrior, Ride7	2
Le_06	Microcontroller registers and their availability from the C. GPIO and direct control of digital pins. LEDs, matrix keyboard	2
Le_07	GPIO and OOK modulation: a radio transmitter keying. Decoding the bit stream. Algorithms for transmission with controlled energy level and permissible rate of transmission errors	2
Le_08	Extensions for C in microcontrollers and standard ANSI C	2
Le_09	Floating-point arithmetic and other mathematical operations a microcontroller, or how to live without FPU. When we use fixed-point arithmetic instead of floating point	2
Le_10	Software implementation of OSI layers 2-4. Using the Ethernet interface. Synthesis and decoding of IP/UDP packets in network microcontrollers	2
Le_11	The use of the ADC: collection and processing of data in various formats	2
Le_12	The implementation of memory mapping and segments in C. The memory banks. Organization of the microcontroller memory in C language. Dynamic memory management in microcontrollers	2
Le_13	C language vs. microprocessor architecture. Portability of code and data between hardware platforms	2
Le_14	Interrupts and volatile variables: timer, serial port, external interrupts. The rules for creating efficient code in C	2
Le_15	Final test	2
	TOTAL	30

Form of classes - Project		Quantity
Pr_01	Use of peripherals - standalone device based on microcontroller	6
Pr_02	Communication with external devices. Implementation of the selected communication protocol	12
Pr_03	Implementation of embedded server (tcpd, httpd) using the selected TCP stack	12
	Total	30

TEACHING TOOLS USED
ND_01 The traditional lecture with presentations and discussion ND_02 Development board kits for microcontrollers ND_03 CodeWarrior Integrated Development Environment ND_04 Consultation ND_05 Self study - preparation of selected topics in the lecture ND_06 Self study - implementation of projects agreed with the teacher

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Discussions and final test
F2 (project)	PEK_U01, PEK_U02, PEK_K01, PEK_K02	Execution of tasks
F3	PEK_U01, PEK_U02, PEK_K01, PEK_K02	Project reports
P2 (project) = (F2+F3)/2		

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Bentley, Jon Louis, Perełki programowania, Helion, 2012
2. Francuz, Tomasz, Język C dla mikrokontrolerów AVR : od podstaw do zaawansowanych aplikacji, Helion, 2011
3. Kardaś, Mirosław, Mikrokontrolery AVR : język C : podstawy programowania, Atnel, 2011
4. Kernighan, Brian W., Język ANSI C : programowanie, Helion, 2010
5. Krzysztof Paprocki, Mikrokontrolery STM32 w praktyce, BTC, 2009

Secondary literature

1. A. Silberschatz, P. B. Galvin, G, Gagne, Operating System Concepts, John Wiley & Sons, 2010

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Low level programming in C language

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W17	C01	Le_01-Le_15	ND_01, ND_04, ND_05

PEK_W02	InzA_W02	C01-C03	Le_01-Le_15, Pr_01-Pr_03	ND_01-ND_06
PEK_U01 (skills)	K1eit_U08, K1eit_U18	C02	Pr_01-Pr_03	ND_02-ND_04, ND_06
PEK_U02	InzA_U06	C02-C04	Pr_01-Pr_03	ND_02-ND_04, ND_06
PEK_K01 (competences)	K1eit_K03	C03	Pr_01-Pr_03	ND_06
PEK_K02	InzA_K01	C02-C04	Pr_01-Pr_03	ND_06

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Programowanie aplikacyjne**	
Name in English:	**Application programming**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Optional**	**/ Faculty**
Subject code:	**ETD003085**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			30	
Number of hours of total student workload (CNPS)	60			90	
Form of crediting	Z			Z	
Number of ECTS points	2			3	
Including number of ECTS points for practical (P) classes	0			3	
Including number of ECTS points for direct teacher-student contact (BK) classes	1.2			2.1	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

C01 Gaining theoretical knowledge of application programming
C02 The implementation of practical projects in the field of Application Programming
C03 Gaining experience working in a development team
C04 To prepare students to conduct scientific research in the field of electronics

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Acquiring knowledge is taught in the course of application programming
PEK_W02 The student knows the basic methods, techniques, tools and materials used in solving simple engineering problems from the studied field of study

Relating to skills PEK_U01 Ability to design and implement a computer program in C + +, C #, Java PEK_U02 The student is able to use the analytical, simulation and experimental methods for formulating and solving engineering tasks **Relating to social competences** PEK_K01 Ability to work independently and together with the implementation of software projects PEK_K02 The student is aware of the importance and understands the non-technical aspects and results of engineering activity, including its impact on the environment, and the associated responsibility for made decisions

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Graphical User Interface: WinAPI and event-driven programming - how it works	2
Le_02	Portability of data between systems of different architectures; serialization	2
Le_03	Communication with other applications and devices using the Ethernet / TCP / IP. Implementation of core network services - client and server software, TCP, UDP, HTTP	2
Le_04	Security and control of data integrity using cryptography (CRC, MD5)	2
Le_05	Data visualization - scaling, color masks, OpenGL basics	2
Le_06	3D Engines in practice: Ogre3D, Irrlicht and Unreal	2
Le_07	C # language as a modern object-oriented language. The organization of the project. Defining your own classes	2
Le_08	The basic windowing applications in C # using standard controls. Practical use of GDI+	2
Le_09	Acquiring and processing data from the environment: files, events, keyboard, mouse and HID	2
Le_10	Storage of data - basic programming of SQL databases (ADO.NET, PGSQL)	2
Le_11	XML as an universal and portable data representation language	2
Le_12	WebBrowser control and use. Using of HTML page as an interface for applications	2
Le_13	Multithreading and. NET: critical sections, BackgroundWorker class	2
Le_14	Programming the serial port and the practical use of multi-threading	2
Le_15	Final test	2
	TOTAL	30

Form of classes - Project		Quantity
Pr_01	A simple object-oriented application in C # /. NET or Java (Android)	8
Pr_02	Complex programming project implementing the transfer and storage of data	22
	Total	30

TEACHING TOOLS USED
ND_01 The traditional lecture with presentations and discussion ND_02 Software tools: Integrated Development Environment ND_03 Consultation ND_04 Self study - preparation of selected topics in the lecture ND_05 Self study - implementation of projects agreed with the teacher

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Discussions and final test
F2 (project)	PEK_U01, PEK_U02, PEK_K01, PEK_K02	Partial tests and quizzes
F3	PEK_U01, PEK_U02, PEK_K01, PEK_K02	Project reports
P2 (project) = (F2+F3)/2		

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Friesen, Geoff, Java : przygotowanie do programowania na platformę Android , Helion, 2012
2. Kernighan, Brian W., Lekcja programowania : najlepsze praktyki, Helion, 2011
3. Lis, Marcin, C# : praktyczny kurs, Helion, 2012
4. Petzold, Charles, Programming Microsoft Windows with C#, Microsoft Press, 2001
5. Rasheed, Faraz, Programmer-s Heaven C# School Book, http://www.programmersheaven.com/ebooks/csharp_ebook.pdf, 2012
6. Schildt, Herbert, Java : kompendium programisty, Helion, 2012

Secondary literature

1. Domka, Przemysław, Programowanie strukturalne i obiektowe, WSiP, 2010
2. Karwin, Bill., Antywzorce języka SQL : jak uniknąć pułapek podczas programowania baz danych , Helion, 2012
3. Komatineni, Satya, Android 3 : tworzenie aplikacji , Helion, 2012
4. Michalska, Katarzyna, Application programming - Java and XML technologies, PRINTPAP, 2011

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Application programming

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W28	C01	Le_01-Le_15	ND_01, ND_03, ND_04
PEK_W02	InzA_W02	C01, C04	Le_01-Le_15, Pr_01, Pr_02	ND_01-ND_05

PEK_U01 (skills)	K1eit_U20	C02	Pr_01, Pr_02	ND_02, ND_03, ND_05
PEK_U02	InzA_U02	C02	Pr_01, Pr_02	ND_02, ND_03, ND_05
PEK_K01 (competences)	K1eit_K02, K1eit_K03	C03, C04	Pr_01, Pr_02	ND_05
PEK_K02	InzA_K01	C03, C04	Pr_01, Pr_02	ND_05

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Optyka falowa**	
Name in English:	**Wave optics**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD003089**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge on electromagnetism
2. Capabilities of using differential and integral calculus and complex numbers

SUBJECT OBJECTIVES

C01 Gaining knowledge on light-matter interaction
C02 Gaining knowledge on light interference and polarization and application of these phenomena in optical metrology
C03 Gaining knowledge on light diffraction and its role in optical and optoelectronic instruments
C04 To prepare students to conduct scientific research in the field of electronics

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 The student has fundamental, supported theoretically, knowledge concerning light-matter interaction
PEK_W02 The student knows the basic methods, techniques and tools used in solving simple engineering problems from the studied field of study

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Wave equation, nature of EM waves, propagation of EM waves, polarization of EM waves, light-matter interaction	3
Le_02	Refractive index, dispersion, optical materials, absorption and scattering of light	2
Le_03	Reflection and refraction of plane waves form boundary of two dielectrics, total internal reflection	2
Le_04	Interference of light, Young's fringes, coherence of light	2
Le_05	Interference of waves reflected by plane-parallel plates and thin films, two-beam interferometers, multiple-beam interference, Fabry-Perot interferometer	2
Le_06	Diffraction of light, Huygens principle, Fraunhofer's diffraction on slit and circular aperture, diffraction gratings	2
Le_07	Resolution of optical systems, point spread function and optical transfer function	2
	TOTAL	15

TEACHING TOOLS USED

ND_01 Multimedia presentations
ND_02 Providing lecture notes
ND_03 Consultations
ND_04 Students' own work-preparation to final test

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Final test, 3-4 open questions.

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. I. Wilk, P. Wilku, Optyka fizyczna, część I - dyfrakcja światła, Oficyna Wydawnicza PWR
2. J. Petykiewicz, Optyka falowa, PWN
3. J. R. Meyer-Arendt, Wstęp do optyki, PWN
4. K. Gniadek, Optyczne przetwarzanie informacji, PWN

Secondary literature

1. B. E. A. Saleh, M. C. Teich,, Fundamentals of Photonics, Wiley Series, 2007

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Wave optics

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W04, K1eit_W07, K1eit_W09	C01-C03	Le_01-Le_07	ND_01-ND_04
PEK_W02	InzA_W02	C01-C03	Le_01-Le_07	ND_01-ND_04

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Analogowe i cyfrowe układy elektroniczne I**
Name in English:	**Analog and Digital Electronics Circuits I**
Main field of studies:	**Electronics and Telecommunications**
Level and form of studies:	**I level / Full time**
Kind of subject:	**Obligatory / Faculty**
Subject code:	**ETD004076**
Group of courses:	**NO**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

C01 To acquaint students with basic operating circuits of active electronic components
C02 To acquaint students with basic methods of analysis of circuits with active electronic components
C03 To acquaint students with basic electronic linear circuits designed with discrete components and integrated circuits
C04 To acquaint students with basic electronic analog and digital integrated circuits
C05 To gain competence how to select electronic components to fulfill technical and operational requirements
C06 Preparing students to conduct research related to electronics circuits

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Students have systematic and theoretically founded knowledge of the basic circuits of active electronic components, particularly in the field of amplifying and filtering circuits design

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

Relating to skills

PEK_U01	Students are able to prepare documentation of engineer project in the field of electronic circuits and signal filters
PEK_U02	The student is able to identify and formulate a specification of simple and practical engineering tasks, characteristic for the studied field of study

Relating to social competences

PEK_K01	Student understand the need for use of new techniques and technologies in engineering activities

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Bipolar transistors - classification, parameters, properties	2
Le_02	Biasing and stabilization f bipolar transistors - basic circuits and their properties	2
Le_03	Small signal analysis of OE, OC and OB amplifiers	2
Le_04	Biasing and stabilization of unipolar transistors - basic circuits and their properties	2
Le_05	Small signal analysis of OS, OD and OG amplifiers	2
Le_06	Differential amplifier	2
Le_07	Power audio amplifiers	2
Le_08	Test in writing K1_Wy	2
Le_09	Properties of ideal operational amplifier	2
Le_10	Feedback circuits - classification and electricla properties	2
Le_11	Feedback circuits - classification and electricla properties	2
Le_12	Basic electronic linear circuits with operational amplifiers	2
Le_13	Feedback circuits in configuration of signal filters	2
Le_14	State variable and switched capacitance signal filters	2
Le_15	Test in writing K2	2
	TOTAL	30

Form of classes - Project		Quantity
Pr_01	Mathematical methods in electronic circuit analysis, equivalent model of electronic circuits	2
Pr_02	DC current analysis of electronic circuits	2
Pr_03	AC analysis of electronic circuits	2
Pr_04	Test K1_Pr	2
Pr_05	Design of DC bias circuitry of bipolar and unipolar transistors	2
Pr_06	Design of differential amplifiers	2
Pr_07	TestK2_Pr	2
Pr_08	Defense of low frequency (LF) amplifier	1
	Total	15

TEACHING TOOLS USED	
ND_01	Lecture with discussion
ND_02	Multimedia lecture with discussion
ND_03	Consultations
ND_04	Individual work - preparation of selected topics in the lecture
ND_05	Individual work - preparation for test
ND_06	Individual work- study on defined subject of realized project
ND_07	Test in writing

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (lecture)	PEK_W01, PEK_W02	Test in writing
F2	PEK_W01, PEK_W02	Test in writing
F3 (project)	PEK_U01, PEK_U02	Classes in writing
F4	PEK_U01, PEK_U02	Classes in writing

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. A. Guziński, Liniowe analogowe układy scalone, WNT, Warszawa
2. S. Kuta, Układy elektroniczne, Uczelniane Wydawnictwa Naukowo-Dydaktyczne AGH, Kraków,
3. Z. Nosal, J. Baranowski, Układy analogowe Liniowe, WNT, Warszawa

Secondary literature

1. A. Silberschatz, P. B. Galvin, G, Gagne, Operating System Concepts, John Wiley & Sons, 2010
2. Filipkowski, Układy elektroniczne analogowe i cyfrowe, WNT, Warszawa
3. M. Kulka, Z Nadachowski, Zastosowania wzmacniaczy operacyjnych, Wydawnictwa Naukowo-Techniczne, 1986
4. P. Horowitz, W. Hill, , Sztuka elektroniki, Wydawnictwo Komunikacji i Łączności, 2009
5. Piotr Górecki, Wzmacniacze operacyjne, Wydawnictwo BCT, 2004

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Analog and Digital Electronics Circuits

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W03	C01-C04	Le_01-Le_08	ND_01-ND_05
PEK_W02	InzA_W02	C01-C04	Le_01-Le_08	ND_01-ND_05
PEK_U01 (skills)	K1eit_U01, K1eit_U14	C02-C05	Pr_01-Pr_08	ND_03, ND_06, ND_07
PEK_U02	InzA_U06	C02-C05	Pr_01-Pr_08	ND_03, ND_06, ND_07
PEK_K01 (competences)	K1eit_K02-K1eit_K04	C05	Pr_01-Pr_08	ND_03, ND_06, ND_07

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Mikrosystemy I**	
Name in English:	**Microsystems I**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD004077**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

There are no prerequisites listed for this course

SUBJECT OBJECTIVES

C01 Gaining knowledge about the basics of micromachines technology with elements of nanotechnology, basic knowledge of the design and application of numerous modern sensors, MEMS and microsystems MEOMS, mikroaktuatorów and micromachines and the solutions chosen nanorobots

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Student has knowledge of the micromechanical sensors, actuators and microsystems: construction, technology, operations, together with the basics of phenomena, parameters, and applications in the technics

PEK_W02 He knows the typical engineering technologies in the field of the studied field of study

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	The scope of the lecture, definitions, from microelectronics to micromechanics	2
Le_02	Fundamentals of technology - microelectronics processes for micromachines	2
Le_03	Deep and surface micromachining	2
Le_04	Micromechanical bonding of materials	2
Le_05	3D forming; LIGA, space microlithography, other 3D techniques	2
Le_06	Movement and work at the microscale: static and dynamic micromachines. The use in sensors, transducers and micromachines	2
Le_07	Pressure sensors: design, technology, performance, utilization	2
Le_08	Acceleration sensors, sensors of vibration, force and displacement. Overview of the construction, parameters, applications. Other micromechanical sensors	2
Le_09	Microsystems and micromachines MEMS, MEOMS; construction, operation, application	2
Le_10	Instrumental systems for measurement and control of real time with the use of MEMS and microsystems MEOMS	2
Le_11	Bases of micro and nanofluidics, microfluidics structures and their application	2
Le_12	Chemical Lab-chip/bio-chip/microchips and their use	2
Le_13	Microsystems and micromachines in the automotive, aerospace, military technology and equipment of everyday life	2
Le_14	Microrobots and nanomachines, technology, constructions and selected technical applications today and in the future	2
Le_15	Economic aspects on a global basis, including the EC and national needs. Expected development directions and new applications	2
	TOTAL	30

TEACHING TOOLS USED
ND_01 Lecture with presentations and discussion ND_02 Consultations

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (lecture)	PEK_W01, PEK_W02,	Exam
P1 (lecture)	PEK_W01, PEK_W02	Positive evaluation of exam

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. J. Dziuban, Technologia i zastosowanie mikromechanicznych struktur krzemowych i krzemowo-szklanych w technice mikrosystemów, Oficyna Wydawnicza Politechniki Wrocławskiej, 2002
2. J. Dziuban, Bonding in microsystem technology, Springer, 2007

Secondary literature

1. MacDouk, MEMS Handbook, MC, New York, 2009

SUBJECT SUPERVISOR
Jan.Dziuban@pwr.edu.pl

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Microsystems I

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W05	C01	Le_01-Le_15	ND_01, ND_02
PEK_W02	InzA_W05	C01	Le_01-Le_15	ND_01, ND_02

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Optoelektronika I**	
Name in English:	**Optoelectronics I**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD004078**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge in the field of general physics
2. Knowledge in the field of solid state physics
3. Basic knowledge in the field of semiconductor devices
4. Ability to reach out the supplemental areas of knowledge and skills
5. Organizational competencies related to participation in the lecture

SUBJECT OBJECTIVES

C01 Revision of basic optical phenomena in semiconductor, in particular related to absorption and generation of electromagnetic radiation, basing on specific device applications

C02 Gaining knowledge in the field of formal methods applied for the description of optical phenomena in semiconductors

C03 Familiarizing the students with basic designs of optoelectronic structures, organic and infrared optoelectronics and presentation of applications fields of the optoelectronics systems and components, especially in medicine, fiber optics, optotelecommunications, power engineering and mechatronics

C04 Gaining knowledge about the application of materials, designs and manufacturing technology of optoelectronic heterostructures

C05	Acquiring the ability of literature studies and knowledge presentation in the field of applied designs of optoelectronic structures and the ability of the optoelectronic components selection
C06	Preparing students to carry out scientific research related to optoelectronics and techniques of epitaxial growth of semiconductor layers

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01	The student has knowledge about the theoretical and experimental bases in the field of solid state electronics and photonics (optoelectronics), including necessary knowledge for understanding the physical phenomena that have significant influence on properties of new materials and optoelectronic devices. The student has accurate knowledge about designs and technology (nanotechnology) applied in basic optoelectronic devices and systems.
PEK_W02	The student knows the basic methods, techniques, tools and materials used in solving simple engineering problems from the studied field of study

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Optoelectronics – introduction lecture: definitions, classifications, development trends of optoelectronics. Advantages of optoelectronics. Fields of applications. Elements of optical fiber telecommunication channel.	2
Le_02	Bases of optical phenomena in semiconductor materials, generation and absorption. Mechanisms and types of absorption; optical characteristics of solid state, radiative and non-radiative recombination, van Roosbroeck-Shockley theorem. The application of optical phenomena in nanostructures for optoelectronic devices.	2
Le_03	Energy band gap engineering, engineering methods, semiconductor compounds, planar doped heterostructures, heterojunction.	2
Le_04	Materials for optoelectronic nanostructures manufacturing. AIIIBV and AIIBVI materials. Vagard’s Law. Materials basic properties.	2
Le_05	Bases of epitaxy, growth modes, epitaxial substrate, requirements and importance of substrate’s selection. Homo- and hetero epitaxy. Methodology of the manufacturing processes of optoelectronic devices. Fundamentals of crystallization and crystal growth control in different growth modes.	2
Le_06	Heterostructures technology for optoelectronic structures. Homo- and heterostructures. Properties of optoelectronic heterostructures and nanostructures. Epitaxial technologies. Epitaxial growth process control. Technical infrastructure applied in the technology of optoelectronic structures.	4
Le_07	Basic techniques for epitaxial growth. LPE and VPE techniques. Technology of complex optoelectronic nanostructures. MOVPE and MBE techniques. Characterization of manufacturing techniques and their comparison. Areas of application.	4
Le_08	Basics of light generation in semiconductor emitters. Analysis of quantum efficiency of light sources. Output coupling of the light from the emitter. Electroluminescence diodes. Spectral characteristics. Parameters of electroluminescence diodes.	2
Le_09	Semiconductor white light source. Emission characteristic. Lightning system. Nanostructures in sources of radiation. Electroluminescence diodes for coupling with optical fiber. Pulsed operation mode of the LED. Diode and liquid crystal displays.	2
Le_10	Bases of laser light generation. Construction of resonant cavity. Lasing threshold. Fabry-Perot resonator. Reflectors in semiconductor optical generators. The I-V and P-I characteristics. Laser’s quantum efficiency. Operating parameters.	2
Le_11	Radiation detectors. Basic mechanisms of detection. Parameters of semiconductor detectors. Noises in detectors. The Basic construction of semiconductor detectors with heterostructure as an active region. Sensitivity characteristics of detectors. Selection of the operation point.	3

Le_12	Photovoltaic cell. Principles of operation. Review of photovoltaic cells constructions and designs. Silicon photovoltaic cells. Photovoltaic cells based on AIIIBV-N compounds. Operation conditions. Operation point. Characteristics of photovoltaic cells. Development trends of photovoltaics.	3
	TOTAL	30

TEACHING TOOLS USED
ND_01 Topic lectures – traditional method of lecture and presentation prepared in Power Point ND_02 Lecture – electronic transcription and multimedia presentation available on the Internet network ND_03 Lecture – self study, solving problems and exercises after lectures ND_04 Consultation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (lecture)	PEK_W01, PEK_W02	Exam

PRIMARY AND SECONDARY LITERATURE

Primary literature

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

Secondary literature

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

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Optoelectronics I

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W01, K1eit_W04, K1eit_W19	C01-C05	Le_01-Le_12	ND_01-ND_04
PEK_W02	InzA_W02	C06	Le_01-Le_12	ND_01-ND_04

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Podstawy konstrukcji aparatury elektronicznej**	
Name in English:	**Foundations of electronic apparatus construction**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD004079**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge transferred in the course Introduction to Electronics
2. Knowledge transferred in the course Materials Engineering

SUBJECT OBJECTIVES

C01 Mastery of theoretical knowledge specified in Le_01-Le_10

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 A general knowledge in the field of designing and manufacturing electronic equipment
PEK_W02 The student knows the typical engineering technologies in the area of electronic apparatus construction

Relating to skills

PEK_U01 Able to correct selection of materials and manufacturing techniques to design electronic equipment meeting specific technical and operational requirements

Relating to social competences	
PEK_K01	Able to set priorities and to choose optimal solutions in the design of electronic devices, also because of the impact on the environment

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Introduction, basic types of electronic equipment	2
Le_02	General rules for constructing electronic equipment	3
Le_03	Computer aided the constructing process	2
Le_04	Materials used in constructions of electronic apparatus	3
Le_05	Modularization and standardization of electronic devices	3
Le_06	Ergonomics, communication and control of devices	3
Le_07	Environmental exposure affecting the electronic equipment	3
Le_08	Heat dissipation, cooling	3
Le_09	Electromagnetic compatibility of electronic devices; groundings	3
Le_10	Proecological design; recycling	3
Le_11	Completion of the course	2
	TOTAL	30

TEACHING TOOLS USED	
ND_01	Lecture with multimedia presentations and discussion
ND_02	Consultation
ND_03	Self-study and preparation for test

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

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

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. J. Felba, R. Kisiel, Podstawy konstrukcji aparatury elektronicznej, Oficyna Wydawnicza Politechniki Wrocławskiej, 2015

Secondary literature

1. J. Felba, Montaż w elektronice, Oficyna Wydawnicza Politechniki Wrocławskiej, 2010
2. R. Kisiel, Podstawy technologii dla elektroników, Wydawnictwo BTC Korporacja, 2012

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Foundations of electronic apparatus construction

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W02, K1eit_W11	C01	Le_01-Le_10	ND_01-ND_03
PEK_W02	InzA_W05	C01	Le_01-Le_10	ND_01-ND_03
PEK_U01 (skills)	K1eit_U01	C01	Le_01-Le_10	ND_01-ND_03
PEK_K01 (competences)	K1eit_K04, K1eit_K05	C01	Le_01-Le_10	ND_01-ND_03

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Półprzewodniki, dielektryki, magnetyki**
Name in English:	**Semiconductors, Dielectrics and Magnetic Materials**
Main field of studies:	**Electronics and Telecommunications**
Level and form of studies:	**I level / Full time**
Kind of subject:	**Obligatory / Faculty**
Subject code:	**ETD004080**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			45		
Number of hours of total student workload (CNPS)			120		
Form of crediting			Z		
Number of ECTS points			4		
Including number of ECTS points for practical (P) classes			4		
Including number of ECTS points for direct teacher-student contact (BK) classes			2.8		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completing the course Electricity and Magnetism
2. Completing the course Analog technique

SUBJECT OBJECTIVES

C01 To familiarize students with the measurement of electrophysical properties of selected materials and semiconductor, dielectric and magnetic components
C02 The practical application of the knowledge gained during the course Dielectrics and magnetic materials
C03 Consolidation of Teamwork
C04 Preparing to conduct research in the subject semiconductors, dielectrics and magnetics

SUBJECT EDUCATIONAL EFFECTS

Relating to skills

PEK_U01 The student measures the basic properties of dielectrics, magnetic materials and semiconductors, understand mechanisms of physical phenomena occurring in these materials
PEK_U02 The student is able to plan and carry out experiments, measurements and interpret the acquired results and draw conclusions

Relating to social competences
PEK_K01 The student works independently and in a team

PROGRAMME CONTENT		
Form of classes - Laboratory		Quantity
La_01	Organizational Classes. To familiarize students with the apparatus and software	3
La_02	Analysis of measurement results using the Origin software	3
La_03	Schottky junction by CV measurements	3
La_04	Measurement of I-V characteristics of Schottky junction	3
La_05	Measurement and evaluation of piezoelectric ceramic parameters	3
La_06	Piezoelectric resonators and filters measurements	3
La_07	Inverse piezoelectric effect measurement	3
La_08	AC properties of materials and electronic components analysis	3
La_09	Characterization of materials by impedance spectroscopy	3
La_10	DC electrical conductivity measurements	3
La_11	Measurements the semiconductors mobility carriers.	3
La_12	Carrier lifetime in semiconductor measurements	3
La_13	Investigation of ferromagnetic materials	3
La_14	Measurements dielectric and magnetic materials by conventional methods	3
La_15	Deadline for correction, grading	3
	Total	45

TEACHING TOOLS USED
ND_01 Verification of the degree preparation of students for laboratory exercises ND_02 Consultations ND_03 Own work - preparation for laboratory exercises

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (lab)	PEK_U01, PEK_U02	A short written test, evaluation reports and the implementation of exercises
F2	PEK_K01	Observation of the behavior of students during the laboratory

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Z. Celiński, Materiałoznawstwo elektrotechniczne, OW PW Warszawa, 2011
2. A. Chełkowski, Fizyka dielektryków, PWN Warszawa, 1993
3. D. K. Schroder, , Semiconductor Material and device characterization, John Wiley&Sons, Inc, 1998
4. M. Soiński, Materiały magnetyczne w technice, Wydawnictwo SEP, 2001
5. W. Marciniak, Przyrządy półprzewodnikowe i układy scalone, PWN Warszawa, 1979
6. W. Soluch, Filtry piezoelektryczne, WKŁ Warszawa, 1982

Secondary literature

1. A. K. Jonscher, Dielectric relaxation in solids, Chelsea Dielectric Press Ltd, 1983
2. J. Martinez-Vega, Dielectric Materials for Electrical Engineering, J. Wiley&Sons, Inc, 2010
3. K. Nitsch, Zastosowanie spektroskopii impedancyjnej w badaniach materiałów elektronicznych, OW PWr Wrocław, 1999
4. S. Grimnes, O. G. Martinsen, Bioimpedance & Bioelectricity Basics, AP, 2000

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Semiconductors, Dielectrics and Magnetic Materials

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_U01 (skills)	K1eit_U04	C01, C02	La_01-La_15	ND_01-ND_03
PEK_U02	InzA_U01	C01, C02	La_01-La_15	ND_01-ND_03
PEK_K01 (competences)	Kleit_K03	C03	La_01-La_15	ND_01-ND_03

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Przyrządy półprzewodnikowe II**	
Name in English:	**Semiconductor Devices II**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD004081**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			45		
Number of hours of total student workload (CNPS)			120		
Form of crediting			Z		
Number of ECTS points			4		
Including number of ECTS points for practical (P) classes			4		
Including number of ECTS points for direct teacher-student contact (BK) classes			2.8		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Credit for ETD003077 course (lecture and lab)

SUBJECT OBJECTIVES

C01 To learn parameters and characteristics of electronic components and circuits
C02 To learn how to choose proper electronic device for circuit design
C03 To learn measuring set-up configurations
C04 Team work skill development
C05 Preparing to conduct research in a semiconductor

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

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

Relating to skills
PEK_U01 Skill of using semiconductor elements in electronic circuits.
PEK_U02 The student is able to plan and carry out experiments, including measurements and computer simulations, interpret the acquired results and draw conclusions.
Relating to social competences
PEK_K01 Independent and team work ability in lab experiments

PROGRAMME CONTENT

Form of classes - Laboratory		Quantity
La_01	Introduction to the Laboratory	3
La_02	Unijunction transistor applications	3
La_03	High frequency parameters of bipolar transistor	3
La_04	Operational amplifier characteristics	3
La_05	Varactors	3
La_06	MOSFET power switch	3
La_07	Thyristor in power circuits	3
La_08	TTL gates	3
La_09	CMOS gates	3
La_10	Optoelectronic components, optocouplers	3
La_11	Bipolar transistor switching	3
La_12	Small-signal h_{ije} parameters of bipolar transistor	3
La_13	Competence test	3
La_14	Extra term	3
La_15	Extra term	3
	Total	45

TEACHING TOOLS USED

ND_01 Laboratory - oral introduction to the experiments, 10-minute quizzes
ND_02 Office hours - tutorials
ND_03 Student work - preparation to the lab

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lab)	PEK_W01, PEK_U01, PEK_U01, PEK_K01	Quizzes, lab reports, oral answers, test of competences

PRIMARY AND SECONDARY LITERATURE
Primary literature 1. Lecture notes 2. W. Marciniak, Przyrządy półprzewodnikowe i układy scalone, WNT, 3. A. Świt, J. Pułtorak, Przyrządy półprzewodnikowe, WNT, 4. B. Streetman, Przyrządy półprzewodnikowe, WNT **Secondary literature** 1. A. Guziński, Liniowe elektroniczne układy analogowe, WNT 2. G. Rizzoni, Fundamentals of Electrical Engineering, McGraw-Hill

SUBJECT SUPERVISOR
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Semiconductor Devices II

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W07, K1eit_W08, K1eit_W15	C01-C03	La_01-La_15	ND_01-ND_04
PEK_U01 (skills)	K1eit_U13, K1eit_U14	C01-C03	La_01-La_15	ND_01-ND_04
PEK_U02	InzA_U01	C01-C03, C05	La_01-La_15	ND_01-ND_04
PEK_K01 (competences)	K1eit_K03, K1eit_K04	C04, C05	La_01-La_15	ND_03, ND_04

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Technologie mikro- nano-**	
Name in English:	**Micro- Nano- Technologies**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD004083**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	45				
Number of hours of total student workload (CNPS)	120				
Form of crediting	E				
Number of ECTS points	4				
Including number of ECTS points for practical (P) classes	0				
Including number of ECTS points for direct teacher-student contact (BK) classes	2.4				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of basic physics
2. Basic knowledge of solid state physics
3. Successful completion of Materials Engineering
4. Successful completion of Semiconductor Devices I

SUBJECT OBJECTIVES

C01 To familiarize students with the methods of fabrication of contemporary micro- and nano-electronics circuits

C02 To familiarize students with the properties of devices fabricated with the use of micro- and nano-electronic techniques

C03 To familiarize students with the current state and trends of development of micro- and nano-electronic technologies

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge	
PEK_W01	The students has ordered knowledge of the manufacturing processes of electronic components and integrated circuits in micro-and nano scale
PEK_W02	The student knows the typical engineering technologies in the area of studied field of study

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Introduction, technology roadmap of modern semiconductor. technology, overview of basic processes of micro- and nanotechnology	1
Le_02	Wafer fabrication (doped silicon, strained silicon, SiGe, SOI and SON technologies) silicon epitaxy	2
Le_03	Thermal oxidation of silicon, dielectric layers and polysilicon fabrication by LPCVD, high-k and low-k dielectric, ULK porous materials	2
Le_04	Advanced micro- and nano-lithographic techniques (photolithography, electron-beam lithography, X-ray lithography, ion-beam lithography, nanoimprint, interference lithography, scanning probe lithography)	2
Le_05	Doping of layers: diffusion and ion implantation, annealing (RTA)	3
Le_06	Wafer cleaning, dry and wet etching of layers	2
Le_07	Metallic contact and interconnects fabrication (silicides, AL, Cu), thin layers materials for diffusion barriers and etch stop layers	2
Le_08	Properties of individual nanoparticles, carbon nanotubes, carbon nanotube transistor	2
Le_09	State of art and progress in thin film technology	2
Le_10	The methods of fabrication of thin films	2
Le_11	The substrates. Main properties and applicability. Cleaning of surface	2
Le_12	Conduction of metallic and resistive thin film .The relation between electrical properties and film thickness	1
Le_13	Conduction of alloys. Mathiessen’s rule. The applications	1
Le_14	The conductive thin films. The metallic multi-layers. The application in microwaves	2
Le_15	Thin dielectric films. The kind of materials. The methods of fabrication. Design requirements in circuits, applications	2
Le_16	The destructive phenomena in resistive, conductive and dielectric thin films (oxidation, recrystallization, diffusion, electromigration ,weak points, hot points, breakdown and others)	2
Le_17	Thick film technology and its application in microelectronics	2
Le_18	Design methods for thick film circuits	2
Le_19	Thick film materials and processes	2
Le_20	Polymer films - materials, processes, properties, applications	2
Le_21	Multichip Module (MCM) technology	2
Le_22	LTCC technology - materials, processes, properties	2
Le_23	Application of LTCC in microelectronics	2
Le_24	Future trends of micro- nanotechnologies	1
	TOTAL	45

TEACHING TOOLS USED	
ND_01	Lecture with presentations and discussion
ND_02	Consultations
ND_03	Own work - self study and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Discussions, examiniation

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. A. Dziedzic, Grubowarstwowe rezystywne mikrokompozyty polimerowo-węglowe, Oficyna Wydawnicza Politechniki Wrocławskiej, 2001
2. A. Dziedzic, L. Golonka, B. Licznerski, B. Morten, M. Prudenziati, Technika grubowarstwowa i jej zastosowania, Wrocław, 1998
3. Ch. P. Poole, F. J. Owens, Introduction to Nanotechnology, John Wiley & Sons, 2003
4. L. Golonka, Zastosowanie ceramiki LTCC w mikroelektronice, Oficyna Wydawnicza Politechniki Wrocławskiej, 2001
5. L. J. Maissel, R. Glang, Handbook of Thin Film Technology, Mc Graw Hill Book Comp., New York London, 1988
6. R. C. Jaeger, Introduction to Microelectronic Fabrication, Prentice Hall, 2002
7. R.R. Tummala, Fundamentals of Microsystems Packaging, McGraw-Hill, New York, 2001
8. S. A. Campbell, The Science and Engineering of Microelectronic Fabrication, Oxford, 2001
9. W. Menz, Microsystem Technology, Albert-Ludwigs University Freiburg, Germany, 1999

Secondary literature

1. Magazines Sensors and Actuators, Vacuum, conference materials (COE, ELTE, IMAPS Poland Chapter, Ceramic Microsystems)

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Micro- Nano- Technologies

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W08	C01-C03	Le_01-Le_24	ND_01-ND_03
PEK_W02	InzA_W05	C01-C03	Le_01-Le_24	ND_01-ND_03

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Technika próżni**	
Name in English:	**Vacuum Techniques**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD004102**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	90		60		
Form of crediting	Z		Z		
Number of ECTS points	3		2		
Including number of ECTS points for practical (P) classes	0		2		
Including number of ECTS points for direct teacher-student contact (BK) classes	1.8		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Credit for physics course

SUBJECT OBJECTIVES

C01 Understanding the phenomena under reduced pressure (vacuum)
C02 Possession of knowledge about the application of modern vacuum techniques (methods of generation and measuring vacuum)
C03 The ability to design a simple vacuum system
C04 The ability of measurements of the basic parameters which determine the conditions of the vacuum thin films deposition process (under reduced pressure)
C05 Preparation for research in the field of vacuum techniques

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge	
PEK_W01	It has knowledge of the phenomena occurring at the reduced pressure of the gas and of the action of vacuum devices (vacuum generation and measurement) in the context of technological processes used in microelectronics
PEK_W02	The student knows the basic methods, techniques, tools and materials used in solving simple engineering problems from the field of vacuum techniques
Relating to skills	
PEK_U01	He can design a simple technological process parameters including vacuum devices (e.g. thin film deposition process)
Relating to social competences	
PEK_K01	Working in a team, is open to new technical and technological solutions in engineering practice

PROGRAMME CONTENT

	Form of classes - Lecture	Quantity
Le_01	Basic definitions. Elements of the kinetic theory of gases	2
Le_02	Gas flow, gas pumping speed	2
Le_03	Design rules for vacuum system	1
Le_04	Vacuum generation - the pumping process under different conditions. Terms vacuum - Knudsen number	1
Le_05	Pre-vacuum pumps (rotary, diaphragm ....)	3
Le_06	High-vacuum flow pumps (diffusion and molecular)	5
Le_07	Gas storage pumps (ion-sorption and kriosorption)	2
Le_08	Pressure measurement, ranges and measurement methods	2
Le_09	Mechanical and viscosity gauges	2
Le_10	Thermal conductivity gauges	2
Le_11	Ion gauges with hot and cold cathode	2
Le_12	Gas flow - the choice of method pumping	1
Le_13	Partial pressure measurements. Mass spectrometer	1
Le_14	The role of the pressure (vacuum) in the thin film deposition processes. Scheme vacuum process	2
Le_15	Credit - examination test	2
	TOTAL	30

	Form of classes - Laboratory	Quantity
La_01	Introduction. Principle of work and measurement of the parameters of the pumping system	3
La_02	Testing and measuring the characteristics of the vacuum cycle in the NP-500 vacuum set	3
La_03	Operation analysis and measurement of the parameters of glow discharge during sputtering using a WMK magnetron	3
La_04	The deposition of thin metal and dielectric films in vacuum	3
La_05	Deadline doing. Improving the failed exercise. Examination	3
	Total	15

TEACHING TOOLS USED	
ND_01	Lecture traditional assisted presentations and interactive elements of the assessment
ND_02	Own work
ND_03	The repetition of the material of the lecture as a base to carry out laboratory projects
ND_04	Evaluation of course of the laboratory - a report on the work
ND_05	Consultation
ND_06	Putting technological tasks - draft process performed by the lab group

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (lecture)	PEK_W01, PEK_W02	Discussions during the lecture, test
P1 = F1 (lecture)	PEK_W01, PEK_W02	Positive mark from test
F2 (lab)	PEK_U01	Short test before the laboratory classes
F3	PEK_U01	Evaluation of the knowledge regarding the realized projects during the laboratory courses (reports)
P2 (laboratory) = 0,4*F2 + 0,6*F3		

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. A. Hałas, P. Szwemin, Podstawy Techniki Próżni, Uczelniane Wydawnictwo Naukowo-Dydaktyczne, Kraków, 2008
2. A. Hałas, Technologia Wysokiej Próżni, PWN W-wa , 1980
3. J. Groszkowski, Technika Wysokiej Próżni, WNT W-wa , 1978
4. W. Posadowski, Lecture notes, 2012

Secondary literature

1. J.O. Hanlon, A user's Guide to Vacuum Technology, Wiley-Interscience, (third edition), 2003
2. M. Wutz, H. Adam, W. Walcher , Theory and Practice of Vacuum Technology, Friedr.Vieweg & Sohn, Braunschweig , 1989
3. Nigel Harris, Modern Vacuum Practice, self-published, (third edition), 2005

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Vacuum Techniques

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	S1ief_W06	C01, C02	Le_01-Le_15	ND_01-ND_03
PEK_W02	InzA_W02	C01, C02, C05	Le_01-Le_15	ND_01-ND_03
PEK_U01 (skills)	S1ief_U08, InzA_U01	C03-C05	La_01-La_05	ND_03-ND_06
PEK_K01 (competences)	K1eit_K02, K1eit_K03	C03, C04	La_01-La_05	ND_01, ND_03, ND_04, ND_06

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Algorytmy przetwarzania danych**
Name in English:	**Data Processing Algorithms**
Main field of studies:	**Electronics and Telecommunications**
Level and form of studies:	**I level / Full time**
Kind of subject:	**Obligatory / Faculty**
Subject code:	**ETD004952**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	90		60		
Form of crediting	Z		Z		
Number of ECTS points	3		2		
Including number of ECTS points for practical (P) classes	0		2		
Including number of ECTS points for direct teacher-student contact (BK) classes	1.8		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematical analysis, algebra

SUBJECT OBJECTIVES

C01 Understanding the theory of neural networks, fuzzy systems and genetic algorithms
C02 Gaining practical experience in the design of neural networks, fuzzy systems, genetic algorithms
C03 Preparing to conduct research on neural networks

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Knowledge of data processing methods and neural, fuzzy, genetic algorithms

Relating to skills

PEK_U01 The ability to construct and matching neural, fuzzy and genetic systems
PEK_U02 The student is able to use the analytical, simulation and experimental methods for formulating and solving engineering tasks

Relating to social competences	
PEK_K01	Correctly identifies the techniques and technologies needed to solve chosen engineering problems

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Linear regression, assess the quality of approximation	2
Le_02	Unidirectional neural network structure	2
Le_03	Error backpropagation	2
Le_04	Gradient Traps - avoidance and escape	2
Le_05	Rank and preprocessing of patterns	2
Le_06	Selection of the number of layers and number of neurons	2
Le_07	The sensitivity analysis based on a neural model	2
Le_08	Self-organizing networks. Kohonen networks	2
Le_09	Cascade-correlation learning agreement	2
Le_10	Recursive Networks and Cellular Networks	2
Le_11	Fuzzy logic	2
Le_12	Methods of fuzzy systems constructing	2
Le_13	Genetic algorithms	2
Le_14	Applications	2
Le_15	Final test	2
	TOTAL	30

Form of classes - Laboratory		Quantity
La_01	Classification. Written character recognition	3
La_02	Classification. Iris recognition	3
La_03	Optimization of neural network	3
La_04	The problem of two spirals. Comparison of the effectiveness of the methods	3
La_05	Fuzzy Temperature Controller	3
	Total	15

TEACHING TOOLS USED

ND_01 Lecture with discussion
ND_02 Self work - literature and preparation for test
ND_03 Computer laboratory
ND_04 Self work - writing reports from laboratories

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01	Final test
F2 (lab)	PEK_U01, PEK_U02, PEK_K01	Observation of student achievement in the laboratory
F3	PEK_U01, PEK_U02, PEK_K01	Reports and discussions
P2 (laboratory) = (F2+F3)/2		

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. S. Osowski, Sieci neuronowe do przetwarzania informacji, Oficyna Wyd. Politechniki Warszawskiej, 2006
2. S. Osowski, Sieci neuronowe w ujęciu algorytmicznym, WNT, Warszawa, 1999

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Data Processing Algorithms

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	S1ec_W01	C01	Le_01-Le_15	ND_01, ND_02
PEK_U01 (skills)	S1ec_U01	C02, C03	La_01-La_05	ND_03, ND_04
PEK_U02	InzA_U02	C02, C03	La_01-La_05	ND_03, ND_04
PEK_K01 (competences)	K1eit_K02	C02, C03	La_01-La_05	ND_03, ND_04

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Analogowe i cyfrowe układy elektroniczne II**	
Name in English:	**Analog and Digital Electronics Circuits II**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD005074**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	60		90		
Form of crediting	E		Z		
Number of ECTS points	2		3		
Including number of ECTS points for practical (P) classes	0		3		
Including number of ECTS points for direct teacher-student contact (BK) classes	1.2		2.1		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

C01 To acquaint students with advanced electronic linear and nonlinear circuits
C02 To acquaint students with advanced methods of analysis of electronic circuits
C03 To acquaint students with advanced analog and digital integrated circuits
C04 To gain competence how to select individually components to fulfill technical and operational requirements and how to test electronic circuits
C05 Preparing students to conduct research related to electronics circuits

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Students have systematic and theoretically founded knowledge of basic circuits with active electronic components, particularly in the field of supply and converter systems

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

Relating to skills

PEK_U01 Students are able to use acquainted methods and mathematical models in analysis and design of linear and nonlinear electronic circuits

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

Relating to social competences

PEK_K01 Students are able to identify priorities needed to realize defined engineering project

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Rectifying circuits, voltage doublers	2
Le_02	Continuous voltage stabilizing circuits	2
Le_03	Basic switching circuits	2
Le_04	Switching voltage stabilizing circuits - coil basing	2
Le_05	Switching voltage stabilizing circuits - transformer basing	2
Le_06	Comparators and flip-flops circuits	2
Le_07	Test in writing K1_Wy	2
Le_08	Basic electronic nonlinear circuits constructed with operational amplifiers	2
Le_09	Basics of analog to digital and digital to analog signal conversion	2
Le_10	Basic digital to analog converters with resistive or capacitive signal dividers	2
Le_11	Basics of time to frequency and parallel analog to digital signal conversion	2
Le_12	Basics of phase shift generators	2
Le_13	Basics of LC and direct digital synthesis signal generators	2
Le_14	Basics of phase locked loop	2
Le_15	Test in writing K2_Wy	2
	TOTAL	30

Form of classes - Laboratory		Quantity
La_01	Introduction and security training	3
La_02	Biasing of bipolar and unipolar transistors	3
La_03	Operational amplifiers in linear applications	3
La_04	Power amplifiers	3
La_05	Active signal filters	3
La_06	Analog arithmetic electronic circuits	3
La_07	Signal generators	3

La_08	Phase locked loop	3
La_09	Analog to digital and digital to analog converters	3
La_10	Auxiliary term, summary and review	3
	Total	30

TEACHING TOOLS USED

ND_01 Lecture with discussion
ND_02 Multimedia lecture with discussion
ND_03 Consultation
ND_04 Individual work - study of defined cases
ND_05 Individual work - preparation for classes
ND_06 Individual work - study defined subject for laboratory exercises
ND_07 Reports in writing of each laboratory exercise

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (lecture)	PEK_W01, PEK_W02	Test in writing K1_Wy
F2	PEK_W01, PEK_W02	Test in writing K2_Wy
P2 = F3 (lab)	PEK_U01, PEK_U02	Arithmetical mean from the marks for the written reports from each laboratory class
P1 (lecture) = 0,5*F1 + 0,5*F2		

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Laboratory instructions
2. J. Baranowski, G. Czajkowski, Układy analogowe nieliniowe i impulsowe, WNT, Warszawa, 2004
3. M. Niedźwiecki, M. Rasiukiewicz, Nieliniowe elektroniczne układy analogowe, WNT, Warszawa, 1994
4. S. Kuta, Układy elektroniczne, Uczelniane Wydawnictwa Naukowo-Dydaktyczne AGH, Kraków, 1995

Secondary literature

1. Laboratorium układów elektronicznych cz.2, script under supervision of A. Prałat, Oficyna wydawnicza PWr,
2. P. Horowitz, W. Hill, Sztuka elektroniki, Wydawnictwo Komunikacji i Ł ączności, 2009
3. Piotr Górecki, Wzmacniacze operacyjne, Wydawnictwo BCT, 2004
4. S. Kuta, Elementy i układy elektroniczne cz.2, Uczelniane Wydawnictwa Naukowo-Dydaktyczne AGH, Kraków, 2000

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Analog and Digital Electronics Circuits

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W03	C01-C03	Le_01-Le_15	ND_01-ND_05
PEK_W02	InzA_W02	C01-C03	Le_01-Le_15	ND_01-ND_05
PEK_U01 (skills)	K1eit_U01, K1eit_U14	C04	La_01-La_10	ND_03, ND_06, ND_07
PEK_U02	InzA_U06	C04, C05	La_01-La_10	ND_03, ND_06, ND_07
PEK_K01 (competences)	K02, K1eit_K03, K1eit_K04, K1eit_K08	C04	La_01-La_10	ND_03, ND_06, ND_07

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Laboratorium Mikroelektroniki (technologie mikro- nano-)**
Name in English:	**Laboratory of Microelectronics (Micro- Nano- Technologies)**
Main field of studies:	**Electronics and Telecommunications**
Level and form of studies:	**I level / Full time**
Kind of subject:	**Obligatory / Faculty**
Subject code:	**ETD005075**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			60		
Number of hours of total student workload (CNPS)			120		
Form of crediting			Z		
Number of ECTS points			4		
Including number of ECTS points for practical (P) classes			4		
Including number of ECTS points for direct teacher-student contact (BK) classes			2.8		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Passed course Micro- nano- technologies

SUBJECT OBJECTIVES

C01 Practical acquaintance the students with realization of basic technological processes connected with fabrication of micro- and nano- structures, components, devices and integrated circuits

C02 Practical acquaintance the students with estimation of basic parameters of micro- and nano- structures, components, devices and integrated circuits

C03 Preparing students to conduct research in the studied area of study

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 The student knows and understands processes of fabrication of electronic elements, integrated circuits and microsystems

Relating to skills

PEK_U01 The student has the ability to select materials and elements as well as device construction fulfilled the technical demands and exploitation conditions

PEK_U02 The student is able to assess the usefulness of routine methods and tools used for solving of a simple and practical engineering task

Relating to social competences

PEK_K01 The student understands the need of using new techniques and technologies in engineering activity and is able to determine the goals and to expect consequences in taken experimental works

PEK_K02 The student works independently and in the team

PROGRAMME CONTENT

Form of classes - Laboratory		Quantity
La_01	Introduction to laboratory (curriculum, requirements, safety)	4
La_02	Modern laboratory of semiconductor technology - infrastructure and technological equipment	4
La_03	Epitaxial layers - technology	4
La_04	Modern technologies of reproduction and masks - fabrication	4
La_05	Photolitography	4
La_06	Thermal processes in semiconductor technology	4
La_07	Thin-film technology - methods, technological equipment, foundations for process design	4
La_08	Fabrication of test structures by chosen deposition method	4
La_09	Measurement of electrical properties of thin films	4
La_10	Technological equipment for thick-film and LTCC technologies	4
La_11	Technology and properties of cermet thick-film resistors	4
La_12	Technology and properties of polymer thick-film resistors	4
La_13	Design of simple thick-film circuits	4
La_14	Piezoresistive effect in thick film resistors	4
La_15	Repeating term	4
	Total	60

TEACHING TOOLS USED

ND_01 Laboratory exercises and discussion
ND_02 Consultations
ND_03 Own work - independent studies and preparation to laboratory exercises

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (lab)	PEK_W01, PEK_U01, PEK_U02, PEK_K01, PEK_K02	Laboratory exercises + reports
P1 = F1 (lab)	PEK_W01, PEK_U01, PEK_U02, PEK_K01, PEK_K02	Mean value from the marks for laboratory reports

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. A. Dziedzic, Grubowarstwowe rezystywne mikrokompozyty polimerowo-węglowe, Oficyna Wydawnicza Politechniki Wrocławskiej, 2001
2. A. Dziedzic, L. Golonka, B. Licznerski, B. Morten, M. Prudenziati, Technika grubowarstwowa i jej zastosowanie, Fundacja Rozwoju Systemu Edukacji, 1998
3. L. Golonka, Zastosowanie ceramiki LTCC w mikroelektronice, Oficyna Wydawnicza Politechniki Wrocławskiej, 2001
4. L.J. Maissel, R. Glang, Handbook of Thin Film Technology, Mc Graw Hill Book Comp., 1988
5. Group work, technologiczne w elektronice półprzewodnikowej, WNT, 1980
6. R. C. Jaeger, Introduction to Microelectronic Fabrication, Prentice Hall, 2002
7. R.R. Tummala, Fundamentals of Microsystems Packaging, McGraw-Hill, 2001

Secondary literature

1. Materials for laboratory classes given or selected by the teacher

SUBJECT SUPERVISOR
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Laboratory of Microelectronics

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W08	C01, C02	La_01-La_15	ND_01-ND_03
PEK_U01 (skills)	K1eit_U01	C01, C02	La_01-La_15	ND_01-ND_03
PEK_U02	InzA_U07	C01- C03	La_01-La_15	ND_01-ND_03
PEK_K01 (competences)	K1eit_K02	C01, C02	La_01-La_15	ND_01-ND_03
PEK_K02	K1eit_K03	C01, C02	La_01-La_15	ND_01-ND_03

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Miernictwo elementów optoelektronicznych**	
Name in English:	**Optoelectronic devices surveying**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD005076**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of electronics and optoelectronics
2. Completed courses: Metrology I and II Semiconductor devices I and II, Optoelectronics I

SUBJECT OBJECTIVES

C01 Gaining and consolidating knowledge on optoelectronics including usable (and detectors of light source, lighting systems, photovoltaics)
C02 The student should after the course be able to perform basic measurements of opto-electronic components
C03 Knowledge of the construction and principles of operation of equipment type monochromator, the spectrometer
C04 Strengthening ability to work independently and in a group of different nature
C05 Preparing to conduct research in the field of optoelectronics

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Student has an ordered and build on the theory of knowledge required for electronics and telecommunication studies on working light emitters and detectors, including semiconductor lighting systems and solar cells. Student is familiar with the construction and operation of measuring devices type monochromator and spectrometer

Relating to skills

PEK_U01 The student is able to assemble the measuring system and the basic parameters and constant current characteristics of detectors and light emitters and their parameters and spectral characteristics

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

Relating to social competences

PEK_K01 The student is able to work in a group of different nature

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Introduction to the course	2
Le_02	Color theory, color mixing	2
Le_03	The basic characteristics of the detectors and ways to measure them	3
Le_04	The basic characteristics of the emitters and ways to measure them	3
Le_05	Solid-state lighting devices	2
Le_06	Solar cells - basis of action	2
Le_07	Test	1
	TOTAL	15

Form of classes - Laboratory		Quantity
La_01	Introduction to the course and health and safety training	3
La_02	Colour theory	3
La_03	Photodetectors	3
La_04	Photodetectors - working frequency	3
La_05	Spectral characteristics of light sources	3
La_06	Spectral characteristics of light sources	3
La_07	Lighting panels	3
La_08	Optocouplers	3
La_09	Solar cells	3
La_10	Grade, additional term	3
	Total	30

TEACHING TOOLS USED	
ND_01	Traditional lecture with presentations and discussion
ND_02	Laboratory: a brief exam at the beginning of the exercises
ND_03	Self work - preparing for the lab exercises
ND_04	Working standalone - independent study and preparation for the test
ND_05	Consultation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (lecture)	PEK_W01	Discussion, final test
F2 (lab)	PEK_U01, PEK_U02	Short tests, laboratory reports, evaluation class implementation exercises
P1 = F1 (lecture)	PEK_W01	Positive mark from the final test
P2 = F2 (lab)	PEK_U01, PEK_U02	Mean value from the short tests, laboratory reports, evaluation class implementation exercises

PRIMARY AND SECONDARY LITERATURE

Primary literature

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

Secondary literature

1. A. Smoliński, Optoelektronika światłowodowa, WKŁ , 1985
2. J. Godlewski, Generacja i detekcja promieniowania optycznego, PWN, 1997
3. J. Hennel, Podstawy elektroniki półprzewodnikowej, WNT, 1986
4. J. Siuzdak, Wstęp do współczesnej telekomunikacji światłowodowej, WKŁ , 1997
5. K. Booth, S. Hill, Optoelektronika, WKŁ , 2001
6. R. Bacewicz, Optyka ciała stałego, Oficyna Wydawnicza Politechniki Warszawskiej, 1995
7. Different authors, actual subject’s literature, datasheets, Internet, scientific reports

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Optoelectronic devices surveying

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W05, K1eit_W07, K1eit_W09	C01, C03	Le_01-Le_08	ND_01, ND_04, ND_05
PEK_U01 (skills)	K1eit_U09, K1eit_U13, K1eit_U14	C02-C05	La_01-La_10	ND_02- ND_04
PEK_U02	InzA_U01	C02-C05	La_01-La_10	ND_02- ND_04
PEK_K01 (competences)	K1eit_K03	C04	La_01-La_10	ND_02

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Mikroprocesory i mikrosterowniki**
Name in English:	**Microprocessors and Microcontrollers**
Main field of studies:	**Electronics and Telecommunications**
Level and form of studies:	**I level / Full time**
Kind of subject:	**Obligatory / Faculty**
Subject code:	**ETD005080**
Group of courses:	**NO**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed the course material: Informatics
2. Completed the course material: Introduction to Digital and Microprocessor Systems

SUBJECT OBJECTIVES

C01 Gaining the ability of programming and use of microprocessors and microcontrollers for engineering
C02 Gaining the ability of communicating of microprocessors and the digital systems
C03 To prepare students to conduct scientific research in the field of microprocessors and microcontrollers

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Has knowledge of microprocessor architectures and their programming
PEK_W02 The student knows the basic methods, techniques, tools and materials used in solving simple engineering problems from the studied field of study

Relating to skills PEK_U01 Is capable to program the microprocessor, microcontroller and evaluate its functionality PEK_U02 The student is able to identify and formulate a specification of simple and practical engineering tasks, characteristic for the studied field of study **Relating to social competences** PEK_K01 Is capable to point the priorities required to accomplish a specific task

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Introduction to the topic	2
Le_02	Microprocessors architecture, I/O ports	2
Le_03	Instruction Set (for AVR example)	4
Le_04	Interrupts – mechanisms and uses	2
Le_05	Peripheral features (for AVR example)	4
Le_06	Colloquium	2
Le_07	Peripheral features (for AVR example) – part II	4
Le_08	Communication interfaces	4
Le_09	AVR programming in C	2
Le_10	Microprocessors architecture – constructions, comparison	2
Le_11	Colloquium	2
	TOTAL	30

Form of classes - Laboratory		Quantity
La_01	Organizational classes / introduction to the topic	4
La_02	I/O ports (ATMega8535)	8
La_03	Peripheral features (ATMega8535)	12
La_04	Communication interfaces (ATMega8535)	4
La_05	Additional term, summary	2
	Total	30

TEACHING TOOLS USED
ND_01 Own work - preparation for classes ND_02 Task realization using microprocessor development board ND_03 Traditional lecture, using of a computer projector

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Final test
P2 = F2 (lab)	PEK_U01, PEK_U02, PEK_K01	Evaluation of the individual work

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Atmel AVR ATMEGA – technical documentation
2. J. Doliński, Mikrokontrolery AVR w praktyce, BTC, 2008
3. R. Baranowski, Mikrokontrolery AVR ATmega w praktyce, BTC, 2005
4. M. Kardaś, Mikrokontrolery AVR - język C: podstawy programowania

Secondary literature

1. J.M. Sibigtroth, Zrozumieć małe mikrokontrolery, BTC, 2003
2. P. Górecki, Mikrokontrolery dla początkujących, BTC, 2006

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Microprocessors and Microcontrollers

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W17, K1eit_W30	C01, C02	Le_01-Le_09, La_01-La_05	ND_01-ND_03
PEK_W02	InzA_W02	C01-C03	Le_01-Le_09, La_01-La_05	ND_01-ND_03
PEK_U01 (skills)	K1eit_U18	C01-C03	Le_01-Le_09, La_01-La_05	ND_01-ND_03
PEK_U02	InzA_U06	C01-C03	Le_01-Le_09, La_01-La_05	ND_01-ND_03
PEK_K01 (competences)	K1eit_K04	C01-C03	Le_01-Le_09, La_01-La_05	ND_01-ND_03

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Montaż w elektronice i mikrosystemach I**	
Name in English:	**Electronics and Microsystems Packaging I**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD005081**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The knowledge gained in this course: Introduction to Electronics
2. Knowledge from the course Semiconductor Devices

SUBJECT OBJECTIVES

C01 Mastery of theoretical knowledge specified in Le_01-Le_13
C02 Preparation for research in the field of installation in electronics and microsystems

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 It has a structured and theoretically founded knowledge in the field of electronic packaging which allows design of electronic systems based on the available electronic components and assembly techniques

PEK_W02 The student knows the typical engineering technologies in the area of electronics and microsystems packaging

<u>Relating to skills</u> PEK_U01 Able to properly select and apply the techniques of electronic packaging according to the design requirements and reliability of made devices **<u>Relating to social competences</u>** PEK_K01 Able to set priorities in the use of adequate techniques for electronic packaging

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Introduction, aims of electronic packaging	2
Le_02	Packaging levels and packaging technologies	2
Le_03	Wire bonding	2
Le_04	Flip chip packaging	2
Le_05	Elements and architecture of connections	3
Le_06	Substrates. Printed circuit boards	2
Le_07	The base of soldering process, alloys and solder paste	2
Le_08	Soldering technologies	3
Le_09	Defects of solder joints	2
Le_10	Cleaning after soldering	2
Le_11	Adhesives and techniques of applying adhesives in electronic packaging	2
Le_12	Connections and Connectors	2
Le_13	Environmental exposure, heat dissipation problems	2
Le_14	Completion of the course	2
	TOTAL	30

TEACHING TOOLS USED
ND_01 Lecture with multimedia presentations and discussion ND_02 Consultation ND_03 Self-study and exam preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (lecture)	PEK_W01, PEK_W02 PEK_U01, PEK_K01	Exam
P1 = F1 (lecture)	PEK_W01, PEK_W02 PEK_U01, PEK_K01	Positive mark from the exam

PRIMARY AND SECONDARY LITERATURE
Primary literature 1. J. Felba, Montaż w elektronice, Oficyna Wydawnicza Politechniki Wrocławskiej, 2010 **Secondary literature** 1. R. R. Tummala, Fundamentals of Microsystems Packaging, McGraw-Hill,, 2001 2. K. Bukat, H. Hackiewicz, Lutowanie bezołowiowe, Wydawnictwo BTC, Warszawa, 2007 3. R. Kisiel, Połączenia lutowane w montażu elektronicznym z zastosowaniem materiałów ekologicznych, Oficyna Wydawnicza Politechniki Warszawskiej, 2009 4. R. Kisiel, Podstawy technologii dla elektroników, Wydawnictwo BTC Korporacja, 2012

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Electronics and Microsystems Packaging I

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W02, K1eit_W21	C01	Wy_01-Wy_13	ND_01-ND_03
PEK_W02	InzA_W05	C01, C02	Wy_01-Wy_13	ND_01-ND_03
PEK_U01 (skills)	K1eit_U15	C01, C02	Wy_01-Wy_13	ND_01-ND_03
PEK_K01 (competences)	K1eit_K04	C01	Wy_01-Wy_13	ND_01-ND_03

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Przetwarzanie sygnałów**	
Name in English:	**Signal Processing**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD005082**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of mathematical analysis, linear algebra, probability and statistics

SUBJECT OBJECTIVES

C01 Learning of basic techniques of signal processing and analysis
C02 Learning of implementation of basic digital signal processing algorithms with script lanquages (offline processing)
C03 Bringing the need for application of digtal techniques of signal processing and anlysis to attention of students
C04 Preparing to conduct research in the subject signal processing

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge	
PEK_W01	Students will possess knowledge of processing and analysis of deterministic and stochastic signals in time and frequency domain
Relating to skills	
PEK_U01	Using scripting languages, student can analyze signals by means of the Fourier transform, design digital, band, FIR and IIR filters
PEK_U02	The student is able to use the analytical, simulation and experimental methods for formulating and solving engineering tasks
Relating to social competences	
PEK_K01	Student will understand the necessity of using of signal processing techniques in engineering. He can predict results of a processing in a given engineering problem

PROGRAMME CONTENT

	Form of classes - Lecture	Quantity
Le_01	Potential applications of signal processing techniques. Basic terms and definitions in time domain	2
Le_02	The family of Fourier transforms - representation of signals in frequency domain	2
Le_03	Properties of Fourier transforms, especially DFT	2
Le_04	Random signals - stochastic processes in time domain	2
Le_05	Stochastic processes in frequency domain	2
Le_06	Linear systems, superposition principle, properties in time and frequency domain	2
Le_07	Laplace and Z transform in linear systems	2
Le_08	Test no. 1	2
Le_09	Analog to digital conversion - sampling, quantization and properties of ADCs	2
Le_10	Digital to analog conversion - signal reconstruction, properties of DACs	2
Le_11	Digital filtering - band finite impulse response filters	2
Le_12	Digital filtering- band infinite impulse response filters	2
Le_13	Digital filtering - filters with customized frequency or impulse response	2
Le_14	Measurements of amplitued phase and frequency of digital signals	2
Le_15	Test no. 2	2
	TOTAL	30

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

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (lecture)	PEK_W01	Test no. 1
F2	PEK_W01	Test no. 2
F3 (lab)	PEK_U01, PEK_U02, PEK_K01	Assessment of preparation for the laboratory
F4	PEK_U01, PEK_U02, PEK_K01	Assessment of work at the laboratory
P1 (lecture) = 0,5*(F1 + F2)		
P2 (laboratory) = 0,5*(F3 + F4)		

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. J. Szabatin, Podstawy teorii sygnałów, WKŁ Warszawa, 2007
2. R.G. Lyons, Wprowadzenie do cyfrowego przetwarzania sygnałów, WKŁ Warszawa, 2000
3. S. W. Smith, Cyfrowe przetwarzanie sygnałów - praktyczny poradnik dla inżynierów i naukowców, BTC Warszawa, 2007

Secondary literature

1. A. Papoulis, Probability, Random Variables and Stochastic Processes, MacGraw-Hill, 1991
2. R.N. Bracewell, The Fourier Transform and Its Applications, MacGraw-Hill, 2000

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Signal Processing

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W14	C01	Le_01-Le_15	ND_01, ND_03, ND_04, ND_06
PEK_U01 (skills)	K1eit_U17	C02, C04	La_01-La_05	ND_02, ND_05
PEK_U02	InzA_U02	C02, C04	La_01-La_05	ND_02, ND_05
PEK_K01 (competences)	K1eit_K02	C03	Le_01-Le_15, La_01-La_05	ND_01-ND_06

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Światłowody I**	
Name in English:	**Optical Fibers I**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD005083**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of physics and optics

SUBJECT OBJECTIVES

C01 A reminder of fundamental knowledge of fiber optics
C02 Familiarizing students with the basic properties of optical waveguides
C03 Familiarizing students with the most important applications of optical fibers
C04 Obtaining knowledge on the most important optoelectronic devices interacting with optical waveguides - such as light sources and photodetectors
C05 Obtaining knowledge on the various passive elements of the fiber-optic track

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge	
PEK_W01	Has well organized and theoretically founded knowledge on photonics, including knowledge necessary to understand fundamentals of operation of optical communication systems, and knowledge on optical recording and information processing
PEK_W02	He knows the typical engineering technologies in the field of fiber optics

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Introduction, classification of optical waveguides	2
Le_02	Fundamental properties of optical fibers	2
Le_03	Planar optical waveguides - analysis with the methods of geometrical optics	2
Le_04	Modal properties of optical waveguides	2
Le_05	Attenuation, dispersion and other properties of optical waveguides	2
Le_06	Manufacturing methods of optical fibers	2
Le_07	Optical cables. Construction and principles of installation	2
Le_08	Fundamentals of integrated optics	2
Le_09	Connections of optical fibers	2
Le_10	Passive elements of fiber-optic track	2
Le_11	Measurements of optical-fiber lines	2
Le_12	Light sources	2
Le_13	Photodetectors	2
Le_14	Non-telecommunication application of optical fibers	2
Le_15	Colloquiums and tests	2
	TOTAL	30

TEACHING TOOLS USED	
ND_01	Classical lecture with presentations and discussion
ND_02	Lecture supported with e-learning tools
ND_03	Own work - preparation of selected issues for the lecture
ND_04	Own work - self-study and preparation for examinations
ND_05	Consultations

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (lecture)	PEK_W01, PEK_W02	Discussions, consultations, tests on-line (forming score)
P1 (lecture)	PEK_W01, PEK_W02	Test, final exam (summarizing score)

PRIMARY AND SECONDARY LITERATURE
Primary literature 1. M. Szustakowski, Elementy techniki światłowodowej, WNT, 1992 **Secondary literature** 1. John E. Midwinter, Y. L. Guo, Optoelektronika i Technika Światłowodowa, WKŁ, 1995

SUBJECT SUPERVISOR
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Optical Fibers I

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W05, K1eit_W09	C01-C05	Le_01-Le_15	ND_01-ND_05
PEK_W02	InzA_W02	C01-C05	Le_01-Le_15	ND_01-ND_05

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Optoelektronika II**	
Name in English:	**Optoelectronics II**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Optional**	**/ Faculty**
Subject code:	**ETD005101**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the solid state physics
2. Completed a course of Semiconductor Devices
3. Completed a course of Wave Optics
4. Completed a course of Basic of the Solid State Electronics
5. Completed a course of Optoelectronics I
6. Completed a course of Micro- and Nano - Technologies

SUBJECT OBJECTIVES

C01 Consolidation and practical application of the knowledge connected with a work of optoelectronic components and devices

C02 Understanding both the phenomena occurring in the semiconductor emitters, detectors, solar cells and the influence of the material and construction parameters on output optoelectronic devices performance

C03 Acquiring skills connected with applying of the simple simulation programs for optoelectronic semiconductor device designing

C04 Acquiring of the practical skills in the field of realization of optoelectronic device design

C05 Improving the ability of your own work presentation using different form - oral presentation and elaborated reports

C06	Acquiring the ability to conduct scientific research related to technical sciences, in the range of disciplines such as electronics, materials engineering, optoelectronics

SUBJECT EDUCATIONAL EFFECTS

Relating to skills

PEK_U01 Can use a knowledge of the basic construction equipment, electronic and optoelectronic components and fundamentals of telecommunications; describes the construction and principle of operation of optoelectronic devices, can realized the design and technological tasks connected with optoelectronics and telecommunications independently with particular regard to the specific properties and requirements of AIIIBV semiconductor compounds; can apply the suitable simulation programs to support design and engineering work and for elaboration and documenting of the results coming from calculations and simulations

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

Relating to social competences

PEK_K01 Can work independently and in a team

PROGRAMME CONTENT

Form of classes - Project		Quantity
Pr_01	Introduction to the project course	2
Pr_02	Oral presentation of the basic issues connected with the construction and work of the semiconductor emitters, detectors and solar cells	4
Pr_03	Presentation of a device technology based on AIIIBV semiconductor compounds	2
Pr_04	Introduction to the SimWindows v. 1.5.0 software	4
Pr_05	The main project realization - design of the optoelectronic component chosen from the literature review or suggested by teacher supported by theoretical knowledge connected with the work and output parameters of the designed element	6
Pr_06	Computer simulations of the designed epitaxial structure using SimWindows v. 1.5.0 software. Optimization of the material and construction parameters	4
Pr_07	Design of the device structure and proposition of its fabrication technology	4
Pr_08	Elaboration of the achieved results - preparation of the report with its electronic form	2
Pr_09	Final oral presentation of the realized project	2
	Total	30

TEACHING TOOLS USED

ND_01 Multimedia presentations and discussion
ND_02 Short tests
ND_03 Consultations
ND_04 Individual work - literature studies and preparation for the project task
ND_05 Individual work - realization of the project task, practical exercises using SimWindows v. 1.5.0 software
ND_06 Individual work - preparation of the final report with its electronic form

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (project)	PEK_U01, PEK_U02, PEK_K01	Short tests, homework, own work connected with the design task, final oral presentation of the realized project
P1 = F1 (project)	PEK_U01, PEK_U02, PEK_K01	Average mark from the realized project

PRIMARY AND SECONDARY LITERATURE

Primary literature

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

Secondary literature

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

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Optoelectronics II

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_U01 (skills)	S1ief _U02	C01-C06	Pr_01-Pr_09	ND_01-ND_06
PEK_U02	InzA_U02	C01-C06	Pr_01-Pr_09	ND_01-ND_06
PEK_K01 (competences)	K1eit_K03	C02-C06	Pr_05-Pr_09	ND_04-ND_06

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Modelowanie mikrosystemów**	
Name in English:	**Modeling of Microsystems**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD005102**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

No requirements

SUBJECT OBJECTIVES

C01 Basic knowledge and practical implementation of the platform for numerical simulation and computer enhanced development of microsystems

C02 Preparing to conduct research in the field of microsystems

SUBJECT EDUCATIONAL EFFECTS

Relating to skills

PEK_U01 Is able to analyse physical phenomena in various types of microsystems, is able to model properties and work of microsystems

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

Relating to social competences	
PEK_K01	Understands the necessity of optimization procedures and application of new techniques in engineering activities

PROGRAMME CONTENT		
Form of classes - Laboratory		Quantity
La_01	Introduction to COMSOL and MEMS module	2
La_02	Piezoreistive pressure sensor	4
La_03	Optical silicon pressure sensors with membrane	4
La_04	Capacitive pressure sensors	4
La_05	Multi-stream mixer and heat exchanger	4
La_06	Lab-chip with osmothic flow	4
La_07	Self-work project	8
	Total	30

TEACHING TOOLS USED
ND_01 Laboratory exercises ND_02 Self-work project

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (lab)	PEK_U01, PEK_U02, PEK_K01	Notes from realized exercises
F2	PEK_U01, PEK_U02, PEK_K01	Nots of self-work
P1 (laboratory) = 0,5*(F3 + F4)		

PRIMARY AND SECONDARY LITERATURE
Primary literature
1. Examples provided with the Comsol Software

SUBJECT SUPERVISOR
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Modeling of Microsystems

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_U01 (skills)	S1ief_U05	C01, C02	La_01-La_07	ND_01, ND_02
PEK_U02	InzA_U02	C01, C02	La_01-La_07	ND_01, ND_02
PEK_K01 (competences)	K1eit_K02	C01, C02	La_01-La_07	ND_01, ND_02

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Mikrosystemy w biologii i medycynie**
Name in English:	**Microsystems in Biology and Medicine**
Main field of studies:	**Electronics and Telecommunications**
Level and form of studies:	**I level / Full time**
Kind of subject:	**Obligatory / Faculty**
Subject code:	**ETD005103**
Group of courses:	**NO**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

No requirements

SUBJECT OBJECTIVES

C01 To make students acquainted with construction and operating of selected microsystems and with their application possibilities in biology and medicine, as well as with devices/apparatuses containing microsystem elements/units intended for realization of definite tasks

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 One has general knowledge in the field of construction and operating of selected microsystems used in biology and medicine, he/she knows selected devices/apparatuses containing microsystem elements/units intended for realization of definite tasks in biology and medicine, he/she knows utilizing rules of microsystems applied in biology and medicine

PEK_W02 Has basic knowledge necessary for understanding of social, medical and medical aspects of engineering works

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Introduction to the lecture	1
Le_02	Microtechnologies used in molecular genetics (DNA chip, PCR)	4
Le_03	Microsystems for minimal invasive surgery (MIS)	4
Le_04	Left Ventricular Assist Device, Artificial Heart	4
Le_05	Artificial senses. 1. Electronic hearing	3
Le_06	Bionic eye	3
Le_07	Invasive systems of blood pressure measurements	2
Le_08	Noninvasive systems of blood pressure measurements	2
Le_09	Miniature robots for colonoscopy and endoscopy	1
Le_10	Microneedles for transdermal drug delivery	2
Le_11	Micromechanical tonometer, sensors and microsystems for medical diagnostics	2
Le_12	Test	2
	TOTAL	30

TEACHING TOOLS USED

ND_01 Traditional lecture with multimedia presentations and discussion
ND_02 Consultations
ND_03 Own (personal) work - individual studies and preparation to the test

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (lecture)	PEK_W01, PEK_W02	Test
F2	PEK_W01, PEK_W02	Positive mark from the test

PRIMARY AND SECONDARY LITERATURE

Primary literature

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

Secondary literature

1. Scientific Journals: Sensors and Actuators, Journal of Micromechanics and Microengineering, Micro Electro Mechanical Systems

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Microsystems in Biology and Medicine

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	S1ief_W03	C01	Le_01-Le_11	ND_01-ND_03
PEK_W02	InzA_W03	C01	Le_01-Le_11	ND_01-ND_03

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Projektowanie VLSI**
Name in English:	**VLSI Circuits Design**
Main field of studies:	**Electronics and Telecommunications**
Level and form of studies:	**I level / Full time**
Kind of subject:	**Obligatory / Faculty**
Subject code:	**ETD005202**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	90		60		
Form of crediting	Z		Z		
Number of ECTS points	3		2		
Including number of ECTS points for practical (P) classes	0		2		
Including number of ECTS points for direct teacher-student contact (BK) classes	1.8		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of Digital and Microprocessor I (ETD 2070) and II (ETD 3078). Programming Basics.

SUBJECT OBJECTIVES

C01 Gaining knowledge of the principles of specialized digital circuits design, methods of verification and testing of digital circuits, hardware description language – VHDL
C02 Gaining practical experience in the design and simulation of digital circuits
C03 Preparing to conduct research in the field of IC design

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Knowledge of the principles of designing specialized VLSI digital circuits
PEK_W02 He knows the typical engineering technologies and design methods specific integrated circuits

Relating to skills PEK_U01 Designing of specialized digital circuits, use of VHDL language, verification procedures PEK_U02 The student is able to use the analytical and simulation methods for formulating and solving engineering tasks **Relating to social competences** PEK_K01 Sense of responsibility of designer of the electronic system for the security of the product users

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Introduction to synchronous digital circuits	2
Le_02	VHDL basics	2
Le_03	Tools for simulation and synthesis	2
Le_04	Combinatorial logic in VHDL	2
Le_05	Basic techniques of verification	2
Le_06	Registers and latches	2
Le_07	Types in VHDL	2
Le_08	Shift registers, counters	2
Le_09	Sequential logic - examples	2
Le_10	SERDES systems	2
Le_11	State machines	2
Le_12	Self-checking test benches, loops	2
Le_13	Example project - SPI interface	2
Le_14	Scan Test and other testing methods	2
Le_15	Credit	2
	TOTAL	30

Form of classes - Laboratory		Quantity
La_01	Xilinx ISE tools	2
La_02	Adders	2
La_03	Multiplexers and encoders	2
La_04	Registers and latches	2
La_05	Shift registers and counters	2
La_06	Serial-to-parallel interface	2
La_07	Parallel-to-serial interface	2
La_08	State machine, part 1 - coding	2
La_09	State machine, part 2 - operation analysis	2
La_10	Modulo arithmetic and U2	2
La_11	PWM system	2
La_12	Individual project - the concept of architecture	2
La_13	Individual project - coding	2

La_14	Individual project - simulation and analysis	2
La_15	Assessment of the project	2
	Total	30

TEACHING TOOLS USED
ND_01 Lecture with discussion ND_02 Computer laboratory ND_03 Self - individual design of the digital circuits

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Final test
F2 (lab)	PEK_U01, PEK_U02, PEK_K01	Evaluation of individual project
F3	PEK_U01, PEK_U02, PEK_K01	Evaluation of the laboratory program implementation
P2 (laboratory) = 0,5*(F2 + F3)		

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

SUBJECT SUPERVISOR
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

VLSI Circuits Design

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	S1ec_W04	C01	Wy_01-Wy_15	ND_01
PEK_W02	InzA_W05	C02, C03	Wy_01-Wy_15	ND_01
PEK_U01 (skills)	S1ec_U03, S1ec_U06	C02, C03	La_01-La_15	ND_02, ND_03

PEK_U02	InzA_U02	C02, C03	La_01-La_15	ND_02, ND_03
PEK_K01 (competences)	K1eit_K05	C02, C03	La_01-La_15	ND_01, ND_02

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Technologia ASIC**
Name in English:	**ASIC technology**
Main field of studies:	**Electronics and Telecommunications**
Level and form of studies:	**I level / Full time**
Kind of subject:	**Obligatory / Faculty**
Subject code:	**ETD005203**
Group of courses:	**NO**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of solid state physics
2. Completion course Semiconductor devices
3. Completion course Semiconductors, dielectrics and magnetics
4. Completion course Micro and nano technology

SUBJECT OBJECTIVES

C01 Presentation of ASIC basic design, technology and problems during work of integrated circuits
C02 Preparing to conduct research in the field of IC design

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Knows and understands the processes of fabrication electronic devices, integrated circuits and microsystems and get knowledge about available integrated circuits, parameters and application
PEK_W02 The student knows the typical engineering technologies in the area of IC design

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	ASIC circuits - introduction	2
Le_02	Analog circuits design	4
Le_03	Layout preparing	4
Le_04	Transistors technology	6
Le_05	ASIC circuits technology	6
Le_06	Signal delay in ASIC circuits	3
Le_07	Power in ASIC circuits	3
Le_08	Final exam	2
	TOTAL	30

TEACHING TOOLS USED

ND_01 Lecture with presentation and discussion
ND_02 Consultations
ND_03 Own work - preparing tasks to the lecture
ND_04 Own work - study and preparing to final test

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

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

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Jari Nurmi, Processor Design: System-On-Chip Computing for ASICs and FPGAs, Springer, 2010
2. Keith Barr, ASIC Design in the Silicon Sandbox: A Complete Guide to Building Mixed-Signal Integrated Circuits, McGraw-Hill Professional, 2006
3. Vikram Arkalgud Chandrasetty, VLSI Design: A Practical Guide for FPGA and ASIC Implementations, Springer, 2011

Secondary literature

1. Aldec, Products, http://www.aldec.com/en, 2012
2. System to ASIC Inc., ASIC Technology, http://www.system-to-asic.com/index.htm, 2012

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

ASIC technology

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1ec_W05	C01, C02	Le_01-Le_08	ND_01-ND_04
PEK_W02	InzA_W05	C01, C02	Le_01-Le_08	ND_01-ND_04

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Laboratorium otwarte (elektroniczne)**	
Name in English:	**Open Laboratory (Electronics)**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Optional**	**/ Faculty**
Subject code:	**ETD006075**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			120		
Form of crediting			Z		
Number of ECTS points			4		
Including number of ECTS points for practical (P) classes			4		
Including number of ECTS points for direct teacher-student contact (BK) classes			2.8		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It is required to pass courses in the field of semiconductor devices, electronics and metrology

SUBJECT OBJECTIVES

C01 Acquiring skills of self-design, implementation and measurement of analog electronic circuits
C02 Preparing to conduct research in the design and testing of electronic systems

SUBJECT EDUCATIONAL EFFECTS

Relating to skills

PEK_U01 Able to design, run and test the electronic analog circuits
PEK_U02 The student is able to assess the usefulness of routine methods and tools used for solving of a simple and practical engineering task, characteristic for the studied field of study and to select and apply the appropriate method and tools

Relating to social competences

PEK_K01 Works independently and in a team

PROGRAMME CONTENT		
Form of classes - Laboratory		Quantity
La_01	Computer simulation of the system chosen for the implementation (LT SPICE)	5
La_02	PCB Design - (EAGLE)	5
La_03	Implementation of the PCB (printing, etching, drilling, ...)	5
La_04	Assembly of the circuit (superficial or wired)	5
La_05	Start-up and measurement of the circuit.	5
La_06	Elaboration of the report	5
	Total	30

TEACHING TOOLS USED

ND_01 Own work - preparation for laboratory
ND_02 Consultations

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lab)	PEK_U01, PEK_U02, PEK_K01	Discussions and final test

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. J. Izydorczyk, PSPICE, komputerowa symulacja układów elektronicznych, Helion, 1993
2. M. Panek, http://www.wemif.pwr.edu.pl/pp/MPanek/ltspice_instr.pdf, Internet, 2010

Secondary literature

1. Disscussion Forum LTSpice, http://tech.groups.yahoo.com/group/LTspice/, Internet, 2010

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Open Laboratory (Electronics)

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_U01 (skills)	K1eit_U14	C01, C02	La_01-La_06	ND_01, ND_02
PEK_U02	InzA_U07	C01, C02	La_01-La_06	ND_01, ND_02
PEK_K01 (competences)	K1eit_K03	C01, C02	La_01-La_06	ND_01, ND_02

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Montaż w elektronice i mikrosystemach II**	
Name in English:	**Electronics and Microsystems Packaging II**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD006076**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The knowledge gained in this course: Electronics and Microsystems Packaging

SUBJECT OBJECTIVES

C01 Gaining practical skills through the implementation of laboratory tasks La_02-La_07
C02 Consolidation of skills of group work
C03 Preparation for research in the field of electronics and microsystems packaging

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 The knowledge of electronic packaging allows design of electronic systems based on the available electronic components and packaging techniques

Relating to skills

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

PEK_U02	The student is able to - according to the given specification - design and implement a simple device, object, system or process, typical for the studied field of study, using appropriate methods, techniques and tools
Relating to social competences	
PEK_K01	Ability for cooperation and work in a laboratory group, taking in the different roles

PROGRAMME CONTENT

Form of classes - Laboratory		Quantity
La_01	Introduction to laboratory classes, health and safety regulations	2
La_02	Surface mount technology	4
La_03	The use of electrically conductive adhesives for electronic packaging	4
La_04	Manual packaging in anti-static repair station	4
La_05	Wire bonding	4
La_06	The study of ionic contamination introduced in the packaging processes	4
La_07	Strength test	4
La_08	The additional term for course credit	4
	Total	30

TEACHING TOOLS USED

ND_01 A short, 10-minute introduction and evaluation of student's knowledge (at the beginning of classes)
ND_02 A brief summary of the results of the work carried out (at the end of classes)
ND_03 Consultation
ND_04 Self-study and preparation for laboratory classes

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (lab)	PEK_W01, PEK_U01, PEK_U02, PEK_K01	Summary results of the work carried out within the laboratory task
P1 = F1 (lab)	PEK_W01, PEK_U01, PEK_U02, PEK_K01	Average mark from the results of the work carried out within the laboratory task

PRIMARY AND SECONDARY LITERATURE

Primary literature

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

Secondary literature

1. R. Kisiel, Podstawy technologii dla elektroników, Wydawnictwo BTC Korporacja, 2012
2. R. Kisiel, Połączenia lutowane w montażu elektronicznym z zastosowaniem materiałów ekologicznych, Oficyna Wydawnicza Politechniki Warszawskiej, 2009
3. K. Bukat, H. Hackiewicz, Lutowanie bezołowiowe, Wydawnictwo BTC, Warszawa, 2007

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Electronics and Microsystems Packaging II

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W02	C01	La_01-La_07	ND_01-ND_04
PEK_U01 (skills)	K1eit_U15	C01, C02	La_01-La_07	ND_01-ND_04
PEK_U02	InzA_U08	C01, C02	La_01-La_07	ND_01-ND_04
PEK_K01 (competences)	K1eit_K03	C02	La_01-La_07	ND_01-ND_04

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Podstawy eksploatacji systemów**	
Name in English:	**Basics of System Operating**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD006077**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of mathematics fundamentals in the range of mathematical analysis, probabilistics and statistics
2. Credit of course : Mathematics analysis I
3. Credit of course: Probability and statistics

SUBJECT OBJECTIVES

C01 To acquaint students with the problems dealing with the fundamentals of operating and reliability of electronic devices
C02 To gain skills of analysis of construction system on reliability characteristic
C03 To gain skills of statistic data analysis resulting from elements and system operating
C04 To understand the need of application of mathematical methods to behaviors description of components and devices during operating
C05 Preparing to conduct research in the use of electronic devices

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge	
PEK_W01	He has knowledge on operating and electronic devices reliability, he knows rules of statistic data analysis resulting from operating of components and systems
PEK_W02	The student has a basic knowledge of the life cycle of the technical equipment, facilities, and systems
Relating to skills	
PEK_U01	He is able to analyze problems dealing with statistic data analysis resulting from elements and system operating
PEK_U02	He is able to solve problems dealing with calculation of reliability characteristics and parameters as well as determination of influence of device construction on them
PEK_U03	The student is able to make a critical analysis of the functioning and assess - especially in connection with the studied field of study - the existing technical solutions, in particular: equipment, facilities, systems, processes, services
Relating to social competences	
PEK_K01	He understands the need of statistic methods application to analysis of operating data

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Basic parameters and characteristics of reliability and operating of systems - definitions, relationships	2
Le_02	Classification of failure, physical phenomena influenced on failure	2
Le_03	Series and parallel systems	2
Le_04	Reparable systems	2
Le_05	Analysis of empirical characteristics	2
Le_06	Estimation and analysis of empirical parameters	2
Le_07	Analysis of censored data	2
Le_08	Test	1
	TOTAL	15

Form of classes - Classes		Quantity
Cl_01	Solution of exercises concerning random processes existing in technical problems	2
Cl_02	Solution of exercises dealing with calculation of characteristics describing reliability	2
Cl_03	Solution of exercises dealing with typical characteristics and calculation of reliability parameters	2
Cl_04	Solution of exercises dealing with series, parallel and mixed systems	2
Cl_05	Data analysis in respect of distribution type	2
Cl_06	Solution of problems dealing with investigation plans	2
Cl_07	Solution of exercises dealing with censored data	2
Cl_08	Test	1
	Total	15

TEACHING TOOLS USED
ND_01 Traditional lecture ND_02 Classes - solving of problems dealing with reliability and systems operating ND_03 Tutorials ND_04 Individual work - studies for lecture ND_05 Individual work - studies of examples and exercises for classes ND_06 Individual work - individual studies for tests

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Credit test
P2 = F2 (classes)	PEK_U01, PEK_U02, PEK_U03, PEK_K01	Discussion, solving of problems

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. M. Sztarski, Niezawodność i eksploatacja urządzeń elektronicznych, WKŁ , 1972
2. D. Bobrowski, Modele i metody matematyczne teorii niezawodności, WNT, 1985
3. F. Grabski, J. Jaźwiński, Funkcje o losowych argumentach w zagadnieniach niezawodności, bezpieczeństwa i logistyki, WKŁ, 2009

Secondary literature

1. S. Firkowicz, Statystyczne badanie wyrobów, WNT, 1970

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Basics of System Operating

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W11	C01-C03	Le_01-Le_07	ND_01, ND_03, ND_04, ND_06
PEK_W02	InzA_W01	C01-C03, C05	Le_01-Le_07	ND_01, ND_03, ND_04, ND_06
PEK_U01 (skills)	K1eit_U05	C01, C02	Cl_01-Cl_04	ND_02, ND_03, ND_05, ND_06

PEK_U02	K1eit_U05	C01, C02	Cl_05-Cl_07	ND_02, ND_03, ND_05, ND_06
PEK_U03	InzA_U05	C01, C03, C05	Cl_05-Cl_07	ND_02, ND_03, ND_05, ND_06
PEK_K01 (competences)	K1eit_K01	C04	Le_01-Le_07, Cl_01-Cl_07	ND_01-ND_06

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics	

SUBJECT CARD

Name in Polish:	**Technika mikrofalowa**	
Name in English:	**Microwave Techniques**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD006078**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed course Electricity and Magnetism
2. Completed course Dielectrics and Magnetics
3. Completed course Semiconductor Devices

SUBJECT OBJECTIVES

C01 Basic knowledge about microwave techniques with special emphases of specific differences between design roles and layouts of circuits at low and high frequencies

C02 Acquisition of practical skills of designing and modelling of particular planar transmission structures and matching networks

C03 Development of practical skills of data acquisition and solving technical problems oriented on structure optimization

C04 Development of teamwork habit in engineers problems solving

C05 Preparing to conduct research in microwave technique

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Has organized knowledge, based on theory and practical calculation examples, knowledge in the field of microwave technique needed for understanding of physical principles of operations of microwave elements, transmission lines and microwave devices and their application in telecommunication, heating techniques and medicine etc.

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

Relating to skills

PEK_U01 Is able, by himself/herself, to realize a project of a simple microwave circuits: filter, resonator, coupler, detector, mixer, matching networks etc. using available CAD software, literature and Internet resources

PEK_U02 The student is able to - according to the given specification - design and implement a simple microwave device, using appropriate methods

Relating to social competences

PEK_K01 Is able to work individually and in a team taking on different duties

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Comparison of low and high frequency techniques. General characteristics of microwave and THz techniques. Application. Specific problems. Long lines	2
Le_02	Transmission lines. Microstripe lines and planar transmission structures. Waveguides. Smith chart. Matching networks	2
Le_03	Basic methods of microwave circuits analyse. Matrix of scattering parameters. Noise in microwave circuits. Examples of CAD tools for microwave circuits analyse	2
Le_04	Basic of microwave measurements. Microwave generator. Microwave amplifier. Performance parameters of microwave amplifiers	2
Le_05	Semiconductor devices and tubes for microwave application. Introduction to HMIC and MMIC. Active and passive MEMS elements	2
Le_06	Passive elements. Detectors and mixers. Microwaves propagation and antennas	2
Le_07	Examples of microwaves application at telecommunication, technological processes and medicine. Radiolocation. Optoelectronic microwave systems	2
Le_08	Test	1
	TOTAL	15

Form of classes - Project		Quantity
Pr_01	Long lines. Demonstration of phenomenon occurs in long lines. Smith chart	2
Pr_02	Matching of the generator to load using lumped elements. Application of analytical, graphic methods and CAD tools	2
Pr_03	Microstripe lines design and others selected planar transmission structures. Application of CAD tools	2
Pr_04	Design of matching networks with distributed elements	2
Pr_05	Project of matching networks layout, selection of materials	2
Pr_06	Planar structures design and modelling using numerical methods	2
Pr_07	Analyze of transistor performance at high frequency amplifier circuit	2
Pr_08	Circuit gain and stability analyze	2
Pr_09	Design of dc bias circuit	2

Pr_10	Presentation of project assumption of basic amplifiers on MESFET/HEMT fabricated at HMIC technology	2
Pr_11	Analyze of requirements and transistor selection. Gain and stability analyze. Application of CAD tools	2
Pr_12	Selection and analyze of matching networks of projected amplifier. Application of CAD tools	2
Pr_13	Project of amplifier circuit and its optimization. Application of CAD tools	2
Pr_14	Simulation of projected amplifier performance using CAD tools	2
Pr_15	Assessment and evaluation of the carried out project results	2
	Total	30

TEACHING TOOLS USED

ND_01 Lecture with slides and current discussion
ND_02 Calculation examples during the lectures
ND_03 Unassisted preparation of the students to the test
ND_04 Consultation
ND_05 Computer laboratory and measurement laboratory
ND_06 Unassisted preparation of the students to the project subjects
ND_07 Unassisted acquaintance of the students with proposed CAD tools
ND_08 Short tests (duration: 10-15 min.)

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (lecture)	PEK_W01, PEK_W02	Short tests during the classes
F2	PEK_W01, PEK_W02	Final test
F3 (project)	PEK_U01, PEK_U02, PEK_K01	Short presentation by project group of the works progress, defense of the project
P1 (lecture) = 0,5*(F1 + F2)		
P2 (project) = F3		

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. B. Galwas, Mikrofalowe generatory i wzmacniacze tranzystorowe, Wydawnictwa Komunikacji i Łączności, 1991
2. J. A. Dobrowolski, Układy i systemy wielkich częstotliwości. Zadania, Oficyna Wydawnicza Politechniki Warszawskiej, 2002
3. J. A. Dobrowolski, Technika wielkich częstotliwości, Oficyna Wydawnicza Politechniki Warszawskiej, 2001
4. J. Szóstka, Mikrofale, Wydawnictwa Komunikacji i Łączności, 2006
5. W. Czarczyński, Podstawy techniki mikrofalowej, Oficyna Wydawnicza Politechniki Wrocławskiej, 2003

Secondary literature

1. B. Galwas, Miernictwo mikrofalowe, Wydawnictwa Komunikacji i Ł ączności, 1985
2. J. F. White, High frequency techniques, an introduction to RF and microwave engineering, IEEE Press, J. Wiley-Interscience, 2004

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Microwave Techniques

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W02, K1eit_W12	C01	Le_01-Le_07	ND_01-ND_04
PEK_W02	InzA_W02	C01, C05	Le_01-Le_07	ND_01-ND_04
PEK_U01 (skills)	K1eit_U06	C02	Pr_01-Pr_15	ND_05-ND_07
PEK_U02	InzA_U08	C02, C05	Pr_01-Pr_15	ND_05-ND_07
PEK_K01 (competences)	K1eit_K02, K1eit_K03	C03, C04	Pr_10-Pr_15	ND_05-ND_07

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Zastosowanie technik informatycznych i metod numerycznych w elektronice**
Name in English:	**Application of Computer Science Techniques and Numerical Methods in Electronics**
Main field of studies:	**Electronics and Telecommunications**
Level and form of studies:	**I level / Full time**
Kind of subject:	**Optional / Faculty**
Subject code:	**ETD006079**
Group of courses:	**NO**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge on information technology
2. Basic knowledge on numerical methods
3. Computer skills and basic knowledge on typical CAD software for computer aided design

SUBJECT OBJECTIVES

C01 Gaining knowledge on the basics of information technology and numerical methods along with selected examples in the field of computer aided design using CAD tools in electronics: analog and digital analysis, numerical modeling and simulation, etc.
C02 Practical preparation for the project implementation by using appropriate computer aided engineering tools and numerical methods in the field electronics
C03 Strengthening the skills to work independently and in a group
C04 Preparing to conduct research in the field of numerical design of electronic systems

SUBJECT EDUCATIONAL EFFECTS	
Relating to skills	
PEK_U01	Student can find the right tools and methods to support engineering electronics tasks by the appropriate CAD software in order to run: analog and digital analysis, numerical modeling and simulation
PEK_U02	The student is able to use the analytical and simulation methods for formulating and solving engineering task
Relating to social competences	
PEK_K01	Correctly identifies and resolves dilemmas of working as a professional engineer

PROGRAMME CONTENT		
Form of classes - Project		Quantity
Pr_01	Introductory lecture	1
Pr_02	Selection of topics and problems for the project	2
Pr_03	Discussion and presentation of the selected individual projects	2
Pr_04	Discussion and presentation of the selected software tools and numerical methods for the project implementation	2
Pr_05	Discussion and presentation of projects - stage 1	2
Pr_06	Discussion and presentation of projects - stage 2	2
Pr_07	Discussion and presentation of projects - stage 3	2
Pr_08	Assessment of the project	2
	Total	15

TEACHING TOOLS USED	
ND_01	Project: short, 10-minute presentations of project state
ND_02	Consultations
ND_03	Self work - preparation for classes
ND_04	Self work - independent literature studies

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (project)	PEK_U01, PEK_U02, PEK_K01	Presentations of the project and discussion, evaluation of the project

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. E. Thompson, Introduction to the Finite Element Method, John Wiley and Sons, 2005
2. P. Horowitz, W. Hill, Sztuka elektroniki, tom 1 i tom 2, WKŁ, 1995
3. Tao Pang, An Introduction to Computational Physics, Cambrdige University Press, 2006

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Application of Computer Science Techniques and Numerical Methods in Electronics

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_U01 (skills)	K1eit_U06, K1eit_U07	C01, C02	Pr_01-Pr_08	ND_01, ND_02
PEK_U02	InzA_U02	C01, C02, C04	Pr_01-Pr_08	ND_01, ND_02
PEK_K01 (competences)	K1eit_K02	C03	Pr_01-Pr_08	ND_03, ND_04

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Numeryczne modelowanie przyrządów półprzewodnikowych**	
Name in English:	**Computer Modeling of Semiconductor Devices**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Optional**	**/ Faculty**
Subject code:	**ETD006080**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completion of the course: lecture and lab - Semiconductor Devices
2. Passive knowledge of English

SUBJECT OBJECTIVES

C01 To familiarize students with the organization of programs for Unix designing and solving numerical transport in solid-state media (semiconductors)
C02 Consolidation and practical knowledge of the basic content of education
C03 Preparing to conduct research related to computer simulation properties of semiconductor devices

SUBJECT EDUCATIONAL EFFECTS

Relating to skills

PEK_U01 The ability to use simulation software to support the design and engineering work

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

Relating to social competences

PEK_K01 Understanding the need to use new techniques and technologies in engineering activities

PROGRAMME CONTENT

Form of classes - Project		Quantity
Pr_01	Familiar with the program for two-dimensional simulation of semiconductor devices - PISCES B.9009	4
Pr_02	To familiarize with the graphical interpreter - (POSTMINI)	2
Pr_03	Example analysis using external programs	2
Pr_04	Implementation of an individual project	7
	Total	15

TEACHING TOOLS USED

ND_01 Individual work - class discussion

ND_02 Individual work - realization of the project

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (project)	PEK_U01, PEK_U02, PEK_K01	Discussion
F2	PEK_U01, PEK_U02, PEK_K01	Preparation of project report
P1 (project) = 0,5*(F1 + F2)		

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. PISCES manual, The Board of Trustees of Leland Stanford Junior University, 1994
2. PISCES Release B.9009, Card documentation (PDF), PISCES IIB supplemental report, The Board of Trustees of Leland Stanford Junior University, 1983

Secondary literature

1. A. Świt, J. Pułtorak, Przyrządy półprzewodnikowe,, WNT, 1979
2. B. Streetman, Przyrządy półprzewodnikowe, WNT, WNT, 1976
3. W. Marciniak,, Przyrządy półprzewodnikowe i układy scalone, WNT, 1984

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Computer Modeling of Semiconductor Devices

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_U01 (skills)	K1eit_U07	C01-C03	Pr_01-Pr_04	ND_01, ND_02
PEK_U02	InzA_U01	C01-C03	Pr_01-Pr_04	ND_01, ND_02
PEK_K01 (competences)	K1eit_K02	C02, C03	Pr_01-Pr_04	ND_01, ND_02

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Projektowanie wspomagane komputerem**
Name in English:	**Computer aiding of engineering works**
Main field of studies:	**Electronics and Telecommunications**
Level and form of studies:	**I level / Full time**
Kind of subject:	**Optional / Faculty**
Subject code:	**ETD006081**
Group of courses:	**NO**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

No requirements

SUBJECT OBJECTIVES

C01 Familiarizing students with the program supporting the design
C02 Gaining design skills in selected software environment / in the field engineering and microsystems
C03 Skill fixation to work independently

SUBJECT EDUCATIONAL EFFECTS

Relating to skills

PEK_U01 Student can use the selected software environment for design in the field of engineering and microsystems
PEK_U02 Student can be used to formulate and solve engineering tasks simulation methods

Relating to social competences

PEK_K01 Student is able to work independently

PROGRAMME CONTENT		
Form of classes - Project		Quantity
Pr_01	Learning the functions of the design environment	3
Pr_02	Project of photolithographic masks of pressure sensor	4
Pr_03	3D design of the mechanical system	3
Pr_04	Correctness analysis of project, errors elimination	2
Pr_05	Generation of technical documentation	3
	Total	15

TEACHING TOOLS USED	
ND_01	Short presentation design steps at the beginning of classes
ND_02	Consultations
ND_03	Own work - prepare for classes

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (project)	PEK_U01, PEK_U02, PEK_K01	Evaluation of exercises

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. T. Dobrzański, Rysunek techniczny maszynowy, WNT W-wa, 2004

Secondary literature

1. Description of programs: AutoCAD i Inventor, Autodesk, 2012
2. J. Dziuban, Technologia i zastosowanie mikromechanicznych struktur krzemowych i krzemowo-szklanych w technice mikrosystemów, Oficyna Wydawnicza PWr, 2002

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Computer aiding of engineering works

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_U01 (skills)	K1eit_U07	C01, C02	Pr_01-Pr_05	ND_01, ND_02
PEK_U02	InzA_U02	C01, C02	Pr_01-Pr_05	ND_01, ND_02
PEK_K01 (competences)	K1eit_K03	C03	Pr_01-Pr_05	ND_03

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Mikrosystemy w motoryzacji**	
Name in English:	**Automotive Microsystems**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD006101**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It is recommended credit courses in the field of semiconductor devices, electronics and metrology

SUBJECT OBJECTIVES

C01 To familiarize students with the basic microsystems (sensor systems), used in automotive engineering
C02 Introduction to the structure, working conditions and measurement of the main parameters used in the above-mentioned sensor systems
C03 Strengthening self- and teamwork skills

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Has the knowledge of the construction, operation, and applications of sensor systems and microsystems in automotive engineering

Relating to skills

PEK_U01 Able to diagnose and make basic measurements of sensor systems used in automotive engineering

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

Relating to social competences

PEK_K01 Works independently and in a team

PROGRAMME CONTENT

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

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

TEACHING TOOLS USED

ND_01 Traditional lecture with the use of computer projector

ND_02 Self study - preparation for laboratory class

ND_03 Report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01	Final test
P2 = F2 (lab)	PEK_U01, PEK_U02, PEK_K01	Short tests, reports from the laboratory

PRIMARY AND SECONDARY LITERATURE
Primary literature 1. Gajek A., Juda Z., Czujniki, WKŁ Warszawa, 2008 2. Herner A., Elektronika w samochodzie, WKŁ Warszawa, 2001 3. Marek J., Sensors for Automotive Technology, Wiley-VCH, Darmstadt, 2003 **Secondary literature** 1. Technical catalogue, Czujniki w pojazdach samochodowych, f-ma Bosch, 2002 2. Technical catalogue, Układy bezpieczeństwa i komfortu jazdy, f-ma Bosch, 2002 3. Technical catalogue, Mikroelektronika w pojazdach, f-ma Bosch, 2002

SUBJECT SUPERVISOR
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Automotive Microsystems

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W30, S1ief_W04	C01, C02	Wy_01-Wy_07	ND_01
PEK_U01 (skills)	K1eit_U21, S1ief_U06	C01, C02	La_01-La_05	ND_02, ND_03
PEK_U02	InzA_U01	C01, C02	La_01-La_05	ND_02, ND_03
PEK_K01 (competences)	K1eit_K03	C03	La_01-La_05	ND_02, ND_03

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Optoelektronika obrazowa**	
Name in English:	**Imaging Optoelectronics**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD006102**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed the course material: Physics

SUBJECT OBJECTIVES

C01 Knowledge of the principles of operation of equipment for optoelectronic imaging
C02 The ability to measure key parameters of these devices
C03 Preparing to conduct research in the subject optoelectronics imaging

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Knows the principles of optoelectronic devices for image processing

Relating to skills

PEK_U01 Carries out measurements the essential parameters of optoelectronic devices for image processing and is able to use these devices

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

Relating to social competences

PEK_K01 Has the ability to work in group

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Light, physical and psychophysical description, energetic and photometric parameters, colorimetric base	4
Le_02	Fundamentals of geometrical optics - Optical Imaging	3
Le_03	Integrated image analyzers	4
Le_04	Digital imaging cameras, optical filters	3
Le_05	Elements of a television picture transmission. Optoelectronic image processing, basic processes of image synthesis	2
Le_06	Cathode ray tubes	1
Le_07	Active displays	6
Le_08	Passive displays	4
Le_09	Projectors	3
	TOTAL	30

Form of classes - Laboratory		Quantity
La_01	Modulation transfer function and colorimetric properties of video display	3
La_02	Measurements of video cameras - digital and analog	3
La_03	Measurements of digital photographic camera	3
La_04	Measurements of liquid crystal displays	3
La_05	Measurements of the Plasma Display Panel	3
	Total	15

TEACHING TOOLS USED

ND_01 Multimedia presentation
ND_02 Movies and animations
ND_03 Practical laboratory

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01	Written exam
P2 = F2 (lab)	PEK_U01, PEK_U02, PEK_K01	Short tests + presence in the laboratory + reports

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. J. Woźnicki, Podstawowe techniki przetwarzania obrazu, WKŁ, 1996
2. K. Booth, S. Hill, Optoelektronika, WKŁ, 2001
3. M. Rusin, Wizyjne przetworniki optoelektroniczne, WKŁ, 1990
4. Z. Bielecki, A. Rogalski, Detekcja sygnałów optycznych, WNT, 2001

Secondary literature

1. A. Fiok, Telewizja - Podstawy ogólne, WKŁ, 1996

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Imaging Optoelectronics

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	S1ief_W02	C01	Le_01-Le_09	ND_01, ND_02
PEK_U01 (skills)	S1ief_U04	C02	La_01-La_05	ND_03
PEK_U02	InzA_U01	C02, C03	La_01-La_05	ND_03
PEK_K01 (competences)	K1eit_K03	C02	La_01-La_05	ND_03

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Światłowody II**	
Name in English:	**Optical Fibers II**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD006103**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of physics, including optical issues with particular emphasis on geometrical optics
2. Basic knowledge of solid state physics
3. Completed Fiber-optics
4. Completed Optoelectronics

SUBJECT OBJECTIVES

C01 Familiarizing the students with the basic parameters (geometry and transmission) of optic fibers (glass or polymer) and the methods of coupling optical radiation to different types of fiber

C02 Familiarizing the students with the methods of connecting optic fibers and damping factors for fiber optic connectors

C03 Acquiring skills in working with optic fibers (glass and polymer)

C04 Learning the selection of passive and active elements in optoelectronic systems (the type of fiber, the type of light source and detector) used in fiber-optic telecommunications and optical measuring systems

C05 Preparing to conduct research in the field of optical signal transmission

SUBJECT EDUCATIONAL EFFECTS

Relating to skills

PEK_U01 Measuring the basic parameters of optical fibers and fiber bundles, fiber optic connectors

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

Relating to social competences

PEK_K01 Able to interact and work in a laboratory group assuming different roles

PROGRAMME CONTENT

Form of classes - Laboratory		Quantity
La_01	Introductory meeting	2
La_02	Measurement of numerical aperture of glass fibers and polymer fibers	4
La_03	Measurement of the coupling efficiency of the light beam to the optical fiber	4
La_04	Measurements of optical and geometrical parameters of fibers and fiber bundles	4
La_05	Study the impact of positioning errors on the attenuation of fiber optic connectors	4
La_06	The evaluation of the attenuation of light in the material mediums	4
La_07	Measuring the stability and reproducibility of fiber optic connectors attenuation	4
La_08	Additional course hours	4
	Total	30

TEACHING TOOLS USED

ND_01 Tests conducted before classes

ND_02 Consultations with respect to the obtained results and factors determining the accuracy of measurements

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lab)	PEK_U01, PEK_U02, PEK_K01	Partial tests and quizzes, lab reports

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. A. Smoliński, Optoelektronika światłowodowa, WKŁ, 1985
2. J. Siuzdak, Wstęp do współczesnej telekomunikacji światłowodowej, WKŁ, 1997
3. M. Szustakowski, Elementy techniki światłowodowej, WNT, 1992

Secondary literature

1. B. Ziętek,, Optoelektronika, UMK, 2004
2. J. E. Midwinder , Y. L. Guo, Optoelektronika i technika światłowodowa, WKŁ, 1995

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Optical Fibers II

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_U01 (skills)	S1ief_U07	C01-C04	La_01-La_08	ND_01, ND_02
PEK_U02	InzA_U06	C01-C05	La_01-La_08	ND_01, ND_02
PEK_K01 (competences)	K1eit_K03	C03, C04	La_01-La_08	ND_01, ND_02

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Techniki jonowe i plazmowe**	
Name in English:	**Ion and plasma techniques**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD006104**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge in the field of fundamental physics
2. Ability to find additional fields/sources of knowledge and skills

SUBJECT OBJECTIVES

C01 Acquiring the knowledge from the field of phenomena occurring in the plasma gas discharge and their application in technological processes used in microelectronics, nanoelectronics and semiconductor devices technology

C02 Familiarizing the students with modern methods of plasma’s excitation and its application for properties modification of substrate’s material or etched/deposited film

C03 Acquiring the skill to design semiconductor/detector structures, according to the desired properties, achieved during plasma enhanced technological process or carried out in ions/ion beam assisted process

C04 Preparing students to conduct scientific research related to plasma-assisted process

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 The student has accurate knowledge of the phenomena occurring in plasma gas discharges and their application in technological processes used in microelectronics, nanoelectronics and semiconductor devices technology

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

Relating to skills

PEK_U01 The student, according to the desired properties of the manufactured structure (thin-film, semiconductor structure), can propose and design the technological process (PVD, CVD) enhanced by plasma and estimate the results of ion-film-structure interactions

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

Relating to social competences

PEK_K01 The student understands the requirements to use new techniques and technologies in engineering activities and is able to define goals and anticipate the effects of the undertaken experimental works

PEK_K02 The student can work independently and in a team

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

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Introduction. Plasma. Basic properties	2
Le_02	Elementary processes in plasma gas discharge. Elastic and inelastic collisions	2
Le_03	Electrons and ions movement in plasma gas discharge	2
Le_04	Systematic of gas discharges. Self-reliant and non self-reliant discharge. Glow discharge - DC and RF discharges. Arc discharge	2
Le_05	Plasma's diagnostics. Basics parameters for plasma's characterization. Classification of the plasma diagnostics methods. OES and Langmuira's probe methods	2
Le_06	PVD and CVD deposition methods, classification and general characterization	2
Le_07	Ion sputtering. Phenomena occurring on the solid state - gas interface. Mechanism of the sputtering process. Ions function in the film's deposition process	2
Le_08	Film's deposition processes enhanced by plasma and ion beam	2
Le_09	Nucleation process and film's growth in the presence of ion bombardment. Methods applied for simulations of the deposited film's growth	2
Le_10	Overview of deposition processes involving the application of plasma or ion beam. Nucleation and film's growth process in the presence of ion bombardment. Methods applied for simulations of the deposited film's growth	2
Le_11	Magnetron sputtering. Ion plating. Ion Beam Assisted Deposition (IBS, IBAD)	2
Le_12	Overview of plasma enhanced gas discharge (PECVD, ICP PECVD) technological processes	2
Le_13	Ion and plasma etching applied in semiconductor devices technology	2
Le_14	Direct current and radio frequency plasma in RIE, ICP RIE plasma etching	2

Le_15	Ion implantation - doping/modification process of the material's subsurface layer by ion bombardment. Characteristics of the process, systems applied for implantation	2
	TOTAL	30

Form of classes - Laboratory		Quantity
La_01	Introduction. Health and Safety Training. Requirements that vacuum equipment/systems, applied for technological processes in the presence of plasma gas discharge or ion beam, must fulfill	3
La_02	Dielectric films (Si_3N_4, SiO_2 and DLC) deposition process by Plasma Enhanced Chemical Vapour Deposition (PECVD) method	3
La_03	Reactive Ion Etching (RIE) process of semiconductor structures	3
La_04	Plasma's state diagnostics by Langmuira probe method in reactive magnetron sputtering process carried out in the WMK magnetron type in NP-500 vaccum device	3
La_05	Films deposition process by Reactive Magnetron Sputtering	3
La_06	Plasma modification of the thin films surface	3
La_07	Plasma modification of polymeric substrates	3
La_08	Investigation of photocatalytic properties of thin films deposited in Plasma Assisted processes	3
La_09	Investigation of wettability of thin films and substrates with plasma-modified surface	3
La_10	Additional term. Assessment of failed exercises. Final assessment	3
	Total	30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Exam
P2 = F2 (lab)	PEK_U01, PEK_U02, PEK_K01-PEK_K03	Short tests and reports from each laboratory exercise

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. J. Reece Roth, Industrial Plasma Engineering, Institute of Physics Publishing Ltd., 1995
2. J. Zdanowski, W. Oleszkiewicz, Rola jonów w procesach nanoszenia warstw cienkich, Materiały Konferencyjne Wydziału Mechanicznego Politechniki , 2000
3. Michael A. Liberman, Allan J. Lichenberg, Principles of Plasma Discharges and Materials Processing, John Wiley & Sons, 1994
4. R. Hippler, H. Kersten, M. Schmidt, K. H. Schoenbach, Low Temperature Plasmas vol.1, vol.2, Wiley-VCH Verlag GmbH & Co. KGaA, 2008

Secondary literature
1. Francis F.Chen, Jane P. Chang, Lecture Notes on Principles of Plasma Processing, Springer, 2003

SUBJECT SUPERVISOR
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Techniki jonowe i plazmowe

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	S1ief_W08	C01, C02	Le_01-Le_15	ND_01-ND_03
PEK_W02	InzA_W02	C01, C02, C04	Le_01-Le_15	ND_01-ND_03
PEK_U01 (skills)	S1ief_U10	C03	La_01-La_10	ND_03-ND_05
PEK_U02	InzA_U07	C03, C04	La_01-La_10	ND_03-ND_05
PEK_K01 (competences)	K1eit_K02	C02, C03	La_01-La_10	ND_02, ND_04, ND_05
PEK_K02	K1eit_K03	C02, C03	La_01-La_10	ND_02, ND_04, ND_05
PEK_K03	InzA_K01	C02, C03, C04	La_01-La_10	ND_02, ND_04, ND_05

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Systemy zabezpieczeń obiektów**
Name in English:	**Building Access Control and Security Systems**
Main field of studies:	**Electronics and Telecommunications**
Level and form of studies:	**I level / Full time**
Kind of subject:	**Obligatory / Faculty**
Subject code:	**ETD006105**
Group of courses:	**NO**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

No requirements

SUBJECT OBJECTIVES

C01 Familiarizing students with access control systems, CCTV, intruder alarm and intelligent building
C02 Learning how to work with access control systems, CCTV, intruder alarm and intelligent building systems: design, programming, verification and maintenance
C03 Fixation of skills to work independently and in a team

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Student has a general knowledge of the structure and operation of access control systems, CCTV, intruder alarm and intelligent building
PEK_W02 The student has a basic knowledge of the life cycle of the technical equipment, facilities, and systems

Relating to skills	
PEK_U01	Student is able to design, program and operate the access control systems, CCTV, intruder alarm and KNX / EIB
PEK_U02	The student is able to see system and non-technical aspects of engineering tasks during their formulating and solving
Relating to social competences	
PEK_K01	Student is able to work independently and in a group of laboratory

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Intelligent building systems - security and surveillance, control and management of the building	3
Le_02	European bus KNX / EIB	3
Le_03	The intrusion alarm SSWiN	2
Le_04	The control panel, motion detection, detectors	2
Le_05	The access control system	3
Le_06	Video surveillance systems (CCTV)	2
	TOTAL	15

Form of classes - Laboratory		Quantity
La_01	Introduction	2
La_02	The alarm system in a big utility building	4
La_03	Wireless alarm system with an alert function	4
La_04	Managing the security system via Ethernet	4
La_05	The access control system	4
La_06	Digital CCTV system	4
La_07	The design of the KNX / EIB and device programming	4
La_08	Interface for design SSWiN, single-family home security project	4
	Total	30

TEACHING TOOLS USED

ND_01 Traditional lecture with presentation
ND_02 Laboratory: short tests at the beginning of classes
ND_03 Consultations
ND_04 Own work - prepare for laboratory exercises
ND_05 Own work - self-study and prepare for test

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (lecture)	PEK_W01, PEK_W02	Final test
F2 (lab)	PEK_U01, PEK_U02, PEK_K01	Short tests at the beginning of the laboratory exercises

F3	PEK_U01, PEK_U02, PEK_K01	Evaluation of exercises
P1 (lecture) = F1		
P2 (laboratory) = 0,3*F2 + 0,7*F3		

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Andrzej Wójcik, Mechaniczne i elektroniczne systemy zabezpieczeń, Verlag Dashofer, 2003
2. Bimonthly magazine, Zabezpieczenia, ATT Trading Company
3. Bimonthly magazine, Twierdza
4. Bimonthly magazine, Inteligentny Dom, Inteligentny Budynek
5. Bimonthly magazine, Systemy alarmowe
6. Henryk Markiewicz, Instalacje elektryczne, WNT W-wa, 2002
7. Paweł Kałużny, Telewizyjne systemy dozorowe, WKŁ Warszawa, 2008
8. Group work, Automatyczna identyfikacja w systemach logistycznych, Oficyna Wydawnicza PWr, 2004

Secondary literature

1. Krzysztof Ślot, Wybrane zagadnienia biometrii, WKŁ W-wa, 2008
2. W. Jaskulski et al., Vademecum ochrony obiektów zabytkowych, DiG, 1996
3. Zbigniew Bielecki, Detekcja sygnałów optycznych, WNT W-wa, 2001

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Building Access Control and Security Systems

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	S1ief_W09	C01	Le_01-Le_06	ND_01, ND_03, ND_05
PEK_W02	InzA_W01	C01	Le_01-Le_06	ND_01, ND_03, ND_05
PEK_U01 (skills)	S1ief_U12	C02, C03	La_02-La_08	ND_02, ND_04
PEK_U02	InzA_U03	C02, C03	La_02-La_08	ND_02, ND_04
PEK_K01 (competences)	K1eit_K03	C03	La_02-La_08	ND_02, ND_04

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Mikrosystemy II**	
Name in English:	**Microsystems II**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD006106**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Successful completion of Microsystems I

SUBJECT OBJECTIVES

C01 Gaining knowledge of the micromechanical sensors, actuators and microsystems, their construction, operation, together with the basic physics, parameters and usage
C02 Familiarizing yourself with the knowledge of how to design silicon, glass-silicon and polymer microsystems
C03 Design of the chosen microsystem
C04 Fusing ability to work independently and in a team
C05 Preparing to conduct research in the field of microsystems

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Student has a general knowledge of the design of microsystems: use of materials, microengineering techniques, and applications of microsystems

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

Relating to skills

PEK_U01 Student can use knowledge of the microengineering techniques and design selected microsystem. He is able to develop documentation on the project and prepare a presentation of the results of this task

Relating to social competences

PEK_K01 Student can work independently and in groups taking different roles in it

PEK_K02 The student is able to assess the usefulness of routine methods and tools used for solving of a simple and practical engineering task, characteristic for the studied field of study and to select and apply the appropriate method and tools

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Fundamentals of technology, micromechanical constructions, classification of sensors and actuators, basic microsystem instruments, applications, developments	4
Le_02	The stresses and strains in microdevices. Miniature strain gauge transducers. Static and dynamic systems, vibration. Mechanical and electrical goodness. Replacement electromechanical systems. Capacitive and piezoelectric electromechanical processing	4
Le_03	Piezoresistive pressure sensors, chip-package relation, parameters, electronics, normalization and temperature compensation, industrial transducers. Other micromechanical pressure sensors. Manufacturers, economic relations, the use in the technique	4
Le_04	Bulk and surface acceleration sensors, vibration sensors, inclinometers, sensors strokes. The construction, operation, performance, packages, and utilization	4
Le_05	Machines in microscale: from micromechanical actuators to industrial micro-robots. Micromotors and actuators, micromechatronics systems. Control of flow in microfluidics: nozzles, valves, mixers, filters and integrated folders. Use in the art	4
Le_06	Static and dynamic microoptics systems: microlenses and their systems, mirrors, dynamic image correction, interference and DMD projectors. Optical switches for telecommunications. Optical microsensors photo and fluorometric. Other microoptics sensors	4
Le_07	RF microsystems: micromechanical filters and power supplies. Detectors, antennas and other integrated devices for the GHz-THz range. Integrated atomic clocks	4
Le_08	Integrated chips in health care, introduction to microanalysis and microchemistry	2
	TOTAL	30

Form of classes - Project		Quantity
Pr_01	Introduction: lecture program, requirements	1
Pr_02	General principles of designing of the micromechanical sensors and actuators(calculation exercises)	8
Pr_03	Designing and fabrication of photolithographic masks	1
Pr_04	An example of the properly designed silicon pressure sensor	2
Pr_05	Self work: project of the construction of sensor/actuator, technology, and a set of masks	8

Pr_06	Self work: project of assembly, package and electronics for own sensor/actuator	4
Pr_07	Estimate for the microsystem	2
Pr_08	Development of the project report and presentation of the results	4
	Total	30

TEACHING TOOLS USED

ND_01 Traditional lecture with the use of slides, and discussion
ND_02 Tutorials
ND_03 Short tests at the beginning of some classes of project
ND_04 Self study - implementation of the subsequent steps of your own project

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Exam
F2 (project)	PEK_U01, PEK_U02, PEK_K01	Short tests beginning classes of project
F3	PEK_U01, PEK_U02, PEK_K01	Rating of the subsequent stages of the project
P2 (project) = 0,5*(F2 + F3)		

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. A. Górecka-Drzazga, on-line materials for the project classes: www.wemif.net/agd
2. A. Górecka-Drzazga, Mikro- i nanoemitery polowe, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocłąw, 2008
3. G. Gerlach, W. Doetzel, Inroduction to microsystem technology, ohn Willey& Sons, Ltd., 2008
4. G. Kovacs, Micromachined Transducers Sourcebook, McGraw-Hill, 1998
5. J. Dziuban, Technologia i zastosowanie mikromechanicznych struktur krzemowych i krzemowo-szklanych w technice mikrosystemów, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocłąw, 2004
6. J. Dziuban, lecture notes for Microsystems I course
7. M. Gad-el-Hak, The MEMS handbook, CRC Press, 2002
8. M. Madou, Foundamentals of microfabrication, CRC Press, 2002
9. N. Maluf, An introduction to microelectromechanical systems engineering, Artech House, 2000
10. Group work, Procesy technologiczne w elektronice półprzewodnikowej, WN-T, W-wa, 1980
11. R. Beck, Technologia krzemowa, WN PWN, W-wa, 1991
12. S. Franssila, Introduction to microfabrication, John Willey & Sons, Ltd., 2007

Secondary literature

1. B. Galwas, Miernictwo mikrofalowe, Wydawnictwa Komunikacji i Ł ączności, 1985
2. J. F. White, High frequency techniques, an introduction to RF and microwave engineering, IEEE Press, J. Wiley-Interscience, 2004

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Microsystems II

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	S1ief_W05	C01	Le_01-Le_08	ND_01, ND_02
PEK_W02	InzA_W02	C01, C05	Le_01-Le_08	ND_01, ND_02
PEK_U01 (skills)	S1ief_U01	C02-C04	Pr_05-Pr_08	ND_03, ND_04
PEK_U02	InzA_U07	C02-C05	Pr_05-Pr_08	ND_03, ND_04
PEK_K01 (competences)	K1eit_K03	C02-C04	Pr_05-Pr_08	ND_03, ND_04

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Procesory sygnałowe**	
Name in English:	**Signal Processors**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD006201**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	90		60		
Form of crediting	E		Z		
Number of ECTS points	3		2		
Including number of ECTS points for practical (P) classes	0		2		
Including number of ECTS points for direct teacher-student contact (BK) classes	1.8		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of digital circuits
2. C programming skills
3. Knowledge of digital signal processing techniques

SUBJECT OBJECTIVES

C01 Familiarizing of student with DSP processors architecture and online DSP processing
C02 Learning of implementation of basic online DSP techniques in DSP processors
C03 Increasing ability to work in group
C04 Preparing to conduct research in the field of signal processing

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Student will possess knowledge of DSP processors architectures, DSP techniques and hardware support
PEK_W02 The student knows the basic methods, techniques and tools used in solving simple engineering problems from the studied field of study

Relating to skills	
PEK_U01	Student can implement digital filtering and amplitude modulation algorithms in DSP processors. He can use interrupt control and direct memory access to implement efficient data acquisition
PEK_U02	The student is able to - according to the given specification - design and implement a simple device, object or system, typical for the studied field of study, using appropriate methods, techniques and tools
Relating to social competences	
PEK_K01	Student can work in group effectively

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Architecture of microprocessors and features distiquishing DSP processors	2
Le_02	Architecture of modern DSP processor basing on an example TMS320C6713 processor of Texas Instruments	2
Le_03	Instruction set of a modern DSP processors on the basis of an example TMS320C6713 processor	2
Le_04	Pipelining and addressing modes in modern DSP processors on the basis of an example TMS320C6713 processor	2
Le_05	Interrupt control system and using of peripheries in modern DSP processors on the basis of an example TMS320C6713 processor	2
Le_06	DMA system and effective signal processing with the help of circular buffers and ping-pong buffers	2
Le_07	Data acquisition on the basis of an example multichannel buffered serial port of a TMS320C6713 processor	2
Le_08	Test no. 1	2
Le_09	Multiple channels transmission on the basis of multichannel buffered serial port of an example TMS320C6713 processor	2
Le_10	Digital circuits supporting signal processing basing on an example TLV320AIC23 audio codec of Texas Instruments	2
Le_11	Short review on C language	2
Le_12	Online implementation of FIR and IIR filters	2
Le_13	Online implementation of Fast Fourier Transform algorithm	2
Le_14	Code optimization in modern DSP processors basing on an example TMS320C6713 processor and Code Composer Studio environment	2
Le_15	Test no. 2	2
	TOTAL	30

Form of classes - Laboratory		Quantity
La_01	Introductory classes, familiarizing with the Code Composer Studio development environment	3
La_02	Programming of interrupts control system to use timer/counter circuit	3
La_03	Programming of serial port audio codec circuit and implementation of first audio processing (digital sound volume control)	3
La_04	Implementation of circular buffering and FIR, IIR filters	3
La_05	Programming of DMA system and implementation of ping-pong buffering and amplitude modulation	3
	Total	15

TEACHING TOOLS USED	
ND_01	Presentation with audiovisual aids
ND_02	Laboratory classes with developer starter kit with a TMS320C6713 processor
ND_03	Office hours
ND_04	Self-study - given issues preparation
ND_05	Self-study - preparation for classes
ND_06	Self-study and preparation for tests

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Final tests
P2 = F2 (lab)	PEK_U01, PEK_U02, PEK_K01	Assessment of preparations and work at the laboratory

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Technical documentation, TMS320C6000 Programmer's Guide, Texas Instruments, 2011
2. Technical documentation, TMS320C67x/C67x+ DSP CPU and Instruction Set Reference Guide, Texas Instruments, 2006
3. Technical documentation, TMS320C6000 Peripherals Reference Guide, Texas Instruments, 2001

Secondary literature

1. Technical documentation, Dokumentacja procesorów DSP, Producent, 2012

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Signal Processors

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	S1ec_W06	C01	Le_01-Le_15	ND_01, ND_03, ND_04, ND_06
PEK_W02	InzA_W02	C01, C04	Le_01-Le_15	ND_01, ND_03, ND_04, ND_06
PEK_U01 (skills)	S1ec_U03	C02	La_01-La_05	ND_02, ND_05

PEK_U02	InzA_U08	C02, C04	La_01-La_05	ND_02, ND_05
PEK_K01 (competences)	K1eit_K03	C03	La_01-La_05	ND_02, ND_05

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics	

SUBJECT CARD

Name in Polish:	**Programowanie obiektowe**	
Name in English:	**Object-Oriented Programming**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD006202**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

C01 Gaining theoretical knowledge referred to in Le_01-Le_14
C02 The implementation of practical projects in accordance with the guidelines Pr_01-Pr_02
C03 Gaining experience working in a development team
C04 Preparation for research in the area of object-oriented programming

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Has knowledge of the meaning and application of object-oriented programming paradigm
PEK_W02 The student knows the basic methods, techniques, tools and materials used in solving simple engineering problems from the studied field of study

Relating to skills PEK_U01 Able to develop a UML model for selected problem PEK_U02 The student is able to use the analytical, simulation and experimental methods for formulating and solving engineering tasks **Relating to social competences** PEK_K01 Able to work in a development team, taking on the various roles (architect, designer, developer, tester)

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Introduction. Presentation of the OOP paradigm and its range of applications	2
Le_02	Presentation of the UML, its objectives and uses	2
Le_03	Platforms and object-oriented languages: Java (Android) and C# (.NET). Basics of C# language	2
Le_04	Encapsulation, inheritance, polymorphism, abstraction and their use in C#	2
Le_05	Exception handling	2
Le_06	Threads in C#. Data exchange between the application and the outside world via the serial port	2
Le_07	The use of objects representing network connections	2
Le_08	The exchange of data between the components of the system - serialization	2
Le_09	Data storage and access in SQL	2
Le_10	Design patterns	2
Le_11	The views and containers in a portable GUI design	2
Le_12	The design of the sensors and actuators system - the description in UML	2
Le_13	Example implementation of object-oriented sensor system in C#	2
Le_14	Example implementation of object-oriented sensor system in Java (Android)	2
Le_15	Final test	2
	TOTAL	30

Form of classes - Project		Quantity
Pr_01	Development of a UML model of a selected topic. Presentation of UML charts and discussion	10
Pr_02	Implementation of the project for the selected environment (. NET or Android)	20
	Total	30

TEACHING TOOLS USED

ND_01 The traditional lecture with presentations and discussion
ND_02 Consultation
ND_03 Self study - preparation of selected topics in the lecture
ND_04 The implementation of projects agreed with the lecturer and the presentation of the results of a sub-group linked to the discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Discussions and final test
P2 = F2 (project)	PEK_U01, PEK_U02, PEK_K01	Project implementation and reports

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Komatineni, Satya, Android 3 : tworzenie aplikacji, Helion, 2012
2. Kubik, Tomasz., UML and service description languages : information systems modelling, PRINTPAP, 2011
3. Lis, Marcin, C# : praktyczny kurs, Helion, 2012
4. Schildt, Herbert., Java : kompendium programisty, Helion, 2012

Secondary literature

1. Domka, Przemysław, Programowanie strukturalne i obiektowe, WSiP, 2010

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Object-Oriented Programming

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	S1ec_W02,S1ec_W09	C01	Le_01-Le_14	ND_01-ND_03
PEK_W02	InzA_W02	C01, C04	Le_01-Le_14	ND_01-ND_03
PEK_U01 (skills)	S1ec_U02,S1ec_U07	C03	Pr_01, Pr_02	ND_02, ND_04
PEK_U02	InzA_U02	C03, C04	Pr_01, Pr_02	ND_02, ND_04
PEK_K01 (competences)	K1eit_K03	C02	Pr_01, Pr_02	ND_04

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Programowanie układów logicznych**	
Name in English:	**Programming of logical circuits**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD006203**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Digital and Microprocessor Fundamentals I (ETD 2070) and II (ETD 3078), VLSI Design (ETD 5202)

SUBJECT OBJECTIVES

C01 Enlargement the knowledge about digital circuits design, VHDL language and FPGA programming techniques
C02 Preparing to conduct research in the field of the logical circuits

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Extensive knowledge of digital circuit design and FPGA programmable logic
PEK_W02 The student knows the basic methods, techniques and tools used in solving simple engineering problems from the studied field of study

Relating to skills

PEK_U01 Ability of coding in VHDL language and FPGA programming

PEK_U02	The student is able to design and implement a simple device, object or system, typical for the studied field of study, using appropriate methods, techniques and tools
<u>Relating to social competences</u>	
PEK_K01	Understanding the needs to use new techniques and technologies in engineering activities

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Introduction to FPGA technology	2
Le_02	Xilinx tools Xilinx Plan Ahead and IMPACT	2
Le_03	Sequential circuits analysis	2
Le_04	Communications of the digital system with a microprocessor	2
Le_05	Communication with A/D, D/A converters.	2
Le_06	Diagrams and coding hardware description language	2
Le_07	Low-power design	2
Le_08	Time analysis, problem of speed - area	2
Le_09	Dedicated architecture to neural calculation	2
Le_10	DSP architecture for calculation	2
Le_11	Introduction to Verilog	2
Le_12	Optimization of the synthesis process	2
Le_13	Verification by the pattern files	2
Le_14	Comparison of FPGA and ASIC techniques	2
Le_15	Examination	2
	TOTAL	30

Form of classes - Project		Quantity
Pr_01	Coding and synthesizing of sequential digital circuit	2
Pr_02	Programming of the FPGA device	2
Pr_03	Implementation of the SPI interface	2
Pr_04	A/D converter utilization	2
Pr_05	LCD display utilization	2
Pr_06	Modules integration - digital voltmeter	2
Pr_07	Individual project - architecture concepts	2
Pr_08	Individual project - coding	4
Pr_09	Individual project - verification	2
Pr_10	Individual project - synthesis	2
Pr_11	Individual project - optimization	2
Pr_12	Individual project - programming	2
Pr_13	Individual project - examination	2

Pr_14	Presentations of individual projects, discussion	2
	Total	30

TEACHING TOOLS USED
ND_01 Lecture with discussion ND_02 Computer laboratory ND_03 Individual work - preparation for test ND_04 Individual work - individual project

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Final test
P2 = F2 (project)	PEK_U01, PEK_U02, PEK_K01	Rating for individual project

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. M. Zwoliński, Projektowanie układów cyfrowych z wykorzystaniem języka VHDL, WKŁ, 2007

Secondary literature

1. Xilinx Design Suite – technical documentation, Xilinx, 2012
2. Standard no. 1076-1993 (VHDL), IEEE, 1993
3. Standard no. 1364-2001 (Verilog), IEEE, 2001

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Programming of logical circuits

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	S1ec_W04	C01	Le_01-Le_15	ND_01-ND_04
PEK_W02	InzA_W02	C01, C02	Le_01-Le_15	ND_01-ND_04
PEK_U01 (skills)	S1ec_U03, S1ec_U04	C01	Pr_01-Pr_14	ND_01-ND_04

PEK_U02	InzA_U08	C02, C03	Pr_01-Pr_14	ND_01-ND_04
PEK_K01 (competences)	K1eit_K02	C01, C02	Pr_01-Pr_14	ND_01-ND_04

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Protokoły i interfejsy**
Name in English:	**Protocols and interfaces**
Main field of studies:	**Electronics and Telecommunications**
Level and form of studies:	**I level / Full time**
Kind of subject:	**Obligatory / Faculty**
Subject code:	**ETD006204**
Group of courses:	**NO**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge transferred during computer networks course
2. Knowledge transferred during informatics course
3. Knowledge transferred during metrology course

SUBJECT OBJECTIVES

C01 Mastery of theoretical knowledge referred to in Se_01-Se_13
C02 The consolidation of ability to work independently and in a team project
C03 The consolidation of skills of the results presentation

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Has knowledge of wired and wireless communication protocols and interfaces

Relating to skills

PEK_U01 Able to select and configure a digital communication interface

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

Relating to social competences

PEK_K01 Able to formulate and present issues concerning the problems in the form of a multimedia presentation

PROGRAMME CONTENT

Form of classes - Seminar		Quantity
Se_01	Ethernet and WiFi interface, protocol TCP / IP, implementation	2
Se_02	UDP interface and protocol	1
Se_03	I2C interface and protocol	1
Se_04	JTAG interface and protocol	1
Se_05	GPiB interface and protocol	1
Se_06	USB interface and protocol	1
Se_07	One Wire interface and protocol	1
Se_08	CAN interface and protocol	1
Se_09	RS232 interface and protocol	1
Se_10	HDMI interface and protocol	1
Se_11	Fire Wire interface and protocol	1
Se_12	IDE/SCSI interface and protocol	1
Se_13	SATA interface and protocol	1
Se_14	Summary and course rating	1
	TOTAL	15

TEACHING TOOLS USED

ND_01 Self-study - study and preparation for seminar

ND_02 Self-study - multimedia presentation at the seminar

ND_03 Consultations

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (seminar)	PEK_W01, PEK_U01, PEK_U02, PEK_K01	Average rating of the multimedia presentation and discussion

PRIMARY AND SECONDARY LITERATURE
Primary literature 1. Andrew S. Tanenbaum, David J. Wetherall, Sieci komputerowe. Wydanie V, Helion, 2012 2. Michael Gook, Interfejsy sprzętowe komputerów PC, Helion, 2005 **Secondary literature** 1. Michał Klebanowski, Przetwarzanie sygnałów w praktyce, Wydawnictwo WKiŁ, 2009 2. Piotr Celiński, Interfejsy. Cyfrowe technologie w komunikowaniu - Piotr Celiński Interfejsy. Cyfrowe technologie w komunikowaniu, Wydawnictwo Uniwersytetu Wrocławskiego, 2010 3. Wojciech Mielczarek, USB. Uniwersalny interfejs szeregowy, Helion, 2005 4. Wojciech Mielczarek, Szeregowe interfejsy cyfrowe, Helion, 1994

SUBJECT SUPERVISOR
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Protocols and interfaces

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W17, K1eit_W18, K1eit_W30, S1ec_W10	C01	Se_01-Se_13	ND_01-ND_03
PEK_U01 (skills)	K1eit_U10, K1eit_U21, S1ec_U08	C01	Se_01-Se_13	ND_01-ND_03
PEK_U02	InzA_U07	C01	Se_01-Se_13	ND_01-ND_03
PEK_K01 (competences)	K1eit_K03, K1eit_K04	C02, C03	Se_01-Se_13	ND_01-ND_03

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Weryfikacja systemów cyfrowych**	
Name in English:	**Verification of digital systems**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD006205**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge transferred in the course: Computer Science or Introduction to Computer Science
2. Knowledge transferred in the courses: Fundamentals of Digital and Microprocessor Systems I and II
3. Knowledge transferred in the course: Scripting languages
4. Knowledge transferred in the course: VLSI Design

SUBJECT OBJECTIVES

C01 Mastery of theoretical knowledge specified in Le_01-Le_06
C02 Gaining practical skills through the project Pr_01
C03 The consolidation of skills of group work
C04 Preparing to conduct research in the field of digital technology

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge	
PEK_W01	He has expertise in the verification of digital systems and understand the methodology and application areas of program verification of digital systems
Relating to skills	
PEK_U01	Is able to select and properly use development tools for testing digital systems and design verification strategy and write a program for verification of digital systems
PEK_U02	The student is able to plan and carry out experiments, including measurements and computer simulations, interpret the acquired results and draw conclusions
Relating to social competences	
PEK_K01	Is able to interact and work in a project group, taking in various roles, set priorities during the project and understands the need to use modern tools for the verification of digital systems

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Digital systems, and the need for verification. Introduction	2
Le_02	The methodology of verification of digital systems	2
Le_03	The test environment; Verification components	2
Le_04	Interfaces, communication and encapsulation in a test environment	2
Le_05	Sequences and test stimulus	3
Le_06	Monitoring, reporting and analysis of results	3
Le_07	Final test	1
	TOTAL	15

Form of classes - Project		Quantity
Pr_01	Project of the selected digital system verification program	15
	Total	15

TEACHING TOOLS USED	
ND_01	Traditional lecture with multimedia presentations and discussion
ND_02	Consultation
ND_03	Self - preparation for the lecture selected issues
ND_04	Self - self-study and preparation for test
ND_05	Self - realization of the project

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01	Final test
P2 = F2 (project)	PEK_U01, PEK_U02, PEK_K01	Average rating of reports on the implementation of the project

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. R. Zurawski, Embedded Systems Handbook, CRC Press, 2009

Secondary literature

1. C. Spear, G. Tumbush, System Verilog for Verification, Springer, 2012
2. G.Nicolescu, P.J.Mosterman, Model-Based Design for Embedded Systems (Computational Analysis, Synthesis, and Design of Dynamic Systems), CRC Press, 2009

SUBJECT SUPERVISOR
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Verification of digital systems

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	S1ec_W07	C01	Le_01-Le_07	ND_01-ND_04
PEK_U01 (skills)	S1ec_U06	C02, C03	Pr_01	ND_02, ND_05
PEK_U02	InzA_U01	C02, C03	Pr_01	ND_02, ND_05
PEK_K01 (competences)	K1eit_K02, K1eit_K03	C02, C03	Pr_01	ND_01-ND_05

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Wbudowane systemy operacyjne**	
Name in English:	**Embedded operation systems**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD006206**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge one of the high level programing language
2. Knowledge of basic physics
3. Complete course Computer networks
4. Complete course Informatics

SUBJECT OBJECTIVES

C01 Presentation of mobile operating systems and devices utilizing mobile systems
C02 Acquiring of the skill in programing mobile devices, preparing system and programing own applications
C03 Practice of the team work skills
C04 Preparing to conduct research using new information technologies

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Have got knowledge about hardware and information technology needed during technical study, especially about operating systems, office applications, mathematic software, data bases and basic programing or microprocessor system architecture and its programing

PEK_W02	The student knows the typical engineering technologies in the area of studied field of study

Relating to skills

PEK_U01	Have got knowledge how to programing microprocessor, microsystem and evaluate its functional possibilities
PEK_U02	The student is able to use the analytical and simulation methods for solving engineering tasks

Relating to social competences

PEK_K01	Understand the needed of using new technics and technologies in engineering work and is able to define destinations and forecast results in experimental works also works alone and in team

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Graphics mobile operating systems (android, windows mobile, linux)	2
Le_02	FreeRTOS + QNX - parameters and applications	2
Le_03	Bootloader and preparing imx53 or beagleboard to start the system	2
Le_04	Linux (ubuntu) for imx53	2
Le_05	Linux using for home internet center, control devices, remote recording files etc.	2
Le_06	Android system for imx53	2
Le_07	Applications structure for Android system	2
Le_08	HID devices	2
Le_09	Real-time system (freeRTOS) inside, how to prepare own application	2
Le_10	FAT file system, partitions, data organisation in memory card	2
Le_11	MXQ RTOS: USB mass storage + FAT	3
Le_12	Internet embededd systems: TCP stack implementation, embededd HTTP server	3
Le_13	Security service	2
Le_14	Final exam	2
	TOTAL	15

Form of classes - Project		Quantity
Pr_01	Introduction	2
Pr_02	Preparing and installation of mobile system	8
Pr_03	Programing own applications for mobile system	18
Pr_04	Summary	2
	Total	30

TEACHING TOOLS USED

ND_01 Lecture with presentation and discussion
ND_02 Project: preparing reports
ND_03 Consultations
ND_04 Own work - preparing tasks to the lecture
ND_05 Own work - study and preparing to the project
ND_06 Own work - study and preparing to final exam

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Discussions, final exam
P2 = F2 (project)	PEK_U01, PEK_U02, PEK_K01	Marks average from tasks

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Abraham Silberschatz, Greg Gagne, Peter B. Galvin, Operating System Concepts, Wiley, 2011
2. Ed Lipiansky, Embedded Systems Hardware for Software Engineers, McGraw-Hill Professional, 2011
3. Robert Love, Linux Kernel Development (3rd Edition), Addison-Wesley Professional, 2010

Secondary literature

1. Micro Digital, Products, http://www.smxrtos.com, 2012
2. Texas Instruments, Processors, http://www.ti.com/lsds/ti/dsp/embedded_processor.page, 2012

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Embedded operation systems

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	S1ec_W09	C01	Wy_01-Wy_14	ND_01, ND_03, ND_04, ND_06
PEK_W02	InzA_W05	C01, C04	Wy_01-Wy_14	ND_01, ND_03, ND_04, ND_06
PEK_U01 (skills)	S1ec_U07	C02, C03, C04	Pr_01-Pr_04	ND_02, ND_03, ND_05
PEK_U02	InzA_U02	C02, C03	Pr_01-Pr_04	ND_02, ND_03, ND_05
PEK_K01 (competences)	K1eit_K02, K1eit_K03	C02, C03	Pr_01-Pr_04	ND_02, ND_03, ND_05

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Inżynieria produkcji**	
Name in English:	**Manufacturing Engineering**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD007068**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Introduction to Management
2. Protection of intellectual property
3. Ergonomics and safety

SUBJECT OBJECTIVES

C01 Acquainting students with the basics of manufacturing engineering, including the production organization and quality management

C02 Strengthening the skills of thinking and acting in an enterprising manner

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Contains basic knowledge on manufacturing engineering with particular emphasis on quality management and production organization

PEK_W02 The student has a basic knowledge concerning management, including the quality management, and running an economic activity

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Introduction to Manufacturing Engineering	3
Le_02	Production organization	3
Le_03	Quality management	3
Le_04	Statistical Methods of process control	3
Le_05	FMEA	3
Le_06	Six Sigma	3
Le_07	Taguchy method	3
Le_08	Design of Experiments	3
Le_09	ISO	3
Le_10	Test	3
	TOTAL	30

TEACHING TOOLS USED

ND_01 Traditional lecture with multimedia presentations and discussion
ND_02 Consultations
ND_03 Self work - preparation for the lecture of the given problems
ND_04 Self work - self-study and preparation for the final test

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

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

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Czesław Skowronek, Zdzisław Sariusz-Wolski, Logistyka w przedsiębiorstwie, Polskie Wydawnictwo Ekonomiczne, Warszawa, 2003
2. Dennis Lock, Podręcznik Zarządzania Jakością, Wydawnictwo Naukowe PWN, Warszawa, 2002
3. Marek Brzeziński (red), Organizacja i sterowanie produkcją; Projektowanie systemów i procesów sterowania produkcją, Agencja Wydawnicza PLACET, Warszawa, 2002

Secondary literature

1. L.M. Rumszycki, Matematyczne opracowanie wyników eksperymentu, Wydawnictwa Naukowo-Techniczne, Warszawa, 1973
2. Marvin A. Moss, Applying TQM to product design and development, Marcel Dekker, Inc., 1995
3. Phillip J. Ross, Taguchi Techniques for Quality Engineering, McGraw-Hill Book Company, 1988

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Manufacturing Engineering

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W25, K1eit_W27	C01, C02	Le_01- Le_10	ND_01-ND_04
PEK_W02	InzA_W04	C01, C02	Le_01- Le_10	ND_01-ND_04

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Praktyka zawodowa**	
Name in English:	**Student's practice**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD007069**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

No requirements

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

Relating to skills

PEK_U01 Have got knowledge how choose materials, parts and construction of devices for technical demands and utilization conditions
PEK_U02 Have got knowledge how to use safety instructions
PEK_U03 The student is able to see system and non-technical aspects of engineering tasks during their formulating and solving

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1	PEK_U1-PEK_U03, PEK_K01, PEK_K02	Opinion of the practice administrator

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Student's practice

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_U01 (skills)	K1eit_U01	C01, C02		
PEK_U02	K1eit_U09	C01, C02		
PEK_U03	InzA_U03	C01, C02		
PEK_K01 (competences)	K1eit_K03	C01, C02		
PEK_K02	K1eit_K06, InzA_K02	C01, C02		

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Technika laserowa**	
Name in English:	**Laser Technique**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD007101**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Physics 2
2. Mathematical analysis 2
3. The ability to self-education
4. Ability to work in a team

SUBJECT OBJECTIVES

C01 Acquiring skills for experimentation in the field of laser technology
C02 The ability to use elementary equipment used in laser technique
C03 Learning to self-interpretation of the results
C04 Introduction to some basic issues related to the fundamentals of laser technology
C05 Presentation of the basic types of lasers, their performance and applications
C06 Preparing to conduct research in the field of the laser technique

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge	
PEK_W01	He understands quantum mechanisms responsible for operation of lasers
PEK_W02	He knows the basic parameters of lasers, their types and their applications
Relating to skills	
PEK_U01	He can carry out experiments in the field of laser technology
PEK_U02	He is able to interpret the results
PEK_U03	The student is able to plan and carry out experiments, including measurements and computer simulations, interpret the acquired results and draw conclusions

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Parameters and properties of electromagnetic radiation	2
Le_02	Einstein theory of radiation	2
Le_03	Spectral lines and conditions for quantum amplification	2
Le_04	Gas lasers	2
Le_05	Solid state lasers	2
Le_06	Semiconductor lasers	2
Le_07	The other type of lasers	1
Le_08	Laser applications	2
	TOTAL	30

Form of classes - Laboratory		Quantity
La_01	Organizational meeting. The division into groups. Safety at work	2
La_02	Laser He-Ne, diffraction, transverse modes, laser beam properties	2
La_03	Semiconductor lasers. Basic parameters and characteristics	2
La_04	Michelson interferometer	2
La_05	Basic fiber elements	2
La_06	Acoustooptical Bragg modulator	2
La_07	Laser Adjustment	2
La_08	Analysis of longitudinal modes in He-Ne laser by scanned F-P interferometer	2
La_09	Microchip solid state laser	2
La_10	Laser vibrometry	2
La_11	Coherent detection, heterodyne of two lasers	2
La_12	Electro-optical modulator	2
La_13	Erbium Doped Fiber Amplifier EDFA	2
La_14	Compensatory term 1	2
La_15	Compensatory term 2	2
	Total	30

TEACHING TOOLS USED	
ND_01	Classroom (blackboard and chalk)
ND_02	Projector, computer with software (for example PowerPoint)
ND_03	Laboratory equipped into modern laser equipment
ND_04	Manuals for the laboratory experiments
ND_05	Discussing problems during the laboratory experiments
ND_06	Individual study of selected parts of the program
ND_07	Stand-alone work

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Final test
P2 = F2 (lab)	PEK_U01-PEK_U03	Partial evaluation for the implementation of laboratory experiments

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. B. Ziętek, Optoelektronika, Wydawnictwo Naukowe Uniwersytetu Mikołaja Kopernika, 2011
2. Franciszek Kaczmarek, Wstęp do fizyki laserów, PWN, 1978
3. Koichi Shimoda, Wstęp do fizyki laserów, PWN, 1993

Secondary literature

1. A. Kujawiński, P. Szczepański, Lasery. Fizyczne podstawy, Oficyna Wydawnicza Politechniki Warszawskiej, 1999
2. Z. Bielecki, A. Rogalski , Detekcja Sygnałów Optycznych, WNT, 2001

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Laser Technique

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	S1ief_W01	C04, C05	Le_01-Le_03	ND_01, ND_02, ND_06, ND_07
PEK_W02	S1ief_W01	C04, C05	Le_04-Le_08	ND_01, ND_02, ND_06, ND_07

PEK_U01 (skills)	S1ief_U03	C01-C03	La_02-La_13	ND_03-ND_06
PEK_U02	S1ief_U03	C01-C03	La_02-La_13	ND_03-ND_06
PEK_U03	InzA_U01	C01-C03, C06	La_02-La_13	ND_03-ND_06

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Zastosowanie technik multimedialnych**
Name in English:	**Application of Multimedia Techniques**
Main field of studies:	**Electronics and Telecommunications**
Level and form of studies:	**I level / Full time**
Kind of subject:	**Optional / Faculty**
Subject code:	**ETD007102**
Group of courses:	**NO**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge in information technology
2. Has full command of personal computer

SUBJECT OBJECTIVES

C01 Acquiring knowledge of methods used in creation of multimedia presentation
C02 Acquiring knowledge in the modern systems of interactive services operation and the hazards related it
C03 Acquiring skills in using multimedia techniques for didactic and technical tasks
C04 Consolidation of group work skills

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Has the knowledge of using various multimedia techniques to realization of didactical and technical tasks
PEK_W02 He knows the basic methods and multimedia techniques used for the realization of teaching and engineering tasks concerning the studied field of study

Relating to skills
PEK_U01 Can make a computer presentation using multimedia elements, also in foreign language, considered to be basic for a given field of study
Relating to social competences
PEK_K01 Is able to cooperate and work in a group taking different roles in it
PEK_K02 The student is aware of the importance and understands the non-technical aspects and results of engineering activity, including its impact on the environment, and the associated responsibility for made decisions

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Overview of multimedia techniques part 1	2
Le_02	Overview of multimedia techniques	2
Le_03	Functioning and safety roles in interactive services	2
Le_04	Methods and tools for 2D and 3D animation	2
Le_05	Application of the HTML/XHTML standards	2
Le_06	Principles of creating a coherent presentation	2
Le_07	Hazards related to work with a computer	2
Le_08	Test	1
	TOTAL	15

Form of classes - Project		Quantity
Pr_01	Introduction, Health and Safety rules, familiarization with equipment and software	3
Pr_02	Precise browsing for information in the Internet	3
Pr_03	Elaboration of draft presentation using HTML5 and XHTML	3
Pr_04	Creation of images draft for presentation with the shutter technique	3
Pr_05	Development of multimedia auto-presentation	3
	Total	15

TEACHING TOOLS USED

ND_01 Traditional lecture with presentations and discussion
ND_02 Own work of a student
ND_03 Consultations
ND_04 Report elaboration

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01, PEK_W02	Test in writing
P2 = F2 (project)	PEK_U01, PEK_K01, PEK_K02	Reports of design classes

PRIMARY AND SECONDARY LITERATURE
Primary literature 1. McGloughlin S., Multimedia: concepts and practice, Prentice Hall, Upper Saddle River, NJ, USA, 2001 2. Steinmetz R., Nahrstedt K., Multimedia systems, Series: X media publishing Springer, 2004 3. Tadeusiewicz R., Komputerowa analiza i przetwarzanie obrazów, Wydawnictwo Fundacji Postępu Telekomunikacji, Kraków, 1997 4. Wieczorkowska A., Multimedia. Podstawy teoretyczne i zastosowania praktyczne, PJWSTK, Warszawa, seria: Podręczniki akademickie, tom serii: 30, 2008 **Secondary literature** 1. Czyżewski A., Dźwięk cyfrowy, Oficyna Wydawnicza EXIT, Warszawa, 2001 2. Holzner S., Visual C++, Helion, Gliwice, 1998 3. Skarbek K., Multimedia - algorytmy i standardy kompresji, Akademicka Oficyna Wydawnicza, Warszawa, 1998

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Application of Multimedia Techniques

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	S1ief_W10	C01, C02	Le_01-Le_08	ND_01-ND_03
PEK_W02	InzA_W02	C01, C02	Le_01-Le_08	ND_01-ND_03
PEK_U01 (skills)	S1ief_U11	C03, C04	Pr_01-Pr_05	ND_02, ND_04
PEK_K01 (competences)	Slief K02	C03, C04	Pr_01-Pr_05	ND_04
PEK_K02	InzA_K01	C03, C04	Pr_01-Pr_05	ND_04

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Techniki bezprzewodowe**	
Name in English:	**Wireless Techniques**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Optional**	**/ Faculty**
Subject code:	**ETD007103**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basis knowledge of electromagnetic wave propagation in free space
2. Basis knowledge of modulation methods of analog and digital signals

SUBJECT OBJECTIVES

C01 Gaining the knowledge about fundamentals of data transmission in wireless systems
C02 Gaining the knowledge about types of systems and standards used in wireless communication systems
C03 Gaining the skill in practical designing and configuration of wireless data transmission in WPAN network with application of selected standards
C04 Gaining the skill in the field of designing and analysis of mobile communication systems
C05 Gaining the skill in work team
C06 Preparing to conduct research in the field of wireless systems

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Holding the knowledge in the field of development directions of telecommunication networks, knows technical and social conditions, is able to distinguish wireless systems according to selected criteria, holding the knowledge in the field of classification of radio waves used in wireless telecommunication systems, knows propagation mechanisms of radio waves, knows types and selection criteria of antennas, knows characteristics of standards used in WLAN and WPAN networks, holding the knowledge in the field of types of standards used in mobile communication systems, dispatch and tracking systems, as well as in the field of description of standards and architecture of mobile networks, knows architecture and application of satellite communication systems

Relating to skills

PEK_U01 Is able to run and analyze operation of wireless link connection built in selected standard of WPAN network, is able to design and analyze operation of radio connection link built in selected radio standard, is able to analyze of operation of mobile communication system

PEK_U02 He can - according to preset specifications - run and analyze the effect of a simple wireless device by using the proper techniques and tools

Relating to social competences

PEK_K01 Is able to work independent and in a team to realize entrusted work tasks

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Introduction. Rules. Course contents. History of development of wireless telecommunication systems. Classification of wireless data transmission systems.	2
Le_02	Radio waves - ranges and their description, mechanisms of radio waves propagation.	2
Le_03	Radio interface: parameters, types of antennas, characteristics.	2
Le_04	Local wireless networks: WLAN, WPAN, sensor networks.	2
Le_05	Cordless telephone systems: description, types of standards. Dispatch and tranking systems: description, types of standards	2
Le_06	Mobile communication systems: description, types of standards.	2
Le_07	Satellite systems: communication satellite, types of systems, applications, satellite positioning systems.	2
Le_08	Writing test	1
	TOTAL	15

Form of classes - Project		Quantity
Pr_01	Introduction. Rules. Course contents. Description of project tasks	3
Pr_02	Analysis of operation of radio interface in ZigBee standard	3
Pr_03	Analysis of operation of personal identification system in RFID standard	3
Pr_04	Designing and operation analysis of GSM mobile phone system - part 1	3
Pr_05	Designing and operation analysis of GSM mobile phone system - part 2	3
	Total	15

TEACHING TOOLS USED
ND_01 Lecture with multimedia presentation and discussion ND_02 Students own work: get ready for the lecture ND_03 Consultations ND_04 Students own work: elaboration of entrusted project task

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01	Writing test
P2 = F2 (project)	PEK_U01, PEK_U02	Elaboration of the own project

PRIMARY AND SECONDARY LITERATURE

<u>Primary literature</u>

1. B.A. Miller, C. Bisdikian, Uwolnij się od kabli, Helion, 2003
2. W. Holubowicz, P. Płóciennik, A. Rózanski, Systemy łączności bezprzewodowej, 1997
3. W. Hołubowicz, P. Płóciennik, Cyfrowe systemy telefonii komórkowej GSM900, GSM 1800, UMTS, 1998

<u>Secondary literature</u>

1. A. Engst, G. Fleishmann, Sieci bezprzewodowe: praktyczny przewodnik, Helion, 2005

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Wireless Techniques

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	S1ief_W07	C01, C02	Le_01-Le_07	ND_01-ND_03
PEK_U01 (skills)	S1ief_U09	C03, C04, C06	Pr_02-Pr_05	ND_04, ND_05
PEK_U02	InzA_U08	C03, C04, C06	Pr_02-Pr_05	ND_04, ND_05
PEK_K01 (competences)	K1eit_K03	C05	Pr_02-Pr_05	ND_01-ND_05

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Seminarium dyplomowe**	
Name in English:	**Diploma Seminar**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD007104**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Shortage of ECTS points not greater than resulting from resolution of the Faculty Council

SUBJECT OBJECTIVES

C01 Student acquires presentation skills of personal qualifications in the field of knowledge, learning and social competences

C02 Fixing of skills to work collectively

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 The student has well-ordered and theoretically established knowledge in the field that is demanded in Electonics and Telecommunication field of study and Electronic and Photonic Engineering specialization

Relating to skills

PEK_U01 The student is able to present personal qualifications in the range of knowledge, learning and social competences proper to Electonics and Telecommunication field of study and Electronic and Photonic Engineering specialization

Relating to competences

PEK_K01 The student is able to co-operate and work in group (collectively) accepting various roles in it

PEK_K02 The student is aware of the importance of engineering activities and understand its effects and impact on the environment and the associated responsibility for made decisions

PROGRAMME CONTENT

Form of classes - Seminar		Quantity
Se_01	Introduction to the seminar	1
Se_02	Thesis, final examination - general informations, regular requirements obligatory in Politechnika Wrocławska, the rules of technical and scientific texts creation	2
Se_03	Thesis - students discuss the subject matter and scope of expected research	3
Se_04	Multimedial presentation of CV done by every seminar participant	4
Se_05	Discussion of the exam questions	8
Se_06	Thesis - multimedial presentations of received results	6
Se_07	Thesis - short presentation prepared for the final examination	4
Se_08	Summary of the seminar and credition	2
	TOTAL	30

TEACHING TOOLS USED

ND_01 Presentation of selected issues concerning the thesis and discussion
ND_02 Personal work - preparation to multimedial presentation of assigned problems
ND_03 Personal work - individual studies and preparation to the final examination
ND_04 Consultations

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (seminar)	PEK_W01, PEK_K01, PEK_K02	Control of the activity during classes and participation in the discussion
F2	PEK_U01	Assessment of the presentations about the examination topics
F3	PEK_U01	Assessment of the presentations about the progresses in the diploma thesis
P1 (seminar) = 0,4*F1 + 0,4*F2 + 0,2*F3		

PRIMARY AND SECONDARY LITERATURE
Primary literature 1. Regulations governing higher education studies at Wrocław University of Technology 2. Notes from lectures 3. Scientific publications from the field of the realised diploma thesis

SUBJECT SUPERVISOR
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Diploma Seminar

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W01-K1eit_W30, S1ief_W01-S1ief_W10	C01	Se_02-Se_07	ND_01, ND_02, ND_04
PEK_U01 (skills)	K1eit_U01-K1eit_U22, S1ief_U01-S1ief_U15	C01, C02	Se_02-Se_07	ND_01, ND_02, ND_04
PEK_K01 (competences)	K1eit_K03	C02	Se_02-Se_07	ND_01-ND_03
PEK_K02	InzA_K01	C02	Se_02-Se_07	ND_01-ND_03

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Praca dyplomowa**
Name in English:	**Diploma thesis**
Main field of studies:	**Electronics and Telecommunications**
Level and form of studies:	**I level / Full time**
Kind of subject:	**Optional / Faculty**
Subject code:	**ETD007105**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				450	
Form of crediting				Z	
Number of ECTS points				15	
Including number of ECTS points for practical (P) classes				15	
Including number of ECTS points for direct teacher-student contact (BK) classes				10.5	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

C01 Conduct by the student thesis on the basis of the acquired while studying structured, underpinned by the theory of general and detailed knowledge with a range of science and technical areas relevant to the field of technical studies

C02 Writing by a student "thesis" (as work) and to present an oral presentation concerning the issues of the scope of the study Electronics and Telecommunications, on the basis of the information from the literature and the results of their own work

C03 Persisting the ability to work independently and in a team

C04 Participation in research in an area related to the areas of need for relevant to the field of study of Electronics and Telecommunications and specialization in Electronic and Photonic Engineering

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge	
PEK_W01	The student executed thesis, based on a knowledge obtained during studying in the field of the Electronics and Telecommunications and specialization in Electronic and Photonic Engineering
Relating to skills	
PEK_U01	Student can create technical texts ("thesis") and multimedia presentations, presenting the results of their research; to obtain and analyze information from the literature, databases, and other proper sources, in the field of the Electronics and Telecommunications and specialization in Electronic and Photonic Engineering
Relating to social competences	
PEK_K01	Student can work independently and interact in a group, taking different roles

PROGRAMME CONTENT		
Form of classes - Project		Quantity
Pr_01	Collecting the literature of the subject and to become acquainted with it	
Pr_02	Own work – critical assessment and interpretation of laboratory results	
Pr_03	Writing a thesis as a works	
	Total	

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	Checking up the thesis realization degree
F2	PEK_U01	Thesis review
F3	PEK_K01	Checking up the successive research aims achievement realized personally and in co-operation with research groups
P = 0,4*F1 + 0,4*F2 + 0,2*F3		

PRIMARY AND SECONDARY LITERATURE
Primary literature
1. Specialist subject literature agreed with the promoter

SUBJECT SUPERVISOR
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Diploma thesis

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W01-K1eit_W30, S1ief_W01-S1ief_W10	C01, C04	Pr_01	ND_01, ND_02, ND_04
PEK_U01 (skills)	K1eit_U01-K1eit_U22, S1ief_U01-S1ief_U15	C02, C04	Pr_02, Pr_03	ND_01, ND_02, ND_04
PEK_K01 (competences)	K1eit_K03	C03	Pr_01- Pr_03	ND_01-ND_03

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Procesory osadzone**	
Name in English:	**Embedded processors**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD007211**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of Digital and Microprocessor I (ETD 2070) and II (ETD 3078)
2. VLSI design (ETD 5202)

SUBJECT OBJECTIVES

C01 Introduction of students to the ARM devices programming basics
C02 Obtain knowledge about communication between processors and peripherals
C03 Preparing to conduct research in the field of programming of the processors

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Knowledge about ARM processors architecture and embedded systems

Relating to skills

PEK_U01 Programming ARM processors skills

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

Relating to social competences

PEK_K01 Understanding problems of collaborative programming

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	ARM processors architecture	2
Le_02	Programming tools	2
Le_03	Commands list	2
Le_04	The interrupt system	2
Le_05	Periphery - ports	2
Le_06	Periphery - counters and timers	2
Le_07	Periphery - communication interfaces	2
Le_08	Pipelining	2
Le_09	Programming styles (1) - loops and interrupts	2
Le_10	Programming styles (2) - Threads	2
Le_11	Team programming problems	2
Le_12	JTAG interface	2
Le_13	AMBA bus	2
Le_14	Overview of processors	2
Le_15	Final test	2
	TOTAL	30

Form of classes - Laboratory		Quantity
La_01	Introduction	2
La_02	Ports programming, loops	2
La_03	Counters programming and PWM	2
La_04	Interrupts	2
La_05	Serial interfaces programming	2
La_06	Teamwork - coding	2
La_07	Teamwork - starting	2
La_08	Assessment of the team project	1
	Total	15

TEACHING TOOLS USED
ND_01 Lecture with discussion ND_02 Individual work - reading and preparation for test ND_03 Computer laboratory ND_04 Individual work - a project with a small group

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01	Final test
P2 = F2 (lab)	PEK_U01, PEK_U02, PEK_K01	Evaluation of the project and the implementation of the program of the

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. S. Furber, ARM System-on-Chip Architecture, Addison-Wesley Professional, 2000

Secondary literature

1. S. Furber , ARM System Architecture, Addison-Wesley Longman, 1996

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Embedded processors

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	S1ec_W03, S1ec_W10	C01	Le_01- Le_15	ND_01, ND_03, ND_04
PEK_U01 (skills)	S1ec_U05, S1ec_U10	C02	La_01-La_08	ND_01, ND_03, ND_04
PEK_U02	InzA_U07	C02, C03	La_01-La_08	ND_01, ND_03, ND_04
PEK_K01 (competences)	K1eit_K03	C02	La_01-La_08	ND_01, ND_04

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Systemy bezprzewodowe**	
Name in English:	**Wireless systems**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD007212**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basis knowledge of electromagnetic wave propagation in free space
2. Basis knowledge of modulation methods of analog and digital signals

SUBJECT OBJECTIVES

C01 Gaining the knowledge about data transmission methods in modern wireless systems and about types of standards used in wireless communication systems

C02 Gaining the skill in practical configuration of wireless data transmission in selected WPAN networks standards and gaining the skill in designing and analysis of functioning of selected wireless links

C03 Preparing to conduct research in the field of wireless systems

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Holding the knowledge in the field of development directions of telecommunication networks, knows technical and social conditions, is able to distinguish wireless systems according to selected criteria, holding the knowledge in the field of classification of radio waves used in wireless telecommunication systems, knows propagation mechanisms of radio waves, knows characteristics of typical standards used in WPAN, WiMax, WLAN, sensor networks (802.15.4 family) and GSM systems

Relating to skills

PEK_U01 Is able to run and analyse operation of wireless link connection built in selected standard of WPAN network, is able to design and analyse operation of radio connection link built in selected radio standard

PEK_U02 He can - according to preset specifications - run and analyze the effect of a simple wireless device by using the proper techniques and tools

Relating to social competences

PEK_K01 Is able to work independent and in a team to realize entrusted work tasks, understands the need for application of modern wireless technology in engineering

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Introduction. Rules. Course contents. Classification of modern wireless telecommunication systems	2
Le_02	Classification of radio waves ranges and their description. Mechanisms of radio waves propagation	2
Le_03	WPAN and sensor systems	2
Le_04	WLAN 802.11.x network systems	2
Le_05	WiMAX network systems	2
Le_06	GSM telecommunication systems	2
Le_07	Data transmission in wireless networks	2
Le_08	Writing test	1
	TOTAL	15

Form of classes - Project		Quantity
Pr_01	Introduction. Rules. Course contents. Description of project tasks	3
Pr_02	Setup and operation analysis of wireless link connection in 802.15.4 standard	3
Pr_03	Designing and operation analysis in selected WPAN system	3
Pr_04	Designing and operation analysis of GSM mobile phone system - part 1	3
Pr_05	Designing and operation analysis of GSM mobile phone system - part 2	3
	Total	15

TEACHING TOOLS USED

ND_01 Lecture with multimedia presentation and discussion
ND_02 Students own work: get ready for the lecture
ND_03 Consultations
ND_04 Students own work: elaboration of entrusted project task

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01	Positive mark from writing test
P2 = F2 (project)	PEK_U01, PEK_K01	Positive mark for elaborated project

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Andrzej Grzywak, Maciej Rostański, Piotr Pikiewicz, Sieci bezprzewodowe, Wyższa Szkoła Biznesu, 2009
2. I. P. Kurytnik, M. Karpiński, Bezprzewodowa transmisja informacji, PAK, 2008
3. Piotr Gajewski, Stanisław Wszelak, Technologie bezprzewodowe sieci teleinformatycznych, WKiŁ, 2008

Secondary literature

1. A. Engst, G. Fleishmann, Sieci bezprzewodowe: praktyczny przewodnik, Helion, 2005
2. John Ross, Sieci bezprzewodowe, Helion, 2009
3. K. Sohraby, D. Minoli, T. Znati, Wireless sensor networks, Wiley, 2007

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Wireless systems

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	S1ec_W08	C01	Wy_01-Wy_07	ND_01-ND_03
PEK_U01 (skills)	S1ec_U08	C02	Pr_01-Pr_05	ND_03, ND_04
PEK_U02	InzA_U08	C02, C03	Pr_01-Pr_05	ND_03, ND_04
PEK_K01 (competences)	K1eit_K02	C02	Pr_01-Pr_05	ND_01-ND_04

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Praca dyplomowa**
Name in English:	**Diploma thesis**
Main field of studies:	**Electronics and Telecommunications**
Level and form of studies:	**I level / Full time**
Kind of subject:	**Optional / Faculty**
Subject code:	**ETD007214**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				450	
Form of crediting				Z	
Number of ECTS points				15	
Including number of ECTS points for practical (P) classes				15	
Including number of ECTS points for direct teacher-student contact (BK) classes				10.5	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

C01 Conduct by the student thesis on the basis of the acquired while studying structured, underpinned by the theory of general and detailed knowledge with a range of science and technical areas relevant to the field of technical studies

C02 Writing by a student "thesis" (as work) and to present an oral presentation concerning the issues of the scope of the study Electronics and Telecommunications, on the basis of the information from the literature and the results of their own work

C03 Persisting the ability to work independently and in a team

C04 Participation in research in an area related to the areas of need for relevant to the field of study of Electronics and Telecommunications and specialization in Digital Electronics

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 The student executed thesis, based on a knowledge obtained during studying in the field of the Electronics and Telecommunications and specialization in Digital Electronics

Relating to skills

PEK_U01 Student can create technical texts ("thesis") and multimedia presentations, presenting the results of their research; to obtain and analyze information from the literature, databases, and other proper sources, in the field of the Electronics and Telecommunications and specialization in Digital Electronics

Relating to social competences

PEK_K01 Student can work independently and interact in a group, taking different roles

PROGRAMME CONTENT

Form of classes - Project		Quantity
Pr_01	Collecting the literature of the subject and to become acquainted with it	
Pr_02	Own work – critical assessment and interpretation of laboratory results	
Pr_03	Writing a thesis as a works	
	Total	

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	Checking up the thesis realization degree
F2	PEK_U01	Thesis review
F3	PEK_K01	Checking up the successive research aims achievement realized personally and in co-operation with research groups
P = 0,4*F1 + 0,4*F2 + 0,2*F3		

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. Specialist subject literature agreed with the promoter

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Diploma thesis

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W01-K1eit_W30, S1ec_W01-S1ec_W10	C01, C04	Pr_01	ND_01, ND_02, ND_04
PEK_U01 (skills)	K1eit_U01-K1eit_U22, S1ec_U01-S1ec_U11	C02, C04	Pr_02, Pr_03	ND_01, ND_02, ND_04
PEK_K01 (competences)	K1eit_K03	C03	Pr_01- Pr_03	ND_01-ND_03

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Seminarium dyplomowe**	
Name in English:	**Diploma Seminar**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**ETD007215**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Shortage of ECTS points not greater than resulting from resolution of the Faculty Council

SUBJECT OBJECTIVES

C01 Student acquires presentation skills of personal qualifications in the field of knowledge, learning and social competences

C02 Fixing of skills to work collectively

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge	
PEK_W01	The student has well-ordered and theoretically established knowledge in the field that is demanded in Electonics and Telecommunication field of study and Digital Electronics specialization
Relating to skills	
PEK_U01	The student is able to present personal qualifications in the range of knowledge, learning and social competences proper to Electonics and Telecommunication field of study and Digital Electronics specialization
Relating to competences	
PEK_K01	The student is able to co-operate and work in group (collectively) accepting various roles in it
PEK_K02	The student is aware of the importance of engineering activities and understand its effects and impact on the environment and the associated responsibility for made decisions

PROGRAMME CONTENT

Form of classes - Seminar		Quantity
Se_01	Introduction to the seminar	1
Se_02	Thesis, final examination - general informations, regular requirements obligatory in Politechnika Wrocławska, the rules of technical and scientific texts creation	2
Se_03	Thesis - students discuss the subject matter and scope of expected research	3
Se_04	Multimedial presentation of CV done by every seminar participant	4
Se_05	Discussion of the exam questions	8
Se_06	Thesis - multimedial presentations of received results	6
Se_07	Thesis - short presentation prepared for the final examination	4
Se_08	Summary of the seminar and credition	2
	TOTAL	30

TEACHING TOOLS USED

ND_01 Presentation of selected issues concerning the thesis and discussion
ND_02 Personal work - preparation to multimedial presentation of assigned problems
ND_03 Personal work - individual studies and preparation to the final examination
ND_04 Consultations

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_K01, PEK_K02	Control of the activity during classes and participation in the discussion
F2	PEK_U01	Assessment of the presentations about the examination topics
F3	PEK_U01	Assessment of the presentations about the progresses in the diploma thesis
P = 0,4*F1 + 0,4*F2 + 0,2*F3		

PRIMARY AND SECONDARY LITERATURE
Primary literature 1. Regulations governing higher education studies at Wrocław University of Technology 2. Notes from lectures 3. Scientific publications from the field of the realised diploma thesis

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Diploma Seminar

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W01-K1eit_W30, S1ec_W01-S1ec_W10	C01	Se_02-Se_07	ND_01, ND_02, ND_04
PEK_U01 (skills)	K1eit_U01-K1eit_U22, S1ec_U01-S1ec_U11	C01, C02	Se_02-Se_07	ND_01, ND_02, ND_04
PEK_K01 (competences)	K1eit_K03	C02	Se_02-Se_07	ND_01-ND_03
PEK_K02	InzA_K01	C02	Se_02-Se_07	ND_01-ND_03

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Fizyka 1.1**	
Name in English:	**Physics 1.1**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**FZP001057**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	120	30			
Form of crediting	E	Z			
Number of ECTS points	4	1			
Including number of ECTS points for practical (P) classes	0	1			
Including number of ECTS points for direct teacher-student contact (BK) classes	2.4	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

No requirements

SUBJECT OBJECTIVES

C01 Acquisition of knowledge in physics, including selected sections of mechanics, harmonic vibrations and waves, electricity and magnetism and optics geometric and selected events in the field of wave optics and duality corpuscular-wave, including the knowledge necessary to understand the underlying physical phenomena occurring in parts and electronic circuits and their surroundings

C02 Gaining the skills of qualitative understanding, interpretation and quantitative analysis - based on the laws of physics - selected physical phenomena and processes of the above mentioned fields of physics, occurring in parts and electronic circuits and their surroundings

C03 Preparing students to conduct scientific research in which important aspect of the rights and physical phenomena

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge	
PEK_W01	Has ordered the knowledge of selected fields of physics: classical mechanics, harmonic motion and wave, electricity, electromagnetism, Maxwell's equations, geometric optics and wave and corpuscular-wave duality that allows you to understand the operation of electronic components and systems
PEK_W02	Knows the basic methods, techniques, tools and materials used in solving simple engineering tasks in the field of the studied field of study
Relating to skills	
PEK_U01	Can describe quantitatively and qualitatively physical phenomena occurring in the elements and the electronics in the field covered by the lecture material, using the basic laws of classical mechanics, wave motion, electromagnetism, electrical current, Maxwell's equations, the laws of geometrical optics and wave and corpuscular-wave theory
PEK_U02	Is able to solve elementary tasks of classical mechanics, wave motion, electricity, Maxwell's equations, wave and geometric optics with respect to the electronic components and systems
Relating to social competences	
PEK_K01	Is aware of and understands the validity of non-technical aspects and effects of engineering activities, including its impact on the environment, and the related responsibility for decisions

PROGRAMME CONTENT		
Form of classes - Lecture		Quantity
Le_01	Physical quantities scalar and vector. The definition of scalar and vector product. The derivative of the vector. Vector velocity and acceleration. The principles of conservation of momentum, energy and angular momentum	2
Le_02	One-dimensional simple harmonic motion. The equation of motion and its solution. Speed, acceleration and kinetic energy, potential and overall. The body on the spring	2
Le_03	DC. Ohm's Law, Kirchoff's law. Alternating current. Ohm's law for alternating current. LC circuit	2
Le_04	Damped harmonic motion. The equation of motion and its solution. Logarithmic decrement. Total energy. RLC circuit. Damped harmonic movement to a force. The equation of motion and its solution. RLC resonance system	2
Le_05	Mechanical waves and their types. Wave equation and parameters of the wave. Transport of energy by the wave. Interference of waves, standing waves. Sound wave. The intensity of the wave. The spectrum of sound waves and the decibel scale	2
Le_06	Scalar and vector field. Gradient, divergence, rotation	2
Le_07	Stream electric field. Gauss' law for the electric field. Metals, dielectrics, semiconductors. Magnetic flux. Gauss' law for magnetic field	2
Le_08	Faraday's law of induction. The current shift and Ampere's law - Maxwell. The Lorentz force and the Hall effect. Magnetic properties of matter (diagnosis and paramagnetics, ferromagnetic, hysteresis loop). Superconductors low - and high temperature	2
Le_09	Electromagnetic waves. Spectrum. They wave equation and the wave equation. The speed of electromagnetic wave in vacuum and in a medium of refractive index n	2
Le_10	The interaction of light with matter. Reflection, absorption and transmission of light. Composite index of refraction. Lambert-bouger. Optical density	2
Le_11	Rights of geometrical optics. Total internal reflection. The phenomenon of dispersion. Prism glass as a dispersion in mass spectrometers. The formation of the rainbow. Refraction on a spherical surface. Images created by reflection: mirror flat, concave and convex	2
Le_12	Thin lens focusing and scattering, thin lens system. Disadvantages of view and their correction. Optical instruments: magnifying glass, microscope, telescope	2

Le_13	The wave nature of light. Polarization of electromagnetic waves. Malus Law Interference of light. Young's experiment. Distribution of intensity in the spectrum of the interference of two and more slots. Light interference on thin layers	2
Le_14	Fresnel diffraction and Fraunhofer. Distribution of intensity of diffraction spectrum of a single slit. The diffraction grating as a dispersive element in mass spectrometers. Rayleigh criterion	2
Le_15	Rights blackbody radiation (CDC). Sources of heat as models CDC. Corpuscular theory of light. Planck law. Photoelectric external	2
	TOTAL	30

Form of classes - Classes		Quantity
Cl_01	Organizational matters. A solution for vector calculus and differential	2
Cl_02	Analysis and solving selected issues of harmonic oscillations	2
Cl_03	Analysis and solving selected issues of wave motion	2
Cl_04	Analysis and solving selected issues of electric current	2
Cl_05	Analysis and solving the analysis and solving the tasks of the force field (gradient, divergence, rotation) and in the field of Maxwell's equations	2
Cl_06	Analysis and solving of issues concerning the electromagnetic wave propagation	2
Cl_07	The analysis and problem solving in the field of geometrical optics	2
Cl_08	Final test	1
	Total	15

TEACHING TOOLS USED
ND_01 Traditional lecture with Power Point presentations ND_02 E-materials for the lecture posted on the Internet ND_03 Self - exam preparation ND_04 Consultation and contact us by email ND_05 Self - preparation for exercise and to test

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
F1 (lecture)	PEK_W01, PEK_K01	Activity on the lecture: oral answer and tests
F2	PEK_W01, PEK_K01	Exam
F3 (classes)	PEK_U01, PEK_U02, PEK_K01	Oral response, quizzes for each class
F4	PEK_U01, PEK_U02, PEK_K01	Test
P1 (lecture) = F2 taking into account the F1 (the maximum raising of the mark by 1)		
P2 (classes) = F3 or F4 (if 70% of the short tests was passed)		

PRIMARY AND SECONDARY LITERATURE
Primary literature 1. D. Halliday, R. Resnick, J. Walker, Podstawy fizyki, tom 1, 2,4-5, Wydawnictwo Naukowe PWN, Warszawa 2003 2. J. Walker, Podstawy fizyki. Zbiór zadań, PWN, Warszawa 2005 3. Materiały do wykładu (pliki PPT), dostępne w Internecie: www.if.pwr.wroc.pl\~popko **Secondary literature** 1. I.W. Sawieliew, Wykłady z fizyki, tom 1-3, Wydawnictwa Naukowe PWN, Warszawa, 2003 2. K. Sierański, K. Jezierski, B. Kołodka, Wzory i prawa z objaśnieniami, cz. 1. i 2., Oficyna Wydawnicza SCRIPTA, Wrocław 2005 3. K. Sierański, J. Szatkowski, Wzory i prawa z objaśnieniami, cz. 3., Oficyna Wydawnicza SCRIPTA, Wrocław 2008 4. K. Jezierski, B. Kołodka, K. Sierański, Zadania z rozwiązaniami, cz. 1., i 2., Oficyna Wydawnicza SCRIPTA, Wrocław 1999-2003

SUBJECT SUPERVISOR
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Physics 1.1

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W04	C01, C03	Le_01-Le_15	ND_01-ND_04
PEK_W02	InzA_W02	C01, C03	Le_01-Le_15	ND_01-ND_04
PEK_U01 (skills)	K1eit_U03, K1eit_U04	C01-C03	Le_01-Le_15, Cl_01-Cl_07	ND_01-ND_05
PEK_U02	K1eit_U03, K1eit_U04	C01-C03	Le_01-Le_15, Cl_01-Cl_07	ND_01-ND_05
PEK_K01 (competences)	InzA_K01	C01-C03	Le_01-Le_15	ND_01-ND_04

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Fizyka 3.1**
Name in English:	**Physics 3.1**
Main field of studies:	**Electronics and Telecommunications**
Level and form of studies:	**I level / Full time**
Kind of subject:	**Obligatory / Faculty**
Subject code:	**FZP002079**
Group of courses:	**NO**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Acquiring knowledge specified in K1eit_W01

SUBJECT OBJECTIVES

C01 Acquiring skills of making of simple experiment
C02 Develop skills of making of a written report from the measurements
C03 Develop skills of estimation of measurement uncertainty

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Knows methods for basic physical measurement
PEK_W02 Is familiar with the health and safety regulations in force in the laboratory introductory physics.
PEK_W03 Knows methods of preparing of a written report from the measurements and estimation of measurement uncertainty of simple and complex physical quantities

Relating to skills
PEK_U01 Can use simple measuring devices to measure physical quantities
PEK_U02 Is able to perform simple and complex measurements of physical quantities using the manual of the measurement system
PEK_U03 Knows how prepare the results of the measurements, analyze uncertainty in measurement and prepare a report with measurements made in LPF using computer tools (word processors, office suites, computing environments).
Relating to social competences
PEK_K01 Is able to work in a team
PEK_K02 Understands the need for self-assessment and self-education

PROGRAMME CONTENT		
Form of classes - Laboratory		Quantity
La_01	Lab Introduction to LPF: issues of organization and conduct of classes, to familiarize students with: a) the safety rules for measurements (short health and safety training), b) how to prepare writing reports, c) the basics of the measurement uncertainty analysis. Carrying out simple measurements	1
La_02	Determination of thermal expansion coefficients by electrical method. Measurements of selected physical quantities, preparation of written reports of carried out measurements	2
La_03	Investigation of Hall's Effect. Measurements of selected physical quantities, preparation of written reports of carried out measurements	2
La_04	Investigation of electromagnetic resonance in RLC circuit. Measurements of selected physical quantities, preparation of written reports of carried out measurements	2
La_05	Investigation of external photoelectric effect. Measurements of selected physical quantities, preparation of written reports of carried out measurements	2
La_06	Measurements of focal length of thin lenses. Measurements of selected physical quantities, preparation of written reports of carried out measurements	2
La_07	Measurements of the radius of curvature of the lenses made from glass by the use of interference effects (Newton's rings). Preparation of a written report from the measurements	2
La_08	Supplementary classes, crediting, repetitory	2
	TOTAL	15

TEACHING TOOLS USED
ND_01 Self-study - preparation for exercise
ND_02 Written tests before measurements
ND_03 Independent execution of the experiment
ND_04 Website laboratory Information on laboratory regulations, safety regulations, census exercise - exercise description, work instructions, sample reports, teaching aids
ND_05 Consultation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lab)	PEK_W01-PEK_W03, PEK_U01-PEK_U03, PEK_K01, PEK_K02	Oral answers, discussions, written tests

PRIMARY AND SECONDARY LITERATURE
Primary literature 1. Ćwiczenia Laboratoryjne z Fizyki, Tomy 1-4, Oficyna Wydawnicza Politechniki Wrocławskiej (dostępne wraz z instrukcjami roboczymi na stronie http://www.if.pwr.wroc.pl/lpf) 2. Opisy eksperymentów oraz instrukcje robocze dostępne na stronie http://www.if.pwr.wroc.pi/lpf **Secondary literature** 1. R R. A. Serway, Physics for Scientists and Engineers, 8th Ed., Brooks/Cole, Belmont 2009; Physics for Scientists and Engineers with Modern Physics, 8th Ed., Brooks/Cole, Belmont 2009. 2. Paul A. Tipler, Gene Mosca, Physics for Scientists and Engineers, Extended Version, W. H. Freeman 2007

SUBJECT SUPERVISOR
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Physics 1.1

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W20	C01, C03	La_01-La_08	ND_01-ND_05
PEK_W02	K1eit_W29	C01, C03	La_01-La_08	ND_01-ND_05
PEK_W03	K1eit_W20	C01, C03	La_01-La_08	ND_01-ND_05
PEK_U01 (skills)	K1eit_U04	C01, C02	La_01-La_08	ND_01-ND_05
PEK_U02	K1eit_U04	C01, C02	La_01-La_08	ND_01-ND_05
PEK_U03	K1eit_U13, K1eit_U19	C01, C02	La_01-La_08	ND_01-ND_05
PEK_K01 (competences)	K1eit_K03	C01-C03	La_01-La_08	ND_01-ND_05
PEK_K02	K1eit_K03	C01-C03	La_01-La_08	ND_01-ND_05

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Algebra z geometrią analityczną**	
Name in English:	**Algebra and Analytic Geometry**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**MAT001402**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Knows basic properties of complex numbers
PEK_W02 Knows basic algebraic properties of polynomials
PEK_W03 Knows basic concepts of theory of linear spaces and methods of description of lines, planes and conic sections
PEK_W04 Knows basic methods of solving systems of linear equations

Relating to skills

PEK_U01 Can carry out calculations with complex numbers
PEK_U02 Can add, multiply and divide polynomials
PEK_U03 Can find the equations of planes and lines in three dimensional space
PEK_U04 Can add and multiply matrices and calculate determinants
PEK_U05 Can solve systems of linear equations

PROGRAMME CONTENT

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

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

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

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

PRIMARY AND SECONDARY LITERATURE

Primary literature

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

Secondary literature

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

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Algebra and Analytic Geometry

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W03	C01	Le_01-Le_03, Le_014	ND_01, ND_03
PEK_W02	K1eit_W03	C02	Le_04, Le_05	ND_01, ND_03
PEK_W03	K1eit_W03	C03, C04	Le_06-Le_09, Le_015	ND_01, ND_03
PEK_W04	K1eit_W03	C05	Le_010-Le_013	ND_01, ND_03
PEK_U01 (skills)	K1eit_U02	C01	Cl_01, Cl_06, Cl_07	ND_01-ND_03
PEK_U02	K1eit_U02	C02	Cl_02	ND_01-ND_03
PEK_U03	K1eit_U02	C03, C04	Cl_03- Cl_05	ND_01-ND_03
PEK_U04	K1eit_U02	C05	Cl_06, Cl_07	ND_01-ND_03
PEK_U05	K1eit_U02	C05	Cl_06, Cl_07	ND_01-ND_03

Attachment no. 4 to ZW 33/2012

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Analiza Matematyczna 1.1 A**	
Name in English:	**Mathematical Analysis 1.1 A**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**MAT001412**	
Group of courses:	**NO**	

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

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

Relating to skills PEK_U01 Can examine graphs of simple functions PEK_U02 Can calculate integrals of simple functions **Relating to social competences** PEK_K01 Understand how calculus affects the development of technical civilization

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

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

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

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

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

PRIMARY AND SECONDARY LITERATURE

Primary literature

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

Secondary literature

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

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Mathematical Analysis 1.1 A

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W03	C01	Le_01-Le_15, Cl_01-Cl_15	ND_01-ND_03
PEK_W02	K1eit_W03	C02, C03	Le_11-Le_15, Cl_13-Cl_15	ND_01-ND_03
PEK_U01 (skills)	K1eit_U02	C01	Le_01-Le_15, Cl_01-Cl_15	ND_01-ND_03
PEK_U02	K1eit_U02	C01-C03	Le_01-Le_10, Le_15, Cl_01-Cl_10, Cl_15	ND_01-ND_03
PEK_K01 (competences)	K1eit_K01	C01, C02	Cl_06, Cl_07	ND_01-ND_03

Faculty of Microsystem Electronics and Photonics

SUBJECT CARD

Name in Polish:	**Analiza Matematyczna 2.2 A**	
Name in English:	**Mathematical Analysis 2.2 A**	
Main field of studies:	**Electronics and Telecommunications**	
Level and form of studies:	**I level**	**/ Full time**
Kind of subject:	**Obligatory**	**/ Faculty**
Subject code:	**MAT001424**	
Group of courses:	**NO**	

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	45	30			
Number of hours of total student workload (CNPS)	150	60			
Form of crediting	E	Z			
Number of ECTS points	5	2			
Including number of ECTS points for practical (P) classes	0	2			
Including number of ECTS points for direct teacher-student contact (BK) classes	3.0	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of differential and integral calculus of function of one variable

SUBJECT OBJECTIVES

C01 Knowledge of basic properties of infinite series and power series
C02 Understanding the basic concepts of differential calculus of several variables
C03 Understanding the basic concepts of integral calculus of functions of several variables
C04 Understanding the Laplace transform and Fourier transform

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge

PEK_W01 Know the basic criteria of convergence of infinite series
PEK_W02 Know the basic concepts of differential and integral calculus of functions of several variables
PEK_W03 Know the basic concepts of differential and integral calculus of functions of several variables

Relating to skills

PEK_U01	Can find power series of a function, knows how to use power series for approximations of functions
PEK_U02	Can compute the partial derivatives, directional and gradient functions of several variables and interpret the values, able to solve problems for the optimization of functions of several variables
PEK_U03	Is able to calculate and interpret the integral multiple, able to solve engineering problems using double and triple integrals
PEK_U04	Can calculate integral transforms from simple functions

Relating to social competences

PEK_K01	Understand the role played by Mathematical Analysis to analyze technical problems

PROGRAMME CONTENT

Form of classes - Lecture		Quantity
Le_01	Improper integrals. Cauchy principal value	4
Le_02	Infinite series. The basic criteria for convergence of series. Absolute and conditional convergence. Leibniz criterion	4
Le_03	Power series. The radius and interval of convergence. Cauchy theorem - Hadamard. Taylor Series	4
Le_04	Properties of the space Rn. Subsets of the space Rn. Functions of several variables	2
Le_05	Partial derivatives of the first order. Definition. Geometric interpretation. Higher order partial derivatives. Schwarz theorem	3
Le_06	The plane tangent to the graph of a function of two variables. Directional derivatives. Gradient of a function	2
Le_07	Local extremes of functions of two variables. Sufficient conditions for the existence of extreme. The smallest and the largest value of the function on the set. Examples of extremal problems in geometry and technology	3
Le_08	Conditional extremes conditional function of two variables. Applications. Examples of optimization problems	2
Le_09	Double integrals. The definition of the double integral. Geometric and physical interpretation. Calculation of double integrals normal regions	4
Le_10	Properties of double integrals. Jacobian function. Change of variables in double integrals. Double integral in polar coordinates	2
Le_11	Triple integrals. Reversal iterated integrals. Change of variables in cylindrical and spherical coordinates	2
Le_12	Applications of double and triple integrals in geometry and physics	2
Le_13	Laplace transform	4
Le_14	Inverse Laplace transform and its applications	3
Le_15	Introduction to the Fourier transform	4
	TOTAL	45

Form of classes - Classes		Quantity
Cl_01	Infinite series	2
Cl_02	Power series	2
Cl_03	The functions of two variables	2
Cl_04	Partial derivatives	2
Cl_05	Gradient. Tangent planes	2
Cl_06	Extremes of functions of two variables	2
Cl_07	Conditional Extremes	2

Cl_08	The study of functions of several variables - I	2
Cl_09	The study of functions of several variables - II	2
Cl_10	Double integrals	2
Cl_11	Triple integrals	2
Cl_12	Integrals of functions of several variables	2
Cl_13	Applications of multiple integrals	2
Cl_14	Laplace transform	2
Cl_15	Integral transforms	2
	Total	30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation	Educational effect number	Way of evaluating educational effect achievement
P1 = F1 (lecture)	PEK_W01-PEK_W03	Exam
P2 = F2 (classes)	PEK_U01-PEK_U04, PEK_K01	Colloquium during classes, oral answers

PRIMARY AND SECONDARY LITERATURE

Primary literature

1. F. Leja, Rachunek Różniczkowy i Całkowy, Wydawnictwo Naukowe PWN, 2012
2. R. Leitner, Zarys Matematyki Wyższej dla Studiów Technicznych, Cz. 1-2 WNT, Warszawa, 2006

Secondary literature

1. W. Krysicki, L. Włodarski, Analiza Matematyczna w Zadaniach, Cz. II, PWN, Warszawa 2006
2. G. M. Fichtenholz, Rachunek Różniczkowy i Całkowy, T. I-II, PWN, Warszawa 2007
3. M. Gewert, Z. Skoczylas, Analiza Matematyczna 1. Przykłady i Zadania, Oficyna Wydawnicza GiS, Wrocław 2011

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Mathematical Analysis 2.2 A

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Electronics and Telecommunications

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01 (knowledge)	K1eit_W03	C01	Le_01-Le_03, Cl_01, Cl_02	ND_01-ND_03
PEK_W02	K1eit_W03	C02, C03	Le_04-Le_12, Cl_03-Cl_13	ND_01-ND_03
PEK_W03	K1eit_W03	C04	Le_13-Le_15, Cl_14	ND_01-ND_03
PEK_U01 (skills)	K1eit_U02	C01	Le_01-Le_03, Cl_01, Cl_02	ND_01-ND_03
PEK_U02	K1eit_U02	C02	Le_05-Le_08, Cl_03-Cl_09	ND_01-ND_03
PEK_U03	K1eit_U02	C03	Le_09-Le_12, Cl_10-Cl_13	ND_01-ND_03
PEK_U04	K1eit_U02	C04	Le_13-Le_15, Cl_14, Cl_15	ND_01-ND_03
PEK_K01 (competences)	K1eit_K01	C01-C04	Le_01-Le_15, Cl_01-Cl_15	ND_01-ND_03