PROGRAM OF STUDIES

FACULTY: INFORMATION AND COMMUNICATION TECHNOLOGY
MAIN FIELD OF STUDY: **Applied Computer Science**
BRANCH OF SCIENCE: **Dziedzina nauk inżynieryjno-technicznych**
DISCIPLINES: D1 **Informatyka techniczna i telekomunikacja** (major discipline)
D2* ……...
D3* ……
D4* ……

EDUCATION LEVEL: first-level (~~licencjat~~/inżynier) studies / ~~second-level studies~~ / ~~magister uniform studies~~*
FORM OF STUDIES: full-time studies / ~~part-time studies~~*
PROFILE: general academic / ~~practical~~ *
LANGUAGE OF STUDY: **English/Polish**

Content:

Resolution no. … of the Senate of Wroclaw University of Science and Technology

In effect since 2022/23

*delete as applicable

Zał. Nr 2 do ZW 16/2020

Attachment no. 1. to the Program of Studies

ASSUMED LEARNING OUTCOMES

FACULTY: **Information and Communication Technology**

MAIN FIELD OF STUDY: **Applied Computer Science**

EDUCATION LEVEL: first-level (~~licencjat~~/inżynier) studies ~~/ second-level studies~~ / ~~magister uniform studies~~*

PROFILE: general academic / ~~practical~~ *

Location of the main-field-of study:

Branch of science: **Nauki inżynieryjno-techniczne**

Discipline / disciplines (for several disciplines, please indicate the major discipline)
Informatyka techniczna i telekomunikacja

Explanation of the markings:
P6U – universal first degree characteristics corresponding to education at the first-level studies - 6 PRK level *
P7U – universal first degree characteristics corresponding to education at the second-level studies - 7 PRK level *

P6S – second degree characteristics corresponding to education at the first-level studies - 6 PRK level *
P7S – second degree characteristics corresponding to education at the second-level studies - 7 PRK level *

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

* delete as applicable

Main field of study learning outcomes	Description of learning outcomes for the main-field-of study **Applied Computer Science** After completion of studies, the graduate: Faculty of Information and Communication Technology	Reference to PRK characteristics		
		Universal first degree characteristics (U)	Second degree characteristics typical for qualifications obtained in higher education (S)	
			Characteristics for qualifications on 6 / 7* levels of PRK	Characteristics for qualifications on 6 and 7 levels of PRK, enabling acquiring engineering competences
KNOWLEDGE (W)				
KINF_W01	Has basic general knowledge in the field of selected branches of mathematics: mathematical analysis, linear algebra and analytic geometry, mathematical logic, discrete mathematics, probability theory, and mathematical statistics, that form the theoretical foundations necessary to solve IT engineering problems	P6U_W	P6S_WG	
KINF W02	Has basic knowledge in the selected physics departments	P6U W	P6S WG	
KINF_W03	Knows and understands basic data structures, algorithms, and programming constructs and can implement them in various programming languages	P6U_W	P6S_WG	P6S_WG_inż
KINF_W04	He knows the basic programming paradigms and languages using these paradigms	P6U_W	P6S_WG	
KINF_W05	Has detailed knowledge of software lifecycle models and its processes as well as methodologies, good practices, notation, and support tools for software development	P6U_W	P6S_WG	P6S_WG_inż
KINF_W06	Has basic knowledge in the field of computer structure, organization and architecture	P6U_W	P6S_WG	P6S_WG_inż
KINF_W07	Has knowledge about programming various types of applications, e.g. mobile, web, database, or distributed	P6U_W	P6S_WG	P6S_WG_inż
KINF_W08	Has basic knowledge in the field of construction, operation and administration of operating systems	P6U_W	P6S_WG	P6S_WG_inż
KINF_W09	Has knowledge of computer networks, their architecture and the operation of selected network devices	P6U_W	P6S_WK	P6S_WG_inż
KINF_W10	Has basic knowledge in the field of IT systems security	P6U_W	P6S_WK	P6S_WG_inż

KINF_W11	Has knowledge of modeling different types of processes and knows the methods and techniques used in decision support systems	P6U_W	P6S_WK	P6S_WG_inż
KINF W12	Knows and understands the architecture of database systems and the basic methods and tools for collecting, processing and retrieving information as well as extracting knowledge from data	P6U W	P6S WK	P6S WG inż
KINF_W13	Has systematic knowledge in the field of artificial intelligence, in particular methods of representing and processing knowledge.			P6S_WG_inż
KINF W14	Has detailed knowledge of software and database design			P6S WG inż
KINF_W15	Has basic knowledge in the field of multimedia and multimedia systems			P6S_WG_inż
KINF_W16	He knows typical technologies and programming tools for software developments			P6S_WG_inż
KINF_W17	Has well-formed knowledge in the field of IT project management			P6S_WG_inż
KINF W18	He knows current IT development trends			
KINF_W19	Has basic knowledge of managing the business activities; knows the general principles of creating and running various sorts of individual entrepreneurship			P6S_WK_inż
KINF_W20	Has basic knowledge in the field of protection of intellectual property and patent law			
KINF_W21	Has basic knowledge of humanities that is necessary to understand the social and philosophical conditions of engineering activities			
KINF_W22	He knows and understands the fundamental problems facing modern civilization			
SKILLS (U)				
KINF_U01	Is able to construct and implement algorithms using basic algorithms and data structures	P6U_U	P6S_UW	P6S_UW_inż
KINF_U02	Can choose and evaluate the usefulness of a programming paradigm to a problem and build an application that uses this paradigm	P6U_U	P6S_UW	P6S_UW_inż
KINF_U03	Can describe requirements and design - using the selected modeling language - a general software architecture and a database schema	P6U_U	P6S_UW	P6S_UW_inż

KINF_U04	Is able to implement, in accordance with the design, software and database for simple, typical applications and verify the correctness of the solution.	P6U_U	P6S_UW	P6S_UW_inż
KINF_U05	He can design and build simple logic circuits	P6U_U	P6S_UW	P6S_UW_inż
KINF U06	Can apply an indicated analytical method and plan and conduct a simple engineering experiment or computer simulation; is able to carry out measurements and analyze their results, in particular of selected IT system components	P6U U	P6S UW	P6S UW inż
KINF_U07	He can configure basic devices and network software of computer networks	P6U_U	P6S_UW	P6S_UW_inż
KINF_U08	He can apply the specified security techniques for a given IT system	P6U_U	P6S_UW	P6S_UW_inż
KINF_U09	Is able to create and implement a schedule of works for developing a simple IT system and to pre-estimate the costs and time needed to implement this project.	P6U_U	P6S_UW	P6S_UW_inż
KINF_U10	Is able to formulate and solve complex and atypical problems and carry out tasks in conditions that are not fully predictable	P6U_U	P6S_UW	P6S_UW_inż
KINF_U11	Has the ability to program applications of various types, e.g. mobile, web and database	P6U_U	P6S_UW	P6S_UW_inż
KINF_U12	He can implement a simple multimedia product using carefully selected methods, techniques, and tools	P6U_U	P6S_UW	P6S_UW_inż
KINF_U13	He can apply selected technologies and programming tools	P6U U	P6S UW	P6S UW inż
KINF_U14	He has practical skills related to the administration of selected systems	P6U_U	P6S_UW	P6S_UW_inż
KINF_U15	Is able to describe and make a profound analysis of the functioning of existing IT solutions and evaluate these solutions	P6U_U	P6S_UW	P6S_UW_inż
KINF U16	Can acquire information from literature, databases and other sources, also in English, among others for the purposes of self-education and raising professional competences, can integrate the obtained information, interpret it, draw conclusions, formulate and justify opinions	P6U U	P6S UW	
KINF_U17	Is able to develop documentation on the implementation of an engineering task, prepare a text containing a discussion of achieved results and present a short presentation using	P6U_U	P6S_UW	

	advanced information and communication techniques on the results of this engineering task			
KINF_U18	He can communicate using specialized terminology; take part in discussions, present and evaluate different opinions and stands	P6U_U	P6S_UK	
KINF U19	Has language skills in the fields of science and scientific disciplines, relevant to the studied field of study, in accordance with the requirements set for the B2 level of the European System of Language Description	P6U U	P6S UK	
KINF_U20	Is able to plan and organize work both for an individual and for a team	P6U_U	P6S_UO	
KINF_U21	He can cooperate with other people as part of a team undertaking	P6U U	P6U UO	
KINF_U22	Has the ability to self-education, e.g. to improve his/her professional skills	P6U_U	P6S_UU	
SOCIAL COMPETENCES (K)				
KINF K01	Is ready to critically evaluate his/her knowledge and acquired information	P6U_K	P6U_KK	
KINF K02	He is conscious of knowledge significance in solving cognitive and practical problems; he recognises the need of consulting experts' opinions in case of difficulties with unassisted problem solving	P6U K	P6U KK	
KINF K03	He follows the rules of professional ethics and demands it from others; is ready to take on responsible professional roles	P6U_K	P6U_KR	
KINF K04	He is able to think and act in an entrepreneurial way, he is ready to take action for society and the public interest	P6U_K	P6U_KO	

*delete as applicable

Zał. nr 3 do ZW 16/2020

Attachment no. 2. to the Program of Studies

DESCRIPTION OF THE PROGRAM OF STUDIES

Main field of study: Applied Computer Science **Profile: general academic**

Level of studies: first-level **Form of studies: full-time studies**

1. General description

1.1 Number of semesters: **7**	*1.2 Total number of ECTS points necessary to complete studies at a given level:* **210**
1.3 Total number of hours: **2475**	*1.4 Prerequisites (particularly for second-level studies):* Qualification is based on the results of the matriculation exam, in accordance with the terms and recruitment procedure established for a given academic year
1.5 Upon completion of studies graduate obtains professional degree of: **INŻYNIER (ENGINEER)**	*1.6 Graduate profile, employability:* A graduate has qualifications including knowledge, skills and engineering competences in the following areas: • Computer architecture and organization and low-level programming of devices, such as elements of the Internet of Things (IoT). • Programming languages, algorithms and data structures, programming paradigms and effective programming techniques. • Computer networks, system administration and cybersecurity. • Databases and data warehouses including database design.

	• Software design and project management. • Advanced programming methods and tools, artificial intelligence and knowledge engineering, mobile applications and distributed systems. • Various aspects of multimedia • Trends in IT. The graduate also has knowledge of basic sciences: mathematical analysis, algebra with analytical geometry, logic, discrete mathematics, probability and statistics, and physics which are necessary to solve engineering problems and to continue studies at the second degree. An important supplement to the education is knowledge of the basics of entrepreneurship as well as social and professional problems of IT. In addition, the graduate knows English sufficiently to enable him or her to express freely, also in writing, on topics related to the work performed. Soft skills and the ability to work in a team are also important in educating IT engineers. Graduates of the first degree studies in Applied Computer Science may be employed in IT companies and IT departments of banks and financial institutions or enterprises in Wrocław, as well as throughout Poland and even abroad. Graduates are employed as software testers, programmers, designers, service technicians, system administrators and IT security specialists.
1.7 Possibility of continuing studies: Eligibility to apply for admission to second-cycle study programmes, non-degree postgraduate programmes.	*1.8 Indicate connection with University's mission and its development strategy:* The program of study in Applied Computer Science at the Faculty of Information and Communication Technology is consistent with the mission of Wrocław University of Science and Technology and its development strategy. The program provides the opportunity to acquire knowledge, skills, engineering competences and social competences necessary for a modern IT engineer. The mandatory courses and modules of elective courses offered as part of the study program

	meet the requirements of the Polish Qualifications Framework, and – on the other hand – they meet the dynamically changing needs of the social and economic environment. It is expressed, among others, through: • Participation of members of the Faculty Social Council in the work on the study program. • Participation of highly qualified specialists from outside the university in conducting didactic activities. • Offering student internships in companies or IT departments. Practical classes are held in specialized laboratories with modern computer equipment, dedicated apparatus and software, regularly modernized. Acting in accordance with the strategy of Wroclaw University of Science and Technology in the field of internationalization, the Faculty of Information and Communication Technology offers first-level studies in Applied Computer Science also in English for candidates from Poland and foreigners. Additionally, students can participate in international exchange programs (e.g. ERASMUS +).

2. Detailed description

2.1 Total number of learning outcomes in the program of study:

W (knowledge) = 22, U (skills) = 22, K (competences) = 4, W + U + K = 48

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

D1 (major) ..... (this number must be greater than half the total number of learning outcomes)
D2 .....
D3 .....
D4 .....

2.3 For the main field of study assigned to more than one discipline - percentage share of the number of ECTS points for each discipline:

D1 .....% ECTS points
D2 .....% ECTS points
D3 .....% ECTS points
D4 .....% ECTS points

2.4a. For the general academic profile of the main field of study – the number of ECTS points assigned to the classes related to the University's academic activity in the discipline or disciplines to which the main field of study is assigned – DN (must be greater than 50% of the total number of ECTS points from 1.2) 133

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

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

The study program is the result of close cooperation with the members of the Social Council of the Faculty of Information and Communication Technology. The Council includes representatives of the management of leading IT companies in the Lower Silesia. The assumed learning outcomes meet the current and prospective needs of the market. In particular, the outcomes meet needs for IT specialists of different companies (e-commerce, service, research) dealing with the maintenance/development of IT tools supporting their activities, developers of IT systems as well as companies designing, implementing and maintaining computer systems and networks.

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

126 ECTS

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

Number of ECTS points for obligatory subjects	**39**
Number of ECTS points for optional subjects	**0**
Total number of ECTS points	**39**

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

Number of ECTS points for obligatory subjects	**40**
Number of ECTS points for optional subjects	**43**
Total number of ECTS points	**83**

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

34 ECTS points

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

70 ECTS points

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

The educational process includes active participation in classes organized at the university: lectures, classes, exercises, laboratories, projects and seminars, as well as student's self-learning activities allowing for consolidation, supplementation and extension of knowledge. If necessary, the student can take advantage of individual consultations. The learning outcomes are further developed during mandatory student's internship.

4. List of education blocks:

4.1. List of obligatory blocks:

4.1.1 List of general education blocks

4.1.1.1 *Liberal-managerial subjects* block (*min.* 6 *ECTS points*):

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	ZMZ001643W	Basics of entrepreneurship	2					K1INF_W19	30	60	2		1,2	T	Z				KO
2.	SCZ001115S	Presentation Techniques					2	K1INF_U18	30	60	2		1,2	T	Z				KO
3.	INZ004440W	IT Social and Professional Problems	2					K1INF_W20 K1INF_W22	30	60	2		1,2	T	Z				KO
		Total	4				2		90	180	6		3,6						

4.1.1.4 *Information technologies* block (*min. 9 ECTS points*):

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	INZ004400Wc	Computer System Organization (GK)	2	1				K1INF_W06	45	90	3		1,8	T	Z (w)				PD
2.	INZ004399Wc	Structural and Object oriented Programming (GK)	2	2				K1INF_W03 K1INF_U01 K1INF_U02	60	120	4		2,4	T	Z (w)				PD
3.	INZ004399L	Structural and Object oriented Programming			2			K1INF_W03 K1INF_U01 K1INF_U02	30	60	2		1,2	T	Z			P (2)	PD
		Total	4	3	2				135	270	9		5,4					2	

Altogether for general education blocks

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
8	3	2		2	225	450	15		9

4.1.2 List of basic sciences blocks

4.1.2.1 *Mathematics* block

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	MAT001688Wc	Algebra and Analytic Geometry (GK)	2	2				K1INF_W01	60	180	6		3,6	T	E (w)	O			PD
2.	MAT001689Wc	Mathematical Analysis I (GK)	2	2				K1INF_W01	60	180	6		3,6	T	E (w)	O			PD
3.	MAT001690Wc	Mathematical Analysis II (GK)	2	1				K1INF_W01	45	150	5		3	T	E (w)	O			PD
4.	INZ004406Wc	Discrete Mathematics (GK)	2	2				K1INF_W01	60	150	5		3	T	Z (w)				PD
5.	INZ004410Wc	Theory of Probabilistic and Statistics (GK)	2	2				K1INF_W01	60	200	7		4,2	T	E (w)				PD
		Total	10	9					285	860	29		17,4						

4.1.2.2 *Physics* block

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	FZP001136Wc	General Physics I (GK)	2	1				K1INF_W02	45	120	4		2,4	T	Z (w)	O			PD
2.	FZP001137Wc	General Physics II (GK)	2	1				K1INF_W02	45	120	4		2,4	T	E (w)	O			PD
3.	FZP001137L	General Physics II			1			K1INF_W02	15	60	2		1,2	T	Z	O		P (2)	PD
		Total	4	2	1				105	300	10		6					2	

Altogether for basic sciences blocks:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
14	11	1			390	1160	39		23,4

4.1.3 List of the main field of study blocks

4.1.3.1 *Obligatory main field of study* blocks

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	INZ004402Wc	Logic for IT Specialists (GK)	2	2				K1INF_W01	60	150	5	5	3	T	E (w)		DN		K
2.	INZ004403L	Data Structures and Algorithms			2			K1INF_W03 K1INF_U01	30	60	2	2	1,2	T	Z		DN	P (2)	K
3.	INZ004403Wc	Data Structures and Algorithms (GK)	2	1				K1INF_W03 K1INF_U01	45	120	4	4	2,4	T	E (w)		DN		K
4.	INZ004404W	Computer Architecture	2					K1INF_W06 K1INF_U04 K1INF_U05	30	60	2	2	1,2	T	Z		DN		K
5.	INZ004404L	Computer Architecture			2			K1INF_W06 K1INF_U04 K1INF_U05	30	60	2	2	1,2	T	Z		DN	P (2)	K
6.	INZ004405W	Operating Systems	2					K1INF_W08 K1INF_U06	30	60	2	2	1,2	T	Z		DN		K
7.	INZ004405L	Operating Systems			2			K1INF_W08 K1INF_U06	30	60	2	2	1,2	T	Z		DN	P (2)	K
8.	INZ004407W	Computer Networks	3					K1INF_W09 K1INF_U07	45	110	4	4	2,4	T/Z	E		DN		K
9.	INZ004407L	Computer Networks			2			K1INF_W09 K1INF_U07	30	90	3	3	1,8	T	Z		DN	P (3)	K
10.	INZ004408W	Effective Programming Techniques	1					K1INF_W03 K1INF_U01	15	60	2	2	1,2	T/Z	Z		DN		K
11.	INZ004408L	Effective Programming Techniques			2			K1INF_W03 K1INF_U01	30	90	3	3	1,8	T	Z		DN	P (3)	K
12.	INZ004409L	Programming paradigms			2			K1INF_W04 K1INF_U02	30	60	2	2	1,2	T	Z		DN	P (2)	K
13.	INZ004409Wc	Programming paradigms (GK)	2	1				K1INF_W04 K1INF_U02	45	140	5	5	3	T/Z(w)	E(w)		DN		K
14.	INZ002023L	Data Bases			1			K1INF_W12 K1INF_U03 K1INF_U04	15	60	2	2	1,2	T	Z		DN	P (2)	K
15.	INZ002023Wc	Databases (GK)	2	1				K1INF_W12 K1INF_U03 K1INF_U04	45	115	4	4	2,4	T/Z(w)	E(w)		DN		K
16.	INZ002024L	Systems Analysis and Decision Support Methods			1			K1INF_W11 K1INF_U06	15	50	2	2	1,2	T	Z		DN	P (2)	K
17.	INZ002024Wc	Systems Analysis and Decision Support Methods (GK)	2	1				K1INF_W11 K1INF_U06	45	140	5	5	3	T/Z(w)	E(w)		DN		K
18.	INZ002027W	Introduction to IoT	2					K1INF_W09 K1INF_U04 K1INF_U07	30	60	2	2	1,2	T/Z	E		DN		K
19.	INZ002027L	Introduction to IoT			2			K1INF_W09 K1INF_U04 K1INF_U07	30	90	3	3	1,8	T	Z		DN	P (3)	K
20.	INZ004414L	Basics of Software Engineering			1			K1INF_W05 K1INF_U03	15	30	1	1	0,6	T	Z		DN	P (1)	K

21.	INZ004414Wc	Basics of Software Engineering (GK)	1	2				K1INF_W05 K1INF_U03	45	90	3	3	1,8	T/Z(w)	Z(w)		DN		K
22.	INZ004418W	Cybersecurity	2					K1INF_W10 K1INF_U08	30	90	3	3	1,8	T/Z	E		DN		K
23.	INZ004418L	Cybersecurity			2			K1INF_W10 K1INF_U08	30	60	2	2	1,2	T	Z		DN	P (2)	K
24.	INZ002025W	Script Languages	2					K1INF_W03 K1INF_U01	30	85	3	3	1,8	T/Z	E		DN		K
25.	INZ002025L	Script Languages			2			K1INF_W03 K1INF_U01	30	90	3	3	1,8	T	Z		DN	P (3)	K
26.	INZ004419W	Software Engineering	2					K1INF_W14 K1INF_U03 K1INF_U04 K1INF_U21	30	90	3	3	1,8	T/Z	E		DN		K
27.	INZ004419P	Software Engineering				2		K1INF_W14 K1INF_U03 K1INF_U04 K1INF_U21	30	90	3	3	1,8	T	Z		DN	P (3)	K
28.	INZ004427W	Artificial intelligence and knowledge engineering	2					K1INF_W13 K1INF_U06	30	60	2	2	1,2	T/Z	E		DN		K
29.	INZ004427L	Artificial intelligence and knowledge engineering			2			K1INF_W13 K1INF_U06	30	90	3	3	1,8	T	Z		DN	P (3)	K
30.	INZ002031W	Data Warehouses	2					K1INF_W12 K1INF_U06	30	60	2	2	1,2	T/Z	E		DN		K
31.	INZ002031L	Data Warehouses			2			K1INF_W12 K1INF_U06	30	60	2	2	1,2	T	Z			P (3)	K
		Total	31	8	25	2			990	2530	86	86	51,6					36	

Altogether (for main field of study blocks):

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
31	8	25	2		990	2530	86	86	51,6

4.2 List of optional blocks
4.2.1 List of general education blocks

4.2.1.1 Liberal-managerial subjects blocks: block M10 – Humanistic subject (*min. 2 ECTS points*):

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.		Humanities subject 1	2					K1INF_W21	30	90	2		1,2	T	Z	O			KO
2.		Humanities subject 2	2					K1INF_W21	30	90	2		1,2	T	Z	O			KO
		Total	2						30	90	2		1,2						

4.2.1.2 *Foreign languages* block (*min. 5 ECTS points*):

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	JZL100927BK	Foreign language A1/A2/ B1/ B2.1/ C1.1		4				K1INF_U19	30	60	2		1,2	T	Z	O			KO
2.	JZL100928BK	Foreign language B2.2/C1.2		4				K1INF_U19	60	90	3		1,8	T	Z	O			KO
		Total		8					120	150	5		3						

4.2.1.3 Sporting classes block (*0. ECTS points*):

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	WFW030000BK	Sports I		2					30	30	0		0	T	Z	O			KO
2.	WFW030000BK	Sports II		2					30	30	0		0	T	Z	O			KO
		Total		2					60	60									

Altogether for general education blocks:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
2	12				210	300	7		4,2

4.2.3 List of blocks

4.2.3.1 M1 block - **Administration of Computer Systems** (*min. 4 ECTS points*):

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	INZ004415Wl	Linux Server Administration (GK)	2		2			K1INF_W08 K1IN_U14	60	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
2.	INZ004468Wl	Managing IT infrastructure (GK)	2		2			K1INF_W08 K1IN_U14	60	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
3.	INZ002026Wl	Routing and Switching in Computer Networks (GK)	2		2			K1INF_W08 K1IN_U14	60	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
		Total	2		2				60	120	4	4	2,4					2	

4.2.3.2 M2 block – **Web Technologies** (*min. 4 ECTS points*):

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	INZ004420Wl	Web Systems Programming (GK)	2		2			K1INF_W07 K1INF_U11	60	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
2.	INZ002028Wl	Developing Web Applications with .NET (GK)	2		2			K1INF_W07 K1INF_U11	60	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
		Total	2		2				60	120	4	4	2,4					2	

4.2.3.3 M3 block - **Database Design** (*min. 4 ECTS points*):

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	INZ004470Wp	Database Programming (GK)	1			2		K1INF_W14 K1INF_U03 K1INF_U04	45	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
2.	INZ004424Wp	Database Design (GK)	1			2		K1INF_W14 K1INF_U03 K1INF_U04	45	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
		Total	1			2			45	120	4	4	2,4					2	

4.2.3.4 M4 block – **Mobile applications** (*min. 4 ECTS points*):

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	INZ002029Wl	Mobile Applications for Android (GK)	2		2			K1INF_W07 K1INF_U11	60	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
2.	INZ002030Wl	Mobile Applications for IOS (GK)	2		2			K1INF_W07 K1INF_U11	60	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
		Total	2		2				60	120	4	4	2,4					2	

4.2.3.5 M5 block – **Project Management Basics** (*min. 4 ECTS points*):

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	INZ002032Wls	Introduction to IT Project Management (GK)	1		2		1	K1INF_W17 K1INF_U09 K1INF_U16 K1INF_U18	60	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
2.	INZ002033Wls	Support for IT Project Management (GK)	1		2		1	K1INF_W17 K1INF_U09 K1INF_U16 K1INF_U18	60	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
		Total	1		2		1		60	120	4	4	2,4					2	

4.2.3.6 M6 block – **Distributed Systems** (*min. 4 ECTS points*):

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	INZ002035Wl	Distributed Computer Systems (GK)	2		2			K1INF_W07 K1INF_U11 K1INF_U16	60	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
2.	INZ004470Wl	Cloud programming (GK)	2		2			K1INF_W07 K1INF_U11 K1INF_U16	60	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
		Total	2		2				60	120	4	4	2,4					2	

4.2.3.7 M7 block – **Programming Tools and Technologies** (*min. 4 ECTS points*):

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	INZ004376Wl	Game Programming (GK)	2		2			K1INF_W16 K1INF_U13	60	110	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
2.	INZ004436Wl	Advanced Web Technologies (GK)	2		2			K1INF_W16 K1INF_U13	60	110	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
		Total	2		2				60	110	4	4	2,4					2	

4.2.3.8 M8 block – **Multimedia** (*min. 4 ECTS points*):

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	INZ004437Wl	Computer Graphics (GK)	2		2			K1INF_W15 K1INF_U12	60	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
2.	INZ004438Wl	Programming Multimedia Applications (GK)	2		2			K1INF_W15 K1INF_U12	60	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
3.	INZ004439Wl	Digital Media Processing Techniques (GK)	2		2			K1INF_W15 K1INF_U12	60	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
		Total	2		2				60	120	4	4	2,4					2	

4.2.3.9 M9 block – **Current trends in Computer Science** (*min. 5 ECTS points*):

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	INZ002040Wl	Data Science (GK)	2		2			K1INF_W18 K1INF_U10	60	120	5	5	3	T/Z(w)	Z (w)		DN	P (3)	K
2.	INZ002041Wl	Neural Networks (GK)	2		2			K1INF_W18 K1INF_U10	60	120	5	5	3	T/Z(w)	Z (w)		DN	P (3)	K
3.	INZ002042Wl	Metaheuristics in Problems Solving (GK)	2		2			K1INF_W18 K1INF_U10	60	120	5	5	3	T/Z(w)	Z (w)		DN	P (3)	K
4.	INZ002043Wl	Human–Computer Interaction (GK)	2		2			K1INF_W18 K1INF_U10	60	120	5	5	3	T/Z(w)	Z (w)		DN	P (3)	K
		Total	2		2				60	120	5	5	3					3	

4.2.3.10 Other elective courses/group of courses (*min. 25 ECTS points*):

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	INZ002017Ps	Team Project (GK)				8	1	K1INF_U10 K1INF_U17 K1INF_U20 K1INF_U21 K1INF_U22 K1INF_K01 K1INF_K02 K1INF_K03 K1INF_K04	135	600	20	10	12,6	T	Z		DN	P (19)	K
2.	INZ002044Q	Practical training							160	160	5	0	3		Z		DN	P (5)	K
		Total				8	1		135	760	26	10	15,6					24	

Altogether for blocks:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
16		18	10	2	660	1830 (including 160 of training)	63 (including 5 of training)	47	37,8 (including 3 of training)

4.3 Training block - concerning principles of training crediting – attachment no. 4

Opinion of the Faculty Council concerning the rules of crediting training block

Name of training			
Number of ECTS points	**Number of ECTS points for BU[1] classes**	**Training crediting mode**	**Code**
5	3	Z	

Training duration	Training objective
4 weeks	Getting familiar with the functioning of an IT company or IT department. Getting knowledge about the design, programming, testing or implementation of professional IT solutions as well as practical system administration (connection with one or more mandatory courses is necessary). Implementation of typical IT tasks required practical skills and social competences gained so far, with particular focus on group work.

5. Ways of verifying assumed learning outcomes

Type of classes	Ways of verifying assumed learning outcomes
lecture	Examination, progress/final test
class	progress/final test
laboratory	pretest, report from laboratory, assessment of a solution delivered by student during laboratory
project	project defence, project documentation
seminar	participation in discussion, topic presentation, essay
training	report from training

6. Range of diploma examination

1. Basic digital circuits: logic gates, switches, sequence circuits.
2. Binary arithmetic, Boolean functions, Karnaugh tables.
3. Rules of structural programming. Overview of structural statements.
4. Object-oriented programming – basic concepts and their applications.
5. Basic operations on sets, functions and relations. Propositional calculus. Predicate calculus.
6. Deterministic finite automata – definitions, applications.
7. Examples of computer architectures: von Neuman, Princeton, Harvard.
8. RISC and CISC processors – characteristics, differences.

9. Graphs. Spanning trees. Euler and Hamilton cycles. Cohesion. Graph traversal algorithms.
10. Algorithm – definition. Sorting algorithms. Search algorithms.
11. Basics of algorithm analysis. Computational complexity.
12. Layered structure of the operating system. The concept of system kernel.
13. The OSI layer model.
14. Data link layer protocols. Ethernet network. TCP/IP internet protocol stack.
15. Application layer protocols.
16. Effective programming techniques – examples.
17. Memory management. Common problems. Pointers.
18. Selection of programming paradigms for solving IT problems.
19. Functional programming and imperative programming.
20. Abstract data types and their implementation in programming languages.
21. Identification algorithms of static objects. Analytical and numerical optimization methods.
22. The specificity of the Internet of Things (IoT), application areas, solving problems resulting from a large number of devices, their distribution and a number of generated data.
23. Hardware solutions supporting communication and communication protocols used in embedded systems and IoT.
24. Database models. Relational database. Normalization. Transactions.
25. SQL language. Characteristics. Sub-languages.
26. Software life cycle models.
27. Software development methodologies.
28. The use of lists, sets and dictionaries in Python.
29. Differences and similarities between Java and Python.
30. Principles of parallel programming in Python.
31. UML as a project specification language. Diagrams and their application.
32. Architectural and design patterns – classification, examples, applications.
33. Data protection methods.
34. Basic cryptographic algorithms.
35. Multidimensional data modeling (transactional and analytical data systems, types of multidimensional OLAP structures).
36. ETL process.
37. MDX expressions and directives.
38. Methods of knowledge processing in expert systems.
39. Inference in non-monotonic logic – a planning task.

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

No.	*Course / group of courses code*	*Name of course / group of courses*	*Crediting by deadline of... (number of semester)*
1.	FZP001136Wc	General Physics I (GK)	5
2.	INZ004400Wc	Computer System Organization (GK)	3
3.	INZ004399Wc	Structural and Object oriented Programming (GK)	3
4.	INZ004399L	Structural and Object oriented Programming	3
5.	INZ004402Wc	Logic for IT Specialists (GK)	5
6.	MAT001688Wc	Algebra and Analytic Geometry (GK)	5
7.	MAT001689Wc	Mathematical Analysis I (GK)	5
8.	INZ004403L	Data Structures and Algorithms	6
9.	INZ004403Wc	Data Structures and Algorithms (GK)	6
10.	INZ004404W	Computer Architecture	6
11.	INZ004404L	Computer Architecture	6
12.	INZ004405W	Operating Systems	6
13.	INZ004405L	Operating Systems	6
14.	FZP001137L	General Physics II	5
15.	FZP001137Wc	General Physics II (GK)	5
16.	INZ004406Wc	Discrete Mathematics (GK)	5
17.	MAT001690Wc	Mathematical Analysis II (GK)	5
18.	ZMZ001643W	Basics of entrepreneurship	6
19.	INZ004407W	Computer Networks	6
20.	INZ004407L	Computer Networks	6
21.	INZ004408W	Effective Programming Techniques	6
22.	INZ004408L	Effective Programming Techniques	6
23.	INZ004409L	Programming paradigms	6
24.	INZ004409Wc	Programming paradigms (GK)	6
25.	INZ004410Wc	Theory of Probabilistic and Statistics (GK)	5
26.	JZL100927BK	Foreign language A1/A2/ B1/ B2.1/ C1.1	5
27.	WFW030000BK	Sports I	5
28.	INZ002023L	Databases	6
29.	INZ002023Wc	Databases (GK)	6
30.	INZ002024L	Systems Analysis and Decision Support Methods	6
31.	INZ002024Wc	Systems Analysis and Decision Support Methods (GK)	6

32.	INZ002027W	Introduction to IoT	6
33.	INZ002027L	Introduction to IoT	6
34.	INZ004414L	Basics of Software Engineering	5
35.	INZ004414Wc	Basics of Software Engineering (GK)	5
36.	JZL100928BK	Foreign language B2.2/C1.2	6
37.	WFW030000BK	Sports II	6
38.	SCZ001115S	Presentation Techniques	6
39.	INZ004418W	Cybersecurity	6
40.	INZ004418L	Cybersecurity	6
41.	INZ002025W	Script Languages	6
42.	INZ002025L	Script Languages	6
43.	INZ004419W	Software Engineering	6
44.	INZ004419P	Software Engineering	6
45.	INZ004427W	Artificial intelligence and knowledge engineering	6
46.	INZ004427L	Artificial intelligence and knowledge engineering	6
47.	INZ002031W	Data Warehouses	6
48.	INZ002031L	Data Warehouses	6
49.	INZ004440W	IT Social and Professional Problems	6

8. Plan of studies (attachment no. 4)

Approved by faculty student government legislative body:

11.04.2022r. ..... Date

SAMORZĄD STUDENCKI Wydziału Informatyki i Telekomunikacji

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

..... Date

..... Dean's signature

DZIEKAN Wydziału Informatyki i Telekomunikacji prof. dr hab. inż. Andrzej Kucharski (2)

*delete as appropriate

Zał. nr 4 do ZW 16/2020
Attachment no. 3 to Program of Studies

PLAN OF STUDIES

FACULTY: Information and Communication Technology

MAIN FIELD OF STUDY: Applied Computer Science

EDUCATION LEVEL: first-level (~~licencjat~~/inżynier) studies / ~~second-level studies~~ / ~~magister uniform studies~~*

FORM OF STUDIES: full-time studies / ~~part-time studies~~*

PROFILE: general academic /~~practical~~ *

SPECIALIZATION: not applicable

LANGUAGE OF STUDY: English/Polish

In effect since 2022/23

*delete as applicable

Plan of studies structure (optionally)

1) in point layout; *practical training after VI semester, 5 ECTS + 160 h CNPS added to the balance of semester VI, Mi – modules of optional courses; 1 course to choose*

28	CNPS	ECTS	CNPS	ECTS	CNPS	ECTS	CNPS	ECTS	CNPS	ECTS	CNPS	ECTS	CNPS	ECTS	
27	900	30	900	30	900	30	900	30	900	30	900	30	900	30	
26							Sports II 30 0								
25					Sports I 30 0				Presentation Tech.niques 60 2						
24	General Physics I 120 4 (2+2)		General Physics II 180 6 (3+1+2)				Foreign language B2.2/C1.2 90 3				**M8** – Multimedia 120 4 (2+2)				
23					Foreign language A1/A2/ B1/ B2.1/ C1.1 60 2										
22															
21	Computer System Organization 90 3 (2+1)														
20			Computer Architecture 120 4 (2+2)				**M1** – Administration of Computer 120 4 (2+2)		**M4** – Mobile Applications 120 4 (2+2)						
19					Basics of entrepreneurship 60 2						**M7** – Programming Tools and Technologies 110 4 (2+2)				
18									**M3** – Database design 120 4 (2+2)						
17	Structural and Object oriented Programming 180 6 (2+2+2)				Computer Networks 200 7 (4+3)								M10 – Humanistic subject 90 2		
16			Data Structures and Algorithms 180 6 (2+2+2)				Systems Analysis and Decision Support 190 7 (3+2+2)		**M2** – Web Technologies 120 4 (2+2)		**M6** – Distributed Systems 120 4 (2+2)				
15													**M9** – Current Trends in Computer Science 150 5 (2+3)		
14															
13															
12	Logics for IT Specialists 150 5 (3+2)				Effective Programming Techniques 150 5 (2+3)		Script Langugages 175 6 (3+3)		Cybersecurity 150 5 (3+2)		**M5** – Project Management Basics 120 4 (1+2+1)				
11			Operating Systems 120 4 (2+2)										Team Project 600 21 (19+2)		
10															
9					Programming Paradigms 200 7 (3+2+2)										
8	Algebra and Analytic Geometry 180 6 (3+3)						Databases 175 6 (2+2+2)		Introduction to IoT 150 5 (2+3)		Data Warehouses 120 4 (2+3)				
7			Discrete Mathematics 150 5 (2+3)												
6															
5															
4	Mathematical Analysis I 180 6 (3+3)				Theory of Probabilistic and Statistics 200 7 (4+3)		Basics of Software Engineering 120 4 (1+2+1)		Software Engineering 180 6 (3+3)		Artificial Intelligence and Knowledge Engineering 150 5 (2+3)				
3			Mathematical Analysis II 150 5 (3+2)												
2													IT Social and Prof. Problems 60 2		
1															
	I		II		III		IV		V		VI		VII		Total
	24/360		24/360		25/375		26/360		25/375		24/360		17/285		165/2475

2) in hourly layout

28	CNPS	ECTS	CNPS	ECTS	CNPS	ECTS	CNPS	ECTS	CNPS	ECTS	CNPS	ECTS	
27	900	30	900	30	900	30	900	30	900	30	900	30	
26							Sports II (2h)						
25					Sports I (2h)				Presentation Techniques (00002)				
24	General Physics I (21000)		General Physics II (21100 E)				Foreign language B2.2/C1.2 (4h)				**M8** - Multimedia (20200)		
23					Foreign language A1/A2/ B1/ B2.1/ C1.1 (4h)				**M4** – Mobile applications (20200)				
22													
21	Computer System Organization (21000)												
20			Computer Architecture (20200)				**M1** - Administration of Computer (20200)				**M7** – Programming Tools and Technologies (20200)		
19					Basics of entre-preneurship (20000)				**M3** - Database design (10020)				
18	Structural and Object oriented Programming (22200)												
17					Computer Networks (30200 E)								**M10** - Humanistic subject (2h)
16			Data Structures and Algorithms (21200 E)				Systems Analysis and Decision Support (21100 E)		**M2** – Web Technologies (20200)		**M6** – Distributed Systems (20200)		
15													**M9** - Current Trends in Computer Science (20200)
14													
13													
12	Logics for IT Specialists (22000 E)				Effective Programming Techniques (10200)		Script Languages (20200 E)		Cybersecurity (20200 E)		**M5** - Project Management Basics (10201)		
11			Operating Systems (20200)										Team Project (00081)
10													
9					Programming Paradigms (21200 E)								
8	Algebra and Analytic Geometry (22000 E)						Databases (21100 E)		Introduction to IoT (20200 E)		Data Warehouses (20200 E)		
7			Discrete Mathematics (22000)										
6													
5													
4	Mathematical Analysis I (22000 E)				Theory of Probabilistic and Statistics (22000 E)		Basics of Software Engineering (12100)		Software Engineering (20020 E)		Artificial Intelligence and Knowledge Engineering (20200 E)		
3			Mathematical Analysis II (21000 E)										
2													IT Social and Professio-nal Problems (20000)
1													
	I		II		III		IV		V		VI		VII	Total
	24/360		24/360		25/375		26/360		25/375		24/360		17/285	165/2475

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

Semester 1

Obligatory courses / groups of courses Number of ECTS points 30

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	INZ004399L	Structural and Object oriented Programming			2			K1INF_W03 K1INF_U01 K1INF_U02	30	60	2		1,2	T	Z			P (2)	PD
2.	INZ004400Wc	Computer System Organization (GK)	2	1				K1INF_W06	45	90	3		1,8	T	Z (w)				PD
3.	INZ004399Wc	Structural and Object oriented Programming (GK)	2	2				K1INF_W03 K1INF_U01 K1INF_U02	60	120	4		2,4	T	Z (w)				PD
4.	INZ004402Wc	Logic for IT Specialists (GK)	2	2				K1INF_W01	60	150	5	5	3	T	E (w)		DN		K
5.	FZP001136Wc	General Physics I (GK)	2	1				K1INF_W02	45	120	4		2,4	T	Z (w)	O			PD
6.	MAT001688Wc	Algebra and Analytic Geometry (GK)	2	2				K1INF_W01	60	180	6		3,6	T	E (w)	O			PD
7.	MAT001689Wc	Mathematical Analysis I (GK)	2	2				K1INF_W01	60	180	6		3,6	T	E (w)	O			PD
		Total	12	10	2				360	900	30	5	18					2	

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
12	10	2			360	900	30	5	18

Semester 2

Obligatory courses / groups of courses Number of ECTS points 30

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	INZ004403L	Data Structures and Algorithms			2			K1INF_W03 K1INF_U01	30	60	2	2	1,2	T	Z		DN	P (2)	K
2.	INZ004404W	Computer Architecture	2					K1INF_W06 K1INF_U04 K1INF_U05	30	60	2	2	1,2	T	Z		DN		K
3.	INZ004404L	Computer Architecture			2			K1INF_W06 K1INF_U04 K1INF_U05	30	60	2	2	1,2	T	Z		DN	P (2)	K
4.	FZP001137L	General Physics II			1			K1INF_W02	15	60	2		1,2	T	Z	O		P (2)	PD
5.	INZ004405W	Operating Systems	2					K1INF_W08 K1INF_U06	30	60	2	2	1,2	T	Z		DN		K
6.	INZ004405L	Operating Systems			2			K1INF_W08 K1INF_U06	30	60	2	2	1,2	T	Z		DN	P (2)	K
7.	INZ004403Wc	Data Structures and Algorithms (GK)	2	1				K1INF_W03 K1INF_U01	45	120	4	4	2,4	T	E (w)		DN		K
8.	FZP001137Wc	General Physics II (GK)	2	1				K1INF_W02	45	120	4		2,4	T	E (w)	O			PD
9.	INZ004406Wc	Discrete Mathematics (GK)	2	2				K1INF_W01	60	150	5		3	T	Z (w)				PD
10.	MAT001690Wc	Mathematical Analysis II (GK)	2	1				K1INF_W01	45	150	5		3	T	E (w)	O			PD
		Total																	

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
12	5	7			360	900	30	14	18

Semester 3

Obligatory courses / groups of courses Number of ECTS points 28

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	ZMZ001643W	Basics of entrepreneurship	2					K1INF_W19	30	60	2		1,2	T	Z				KO
2.	INZ004407W	Computer Networks	3					K1INF_W09 K1INF_U07	45	110	4	4	2,4	T/Z	E		DN		K
3.	INZ004407L	Computer Networks			2			K1INF_W09 K1INF_U07	30	90	3	3	1,8	T	Z		DN	P (3)	K
4.	INZ004408W	Effective Programming Techniques	1					K1INF_W03 K1INF_U01	15	60	2	2	1,2	T/Z	Z		DN		K
5.	INZ004408L	Effective Programming Techniques			2			K1INF_W03 K1INF_U01	30	90	3	3	1,8	T	Z		DN	P (3)	K
6.	INZ004409Wc	Programming paradigms			2			K1INF_W04 K1INF_U02	30	60	2	2	1,2	T	Z		DN	P (2)	K
7.	INZ004409L	Programming paradigms (GK)	2	1				K1INF_W04 K1INF_U02	45	140	5	5	3	T/Z(w)	E (w)		DN		K
8.	INZ004410Wc	Theory of Probabilistic and Statistics (GK)	2	2				K1INF_W01	60	200	7		4,2	T/Z(w)	E (w)				PD
		Total	10	3	6				285	810	28	19	16,8					8	

Optional courses / groups of courses (minimum 90 hours in semester, 2 ECTS points)

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	JZL100927BK	Foreign language A1/A2/ B1/ B2.1/ C1.1		4				K1INF_U19	60	60	2		1,2	T	Z	O			KO
2.	WFW030000BK	Sports I		2					30	30	0		0	T	Z	O			KO
		Total		6					90	90	2		1,2						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
10	7	6			375	900	30	19	18

Semester 4

Obligatory courses / groups of courses Number of ECTS points 23

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	INZ002023L	Data Bases			1			K1INF_W13 K1INF_U03 K1INF_U04	15	60	2	2	1,2	T	Z		DN	P (2)	K
2.	INZ002024L	Systems Analysis and Decision Support Methods			1			K1INF_W12 K1INF_U07	15	50	2	2	1,2	T	Z		DN	P (2)	K
3.	INZ002025W	Script Languages	2					K1INF_W03 K1INF_U01	30	85	3	3	1,8	T/Z	E		DN		K
4.	INZ002025L	Script Languages			2			K1INF_W03 K1INF_U01	30	90	3	3	1,8	T	Z		DN	P (3)	K
5.	INZ004414L	Basics of Software Engineering			1			K1INF_W06 K1INF_U03	15	30	1	1	0,6	T	Z		DN	P (1)	K
6.	INZ002023Wc	Data Bases (GK)	2	1				K1INF_W13 K1INF_U03 K1INF_U04	45	115	4	4	2,4	T/Z(w)	E(w)		DN		K
7.	INZ002024Wc	Systems Analysis and Decision Support Methods (GK)	2	1				K1INF_W12 K1INF_U07	45	140	5	5	3	T/Z(w)	E(w)		DN		K
8.	INZ004414Wc	Basics of Software Engineering (GK)	1	2				K1INF_W06 K1INF_U03	45	90	3	3	1,8	T/Z(w)	Z(w)		DN		K
		Total	7	4	5				240	660	23	23	13,8					8	

Optional courses / groups of courses (minimum 60 hours in semester, 3 ECTS points)

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	JZL100928BK	Foreign language B2.2/C1.2		4				K1INF_U17	60	90	3		1,8	T	Z	O			KO
2.	WFW030000BK	Sports II		2					30	30	0		0	T	Z	O			KO
		Total		6					90	120	3		1,8						

Optional M1 block - Administration of Computer Systems (minimum 60 hours in semester, 4 ECTS points, selection of 1 course)

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	INZ004415Wl	Linux Server Administration (GK)	2		2			K1INF_W08 K1IN_U14	60	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
2.	INZ004468Wl	Managing IT infrastructure (GK)	2		2			K1INF_W08 K1IN_U14	60	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
3.	INZ002026Wl	Routing and Switching in Computer Networks (GK)	2		2			K1INF_W08 K1IN_U14	60	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
		Total	2		2				60	120	4	4	2,4					2	

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
9	10	7			390	900	30	27	18

Semester 5

Obligatory courses / groups of courses Number of ECTS points 18

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	SCZ001115S	Presentation Techniques					2	K1INF_U18	30	60	2		1,2	T	Z				KO
2.	INZ004418W	Cybersecurity	2					K1INF_W10 K1INF_U08	30	90	3	3	1,8	T/Z	E		DN		K
3.	INZ004418L	Cybersecurity			2			K1INF_W10 K1INF_U08	30	60	2	2	1,2	T	Z		DN	P (2)	K
4.	INZ002027W	Introduction to IoT	2					K1INF_W09 K1INF_U04 K1INF_U07	30	60	2	2	1,2	T/Z	E		DN		K
5.	INZ002027L	Introduction to IoT			2			K1INF_W09 K1INF_U04 K1INF_U07	30	90	3	3	1,8	T	Z		DN	P (3)	K
6.	INZ004419W	Software Engineering	2					K1INF_W14 K1INF_U03 K1INF_U04 K1INF_U21	30	90	3	3	1,8	T/Z	E		DN		K
7.	INZ004419P	Software Engineering				2		K1INF_W14 K1INF_U03 K1INF_U04 K1INF_U21	30	90	3	3	1,8	T	Z		DN	P (3)	K
		Total	6		4	2	2		210	540	18	16	10,8					8	

Optional block M2 - Web Technologies (minimum 60 hours in semester, 4 ECTS points, selection of 1 course)

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	INZ004420Wl	Web Systems Programming (GK)	2		2			K1INF_W07 K1INF_U11	60	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
2.	INZ002028Wl	Developing Web Applications with .NET (GK)	2		2			K1INF_W07 K1INF_U11	60	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
		Total	2		2				60	120	4	4	2,4					2	

Optional block M3 - Database Design (minimum 45 hours in semester, 4 ECTS points, selection of 1 course)

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	INZ004470Wp	Database Programming (GK)	1			2		K1INF_W14 K1INF_U03 K1INF_U04	45	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
2.	INZ004424Wp	Database Design (GK)	1			2		K1INF_W14 K1INF_U03 K1INF_U04	45	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
		Total	1			2			45	120	4	4	2,4					2	

Optional block M4 - Mobile applications (minimum 60 hours in semester, 4 ECTS points, selection of 1 course)

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	INZ002029Wl	Mobile Applications for Android (GK)	2		2			K1INF_W07 K1INF_U11	60	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
2.	INZ002030Wl	Mobile Applications for IOS (GK)	2		2			K1INF_W07 K1INF_U11	60	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
		Total	2		2				60	120	4		4					2	

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
11		8	4	2	375	900	30	28	18

Semester 6

Obligatory courses / groups of courses Number of ECTS points 9

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	INZ004427W	Artificial intelligence and knowledge engineering	2					K1INF_W13 K1INF_U06	30	60	2	2	1,2	T/Z	E		DN		K
2.	INZ004427L	Artificial intelligence and knowledge engineering			2			K1INF_W13 K1INF_U06	30	90	3	3	1,8	T	Z		DN	P (3)	K
3.	INZ002031W	Data Warehouses	2					K1INF_W12 K1INF_U06	30	60	2	2	1,2	T/Z	E		DN		K
4.	INZ002031L	Data Warehouses			2			K1INF_W12 K1INF_U06	30	60	2	2	1,2	T	Z		DN	P (2)	K
5.	INZ002044Q	Practical training							0	160	5	0	0	T	Z			P(5)	K
		Total	4		4				120	430	14	9	5,4					10	

Optional block M5 - Project Management Basics (minimum 60 hours in semester, 4 ECTS points, selection of 1 course)

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	INZ002032Wls	Introduction to IT Project Management (GK)	1		2		1	K1INF_W17 K1INF_U09 K1INF_U16 K1INF_U18	60	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
2.	INZ002033Wls	Support for IT Project Management (GK)	1		2		1	K1INF_W17 K1INF_U09 K1INF_U16 K1INF_U18	60	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
		Total	1		2		1		60	120	4	4	2,4					2	

Optional block M6 - Distributed Systems (minimum 60 hours in semester, 4 ECTS points, selection of 1 course)

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	INZ002035Wl	Distributed Computer Systems (GK)	2		2			K1INF_W07 K1INF_U11 K1INF_U16	60	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
2.	INZ004470Wl	Cloud programming (GK)	2		2			K1INF_W07 K1INF_U11 K1INF_U16	60	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K

	Total	2		2				60	120	4	4	2,4					2	

Optional block M7 - Programming Tools and Technologies (minimum 60 hours in semester, 4 ECTS points, selection of 1 course)

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	INZ004376Wl	Game Programming (GK)	2		2			K1INF_W16 K1INF_U13	60	110	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
2.	INZ004436Wl	Advanced Web Technologies (GK)	2		2			K1INF_W16 K1INF_U13	60	110	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
		Total	2		2				60	110	4	4	2,4					2	

Optional block M8 - Multimedia (minimum 60 hours in semester, 4 ECTS points, selection of 1 course)

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	INZ004437Wl	Computer Graphics (GK)	2		2			K1INF_W15 K1INF_U12	60	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
2.	INZ004438Wl	Programming Multimedia Applications (GK)	2		2			K1INF_W15 K1INF_U12	60	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
3.	INZ004439Wl	Digital Media Processing Techniques (GK)	2		2			K1INF_W15 K1INF_U12	60	120	4	4	2,4	T/Z(w)	Z (w)		DN	P (2)	K
		Total	2		2				60	120	4	4	2,4				DN	2	

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	Cl	lab	pr	sem					
11		12		1	360	900 (including 160 of training)	30 (including 5 of training)	25	18 (including 3 of training)

Semester 7

Obligatory courses / groups of courses Number of ECTS points 22

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	INZ004440W	IT Social and Professional Problems	2					K1INF_W20 K1INF_W22	30	60	2		1,2	T	Z				KO
2.	INZ002039Ps	Team Project (GK)				8	1	K1INF_U10 K1INF_U17 K1INF_U20 K1INF_U21 K1INF_U22 K1INF_K01 K1INF_K02 K1INF_K03 K1INF_K04	135	600	21	10	12,6	T	Z		DN	P (19)	K
		Total	2			8	1		165	660	23	10	13,8						

Optional block M9 - Current trends in Computer (minimum 60 hours in semester, 5 ECTS points, selection of 1 course)

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.	INZ002040Wl	Data Science (GK)	2		2			K1INF_W18 K1INF_U10	60	150	5	5	3	T/Z(w)	Z (w)		DN	P (3)	K
2.	INZ002041Wl	Neural Networks (GK)	2		2			K1INF_W18 K1INF_U10	60	150	5	5	3	T/Z(w)	Z (w)		DN	P (3)	K
3.	INZ002042Wl	Metaheuristics in Problems Solving (GK)	2		2			K1INF_W18 K1INF_U10	60	150	5	5	3	T/Z(w)	Z (w)		DN	P (3)	K
4.	INZ002043Wl	Human–Computer Interaction (GK)	2		2			K1INF_W18 K1INF_U10	60	150	5	5	3	T/Z(w)	Z (w)		DN	P (3)	K
		Total	2		2				60	150	5	5	3					3	

Optional block M10 - Humanistic subject (minimum 30 hours in semester, 2 ECTS points, selection of 1 course)

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.		Humanities subject 1	2					K1INF_W22	30	90	2		1,2	T	Z	O			KO
2.		Humanities subject 2	2					K1INF_W22	30	90	2		1,2	T	Z	O			KO
		Total	2						30	90	2		1,2						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
6		2	8	1	255	900	30	15	18

3. Set of examinations in semestral arrangement

Course / group of courses code	Names of courses / groups of courses ending with examination	Semester
INZ004402Wc MAT001688Wc MAT001689Wc	1. Logic for IT Specialists 2. Algebra and Analytic Geometry 3. Mathematical Analysis I	1
INZ004403Wc MAT001690Wc FZP001137Wc	1. Data Structures and Algorithms 2. Mathematical Analysis II 3. General Physics II	2
INZ004407W INZ004409Wc INZ004410Wc	1. Computer Networks 2. Programming paradigms 3. Theory of Probabilistic and Statistics	3
INZ002024Wc INZ002023Wc INZ002025W	1. Systems Analysis and Decision Support Methods 2. Databases 3. Script Languages	4
INZ004418W INZ002027W INZ004419W	1. Cybersecurity 2. Introduction to IoT 3. Software Engineering	5
INZ004427W INZ002031W	1. Artificial intelligence and knowledge engineering 2. Data Warehouses	6

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

Semester	Allowable deficit of ECTS points after semester
1	8
2	8
3	8
4	8
5	8
6	0
7	0

Opinion of student government legislative body

11.04.2022 r. ..... SAMORZĄD STUDENCKI Wydziału Informatyki i Telekomunikacji .....

Date — Name and surname, signature of student representative

.... DZIEKAN Wydziału Informatyki i Telekomunikacji

Date — Dean's signature

prof. dr hab. inż. Andrzej Kucharski

(2)

Attachment no. 4 to Program of Studies

See Uchwała nr 28/3/2021-2024
Rady Wydziału Informatyki i Telekomunikacji
Politechniki Wrocławskiej
z dnia 9 lutego 2022 r.
w sprawie zaopiniowania zasad zaliczania studenckich praktyk zawodowych

FACULTY of Information and Communication Technology

SUBJECT CARD

Name in Polish: **Zaawansowane technologie webowe**
Name in English: **Advanced Web Technologies**
Main field of study (if applicable): **Applied Computer Science**
Specialization (if applicable):
Profile: practical
Level and form of studies: **1st, full-time**
Kind of subject: **optional**
Subject code **INZ004436**
Group of courses: **YES**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	50		60		
Form of crediting	Crediting with grade		Crediting with points		
For group of courses mark (X) final course	X				
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,2		1,2		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Ability to structured and object-oriented programming.
2. Basic database skills

SUBJECT OBJECTIVES

C1 The ability to develop advanced web applications using web frameworks

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01 Student could describe basic software components using by developing web systems

PEK_W02 Selects the appropriate technology for programming Web-based systems

relating to skills:

PEK_U01: Student is able to analyze and select the proper types and language constructs to support object-oriented programming paradigm on selected platform

PEK_U02: Student is able to implement a desktop application with the submitted requirements

PEK_U03: Student using information from various sources and is able to choose the right technology to implement an advance web application.

relating to social competences:

PEU_K01 Presents the results of their work

PROGRAMME CONTENT		
Form of classes – lecture		**Number of hours**
Lec1	An introduction to the course and the principles of assessment. Architecture of web services.	2
Lec2	Single Page application principles	2
Lec3	Design patterns (MVC, MVP, MVVM)	2
Lec4	Overview of programming languages and usage of AJAX	2
Lec5	Frameworks overview	2
Lec6	Frontend, backend communication (REST)	2
Lec7	Prototyping	2
Lec8	Object-relational mapping Tools	2
Lec9	Django framework and architecture	2
Lec10	Case study of framework and architecture (II part)	2
Lec11	Performance of web services	2
Lec12	Test of web services	2
Lec13	Prediction in web services	2
Lec14	Web mining	2
Lec15	Final test	2
	Total hours	**30**
Form of classes - laboratory		**Number of hours**
Lab 1	Introductory classes: presentation of health and safety regulations, fire protection rules as well as grading and class policies.	2
Lab 2	Define the functionality of web service Technology selection.	2
Lab 3	Presenting of developing environment	2
Lab 4	System design (UC Diagrams, DB Model, Mockups)	2
Lab 5	Web application - basic version	2
Lab 6	Web application applying data base	2
Lab 7	Web application - functionality part I	2

Lab 8	Web system with login ability	2
Lab 9	Web application - functionality part II	2
Lab 10	Web application - functionality part III	2
Lab 11	Web application - functionality part IV	2
Lab 12	Applying charts in web systems	2
Lab 13	Final application + test	2
Lab 14	Bugs + Final application	2
Lab 15	Credit	2
	Total number of hours	**30**

TEACHING TOOLS USED

N1. Multimedia lecture.
N2. Computer laboratory with development environment.
N3. An e-learning system used for the publication of teaching materials, tests and communication

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
FL – points from laboratory	PEK_U01 PEK_U02 PEK_U03 PEU_K01	Implementation of tasks indicated by the teacher. Scoring on scale (0-10). Positive grade determined by proportional ranges from 50% to 100% of total points.
P Lec	PEK_W01 PEK_W02	Solving tasks from test. Crediting: over 50% points for correct answers in the final test. Positive grade determined by proportional ranges from 50% to 100% of total points.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Scott, Emmit. *SPA design and architecture: understanding single page web applications*. Manning Publications Co., 2015.

[2] Ravindran, Arun. *Django Design Patterns and Best Practices: Industry-standard web development techniques and solutions using Python*. Packt Publishing Ltd, 2018.

[3] Souders, Steve. "High-performance web sites." *Communications of the ACM* 51.12 (2008):

[4] Crowder, Phillip, and David A. Crowder. *Creating web sites bible*. John Wiley & Sons, 2008.

SECONDARY LITERATURE:

[1] Ganeshan, Amuthan. *Spring MVC: Beginner's Guide*. Packt Publishing Ltd, 2016.
[2] Melé, Antonio. *Django 3 By Example: Build powerful and reliable Python web applications from scratch*. Packt Publishing Ltd, 2020.

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

Jolanta Wrzuszczak-Noga, jolanta.wrzuszczak-noga@pwr.edu.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Sztuczna Inteligencja i inżynierii wiedzy
Name of subject in English: Artificial Intelligence and Knowledge Engineering
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic / ~~practical~~*
Level and form of studies: 1st/ ~~2nd level~~, ~~uniform magister studies~~*, full-time / ~~part-time~~*
Kind of subject: obligatory / ~~optional / university-wide~~*
Subject code: INZ004427
Group of courses: ~~YES~~ / 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	Examination / ~~crediting with grade~~*	Examination / crediting with grade*	~~Examination~~ / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark (X) final course					
Number of ECTS points	2		3		
including number of ECTS points for practical classes (P)			3		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,2		1,8		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Programming skills (Java, C ++)
2. Ability to read scientific texts with comprehension, including in English

SUBJECT OBJECTIVES

C1 Acquainting students with the field of artificial intelligence and its possibilities
C2 The ability to identify problems suitable for AI methods and select an appropriate approach to them

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 Getting to know the field of artificial intelligence
PEU_W02 Learning the basic intelligent techniques, applicable to various types of problems

relating to skills:
PEU_U01 The ability to correctly identify problems suitable for the use of intelligent methods
PEU_U02 Ability to select the appropriate intelligent technique for a given problem

relating to social competences:

PEU_K01 The ability to transfer the acquired knowledge and the results of experiments PEU_K02		
PROGRAMME CONTENT		
Lecture		**Number of hours**
Lec 1	Introductory information to the course, discussion on artificial intelligence: understanding and defining AI, the state of development and prospects of AI in Poland	2
Lec 2	Development of the field of AI by discussing selected key achievements of artificial intelligence, legal and ethical aspects of AI development	2
Lec 3	Classic genetic algorithm as an example of a nature-inspired method	2
Lec 4	Search problems	2
Lec 5	Constraint satisfaction problems - definition, methods of solving	2
Lec 6	Designing logical games: game tree, MINMAX algorithm and alpha-beta pruning on the example of a two-player game	2
Lec 7	Planning task as an example of state space searching - forward state propagation, backward state propagation	2
Lec 8	Knowledge base systems, expert systems, discussion of sample expert systems	2
Lec 9	Knowledge, the role of knowledge in artificial intelligence, knowledge representation methods	2
Lec 10	Knowledge processing - forward, backward, mixed reasoning	2
Lec 11	Information uncertain. Methods of processing uncertain information; probability calculus, certainty factor	2
Lec 12	Uncertain information - fuzzy inference	2
Lec 13	Introduction to Machine Learning (ML). ML types. Inductive reasoning	2
Lec 14	Generating decision trees	2
Lec 15	Generating classification rules	2
	Total hours	30
Laboratory		**Number of hours**
Lab 1	Discussion of classes, purpose, regulations, forms of credits	2
Lab 2	Exercise 1: Applying Evolutionary Computing: Performing the first step	2
Lab 3	Exercise 1: Implementation of the second stage of the exercise, discussion of intermediate results	2
Lab 4	Exercise 1: Ending the exercise, submitting the final report	2
Lab 5	Exercise 2: Constraint satisfaction problems - discussion of the exercise, starting the first stage	2
Lab 6	Exercise 2: Carrying out the second stage of the exercise	2
Lab 7	Exercise 2: Ending the exercise, compiling the results, submitting the report	2
Lab 8	Exercise 3: Designing a logical game - overview of the exercise, implementation of the first stage	2
Lab 9	Exercise 3: Implementation of the second stage, min-max	2
Lab10	Exercise 3: Implementing the third stage, algae. alpha-beta	2

Lab11	Exercise 3: Finishing the exercise, submitting the report	2
Lab12	Exercise 4: The application of selected machine learning methods in the analysis of text or images - introducing students to the problems of the exercise	2
Lab13	Exercise 4: Carrying out the first stage of the exercise	2
Lab14	Exercise 4: Completing the exercise, submitting the report	2
Lab15	Discussion and summary of the classes, completion of the course	2
	Total hours	30

TEACHING TOOLS USED

N1. Projector
N2. Remote education systems available at Wrocław University of Science and Technology

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F1		Points for individual laboratory exercises, in accordance with the regulations provided to students, the sum of points will provide the basis for the final laboratory grade.
P Written exam in the form of a test - a selection test with negative points for a wrong answer		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] M. Tim Jones, ARTIFICIAL INTELLIGENCE: A Systems Approach. Infinity Science Press LLC, 2008, dostępna pod adresem: https://archive.org/details/2008ArtificialIntelligenceASystemsApproachM.TimJones http://www.freebookspot.es/Comments.aspx?Element_ID=306137
[2] Mariusz Flasiński, Wstęp do sztucznej inteligencji. Wydawnictwo Naukowe PWN, 2021
[3] Introduction to Machine Learning. Draft, Nils J. Nilsson http://ai.stanford.edu/~nilsson, 2010. Stanford University.
[4] Kwaśnicka H., Spirydowicz A., Uczący się komputer. Programowanie gier logicznych. Oficyna Wydawnicza PWr. Wrocław. 2004.

SECONDARY LITERATURE:

[1] John R. Searle Umysł, mózg i nauka, Wyd. Naukowe PWN, W-wa, 1995, seria Logos. Książkowa wersja cyklu 6 wykładów, po 30 minut każdy na antenie, każdy wykład stanowi całość, wszystkie też stanowią jedną całość – oryginalne treści. Wykłady na zaproszenie dla BBC w 1984 roku, tzw. Wykłady Reithowskie
[2] Terry Dartnall Ed., Artificial Intelligence and Creativity, Kluwer Academic Publishers (Studies in Cognitive Systems, volume 17), 1994.
[3] Publikacje w czasopismach wskazane przez prowadzącego, internetowe źródła o światowych projektach z AI

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

Halina Kwaśnicka, halina.kwasnicka@pwr.edu.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: **Podstawy przedsiębiorczości**
Name of subject in English: **Basics of entrepreneurship**
Main field of study (if applicable): **Computer Science**
Specialization (if applicable):
Profile: **academic**
Level and form of studies: **1st, full-time**
Kind of subject: **obligatory**
Subject code **ZMZ001643W**
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	crediting with grade	Examination / crediting with grade*	Examination / crediting with grade*	crediting with grade	Examination / crediting with grade*
For group of courses mark (X) final course					
Number of ECTS points	2				
including number of ECTS points for practical classes (P)					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,2				

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1.The course is dedicated to students of various specializations who want to gain elementary knowledge about creating and managing the companies (also on Polish market).

SUBJECT OBJECTIVES

C1. Acquiring knowledge of entrepreneurship.
C2. Getting to know the instruments (strategies, models, methods) necessary for business management
C3. An acquaintance with principles of a business plan's preparation and presentation.

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge:
PEK_W01 has a structured knowledge of creating organizational and legal forms of conducting business activity in terms of creating new enterprises,
PEK_W02 characterizes and knows the basic areas of capital raising and strategies, models, management methods and development of business organization.

Relating to skills:
PEK_U01 can search and interpret knowledge related to entrepreneurship,

PEK_U02 is able to construct a business plan for a new company.

Relating to social competences:
PEK_K01 will acquire an active entrepreneurial attitude to the realization of undertakings innovative and creative thinking

PROGRAMME CONTENT

	Lecture	**Number of hours**
Lec 1	Defining entrepreneurship and supporting institutions. Global Entrepreneurship Index.	2
Lec 2	Types of entrepreneurship - nature of business. Characteristics of the entrepreneur	2
Lec 3	Locations of entrepreneurship: households, administrative institutions and market. An exchange of information	2
Lec 4	Analysis of the company's environment	2
Lec 5	Business models and marketing strategy	2
Lec 6	Sources of financing for entrepreneurial activities. Budget elements.	2
Lec 7	Selection of taxation forms. Basic financial statements and factors.	2
Lec 8	Insurance and social security in running a business	2
Lec 9	Material and financial investments	2
Lec 10	Business plan structure	2
Lec 11	Business plan examples	2
Lec 12	Business risk management	2
Lec 13	Electronic business security	2
Lec 14	Intellectual property protection	2
Lec 15	Final test	2
	Total hours	30

TEACHING TOOLS USED

N1. multimedia presentation
N2. presentation of sub-tasks
N3. discussion

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F1	PEK_W01, PEK_W02,PEK_U01, PEK_U02,	Measuring creative thinking by participating in a discussion during the class (lecture)
F2	PEK_W01, PEK_W02,PEK_U01, PEK_U02,	Knowledge measurement by final test
F3	PEK_K01	Measuring knowledge by preparing a business essay

P = 0,25F1 + 0,5F2 + 0,25F3

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE: **online access from the PWr library**

[1] Bill Aulet, Chris Snyder; Marius Ursache, Disciplined Entrepreneurship Workbook, 2017, Wiley
[2] Karin Berglund, Karen Verduijn, Revitalizing Entrepreneurship Education, 2018, Routledge,
[3] Mathew J. Manimala, Entrepreneurship Education, 2017, Springer Singapore
[4] IB. V. Khandekar, Sameer Phan, Iinnovation, Incubation and Entrepreneurship**,** 2017, Singapore Springer Singapore

SECONDARY LITERATURE: **online access from the PWr library**

[5] Álvaro Cuervo ; Álvaro Cuervo; Domingo Ribeiro; Salvador Roig, Entrepreneurship, 2007, Springer Berlin Heidelberg,
[6] Legge, Entrepreneurship, 2004, Macmillan Education UK,
[7] Entrepreneurship, The AMA Dictionary of Business and Management, 2013, : AMACOM, Publishing Division of the American Management Association
[8] Mehmet Huseyin Danis, Hakan Demir, Ender Can, Ugur Bilgin Country Experiences in Economic Development, Management and Entrepreneurship, 2017, Springer International Publishin

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

Anna Maria Kamińska, Anna.maria.kaminska@pwr.edu.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Wprowadzenie do Iinżynierii Oprogramowania
Name of subject in English: Basics of Software Engineering
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic*
Level and form of studies: 1st *, full-time *
Kind of subject: obligatory *
Subject code: INZ004414
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	~~Examination~~ / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark final course with (X)					
Number of ECTS points			1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)			0,6		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of object-oriented programming paradigm

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SUBJECT OBJECTIVES

C1 To gain practical skills in requirement specification, domain modeling and software testing.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

relating to skills:
PEK_U01 student specifies requirements using different techniques
PEK_U02 student develops a user interface prototype
PEK_U03 student develops a system data model with business constraints on the software system
PEK_U04 student defines test cases

Laboratory		**Number of hours**
Lab 1	Organizational activities.	1
Lab 2	Decision tables. User stories.	2

Lab 3	Use-case diagram.	2
Lab 4	Use-case specifications: textual, activity diagrams, acceptance tests.	2
Lab 5	User interface prototype.	2
Lab 6	Data model.	2
Lab 7	OCL.	2
Lab 8	Test cases.	2
	Total hours	15

TEACHING TOOLS USED

N1. Examples of technical documentation and the UML models used in the software engineering area

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1- requirement specification	PEU_U01	Labs 2-4, each with tasks for 10 points max.
F2 – user interface prototype	PEU_U02	Lab 5 (10 points max).
F3 – data model and constraints	PEU_U03	Labs 6-7, each with tasks for 10 points max.
F4 – test cases	PEU_U04	Lab 7 (10 points max).
P1 – final grade	PEU_U01 PEU_U02 PEU_U03 PEU_U04	P = F1 + F2 + F3 (max. 60 points) P < 50% → 2.0 P∈ [50, 60) → 3.0 P∈ [60, 70) → 3.5 P∈ [70, 80) → 4.0 P∈ [80, 90) → 4.5 P∈ [90, 96) → 5.0 P∈ [96, 100] → 5.5
C		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] M. Fowler, UML distilled: a brief guide to the standard object modeling language, Addison-Wesley 2007
[2] Meyer, Software Engineering Springer International Publishing, 2015 (e resources)
[3] B. Hambling, Software Testing, BCS, 2015 (e resources)

SECONDARY LITERATURE:

[1] Rumpe, Modeling with UML, Springer International Publishing, 2016 (e resources)
[2] Rumpe, Agile Modeling with UML, Springer International Publishing, 2017 (e resources)

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

Bogumiła Hnatkowska, Bogumila.Hnatkowska@pwr.edu.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: **Wprowadzenie do inżynierii oprogramowania**
Name of subject in English: **Basics of Software Engineering**
Main field of study (if applicable): **Applied Computer Science**
Specialization (if applicable):
Profile: **academic***
Level and form of studies: **1st *, full-time ***
Kind of subject: **obligatory ***
Subject code **INZ004414**
Group of courses **YES***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	30			
Number of hours of total student workload (CNPS)	90				
Form of crediting	~~Examination~~ / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark final course with (X)	X				
Number of ECTS points	1	2			
including number of ECTS points for practical (P) classes	-				
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0,6	1,2			

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of object-oriented programming paradigm

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SUBJECT OBJECTIVES

C1 To obtain basic knowledge about primary notions in software engineering, including life-cycle models, modelling languages and software testing
C2 To gain practical skills in requirement specification, domain modeling and software testing.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 Student characterizes software lifecycle models
PEU_W02 Student knows UML and OCL constructs
PEU_W03 Student distinguishes between types of tests and test levels

relating to skills:
PEU_U01 Student prepares a software requirement specification (user stories, use-case PEU_U02 Student develops a data model for a software system (class diagram)
PEU_U03 Student specifies business constraints for a software system (in OCL)
PEU_U04 Student specifies tests for a software system at different levels

PROGRAM CONTENT		
Lectures		**Number of hours**
Lec 1	Introduction do Software Engineering. Life-cycle models.	2
Lec 2	Requirement specification. Introduction to UML. Use-case diagrams. User-stories.	3
Lec 3	Use-case specifications. Activity diagrams. Acceptance-tests. GUI prototypes.	2
Lec 4	Analysis. Class diagrams.	2
Lec 5	OCL.	2
Lec 6	Testing.	2
Lec 7	Software development methodologies - review. Final test.	2
	Total hours	15
Classes		**Number of hours**
Cl 1	Course introduction.	1
Cl 2	Flowcharts and their transformation to a source code.	3
Cl 3	Decision tables. Decision trees.	2
Cl 4	Requirements specification: User-stories (epics)	2
Cl 5	Requirements specification: Use-case diagrams.	2
Cl 6	Textual use-case specifications. Activity diagrams. Acceptance-tests.	4
Cl 7	Intermediate test.	2
Cl 8	Glossary. Class diagrams. Transformation to source code.	4
Cl 9	OCL.	4
Cl 10	Testing.	4
Cl 11	Final test.	2
	Total hours	30

TEACHING TOOLS USED
N1. Examples of technical documentation and the UML models used in the software engineering area N2. Materials prepared by the lecturer

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1 – intermediate test (classwork)	PEU_U01	Classwork - written work (tasks to solve) checking the trained skills. maxF1 – maximal number of points for F1
F2 – final test (classwork)	PEU_U01 PEU_U02 PEU_U03 PEU_U04	Classwork – written work (tasks to solve) checking the trained skills. maxF2 – maximal number of points for F2
F3 – activity points	PEU_U02 PEU_U03 PEU_U04	Number of points for student's activity during classes maxF3 = 10% (maxF1 + maxF2)

P1 – final evaluation of classwork	PEU_U02 PEU_U03 PEU_U04	P = (F1 + F2 + F3)/(maxF1 + maxF2 + maxF3) P < 50% → 2.0 P∈ [50, 60) → 3.0 P∈ [60, 70) → 3.5 P∈ [70, 80) → 4.0 P∈ [80, 90) → 4.5 P∈ [90, 96) → 5.0 P∈ [96, 100] → 5.5
P2 – final evaluation of lecture	PEU_W01 PEU_W02 PEU_W03	Colloquium - written work (theoretical problems) checking the gained knowledge from lecture scope. The work is given a positive evaluation, if the student scores at least 50% of the maximum number of points. The final evaluation of the lecture is determined on the basis of this mark. The specific rule is the same as for P1
P – final grade	All	P = 0,7 * P1 + 0,3 * P2

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] M. Fowler, UML distilled: a brief guide to the standard object modeling language, Addison-Wesley 2007
[2] Meyer, Software Engineering Springer International Publishing, 2015 (e resources)
[3] B. Hambling, Software Testing, BCS, 2015 (e resources)

SECONDARY LITERATURE:

[1] Rumpe, Modeling with UML, Springer International Publishing, 2016 (e resources)
[2] Rumpe, Agile Modeling with UML, Springer International Publishing, 2017 (e resources)

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

Bogumiła Hnatkowska, Bogumila.Hnatkowska@pwr.edu.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Programowanie w chmurze
Name of subject in English: Cloud programming
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic / practical*
Level and form of studies: 1st~~/ 2nd~~ level, ~~uniform magister studies~~*, full-time ~~/ part-time studies~~*
Kind of subject: ~~obligatory~~ / optional ~~/ university-wide~~*
Subject code: INZ004470
Group of courses YES

	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	~~Examination /~~ crediting with grade*	Examination / crediting with grade*	~~Examination /~~ crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark final course with (X)	X				
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,2		1,2		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Programming skills in Java / Kotlin
2. Basic knowledge of databases
3. Programming skills to create applications for the Android platform

SUBJECT OBJECTIVES

C1 To familiarize students with various models of cloud computing, offered services and learn about good practices of programming and implementing applications to the cloud.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 - knows various models of cloud computing and the types of services offered.
PEU_W02 - lists and describes Infrastructure as Code tools
PEU_W03 - lists and describes tools for the orchestration of cloud services
relating to skills:
PEU_U01 - implements applications in the cloud using various types of data services, computing services, application services, serverless services.

PROGRAM CONTENT

Lectures		Number of hours
Lec 1	Introduction to the subject, course program description, organization of classes and rules of passing. Introduction of basic concepts, evolution and standardization in the field of cloud computing	1
Lec 2	Cloud security	2
Lec 3	Basic AWS services	2
Lec 4	Docker and Packer	2
Lec 5	Infrastructure as Code tools	4
Lec 6	Cloud service orchestration	4
Lec 7	Cloud data storage	2
Lec 8	Serverless architecture	2
Lec 9	Design and implementation of a cloud application	4
Lec 10	Continuous integration tools	2
Lec 11	Good practices in cloud solutions	2
Lec 12	Test	2
	Total hours	**30**

Laboratory		Number of hours
Lab 1	Preview, health and safety course. Presentation of the scope and principles of evaluation.	2
Lab 2	Design and implementation of a web application - task 1	6
Lab 3	Design and implementation of a mobile application - task 2	6
Lab 4	Dockerization of designed applications - task 3	2
Lab 5	Implementation of the cloud infrastructure using Terraform - task 4	4
Lab 6	Orchestration of the designed application - task 5	4
Lab 7	Application implementation in serverless architecture - task 6	4
Lab 8	Summary and survey of laboratory classes; issuing grades	4
	Total hours	30

TEACHING TOOLS USED

N1. An informative lecture with elements of a problem lecture, supported by multimedia presentations.

N2. Integrated development environment supporting application development on AWS platform.

N3. Student's own work - literature studies.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1 – task 1	PEU_U01	Assessment of the solution of the task 1 on a scale of 0..10 or traditional

F2 – task 2	PEU_U01	Assessment of the solution of the task 1 on a scale of 0..10 or traditional
F3 – task 3	PEU_U01	Assessment of the solution of the task 1 on a scale of 0..10 or traditional
F4 – task 4	PEU_U01	Assessment of the solution of the task 1 on a scale of 0..10 or traditional.
F5 – task 5	PEU_U01	Assessment of the solution of the task 1 on a scale of 0..10 or traditional
F6 – task 6	PEU_U01	Assessment of the solution of the task 1 on a scale of 0..10 or traditional
P1 - partial evaluation (laboratory)	PEU_U01	A pass mark is awarded from the laboratory if the student obtains at least 50% of the maximum number of points. Later, the rating is increased by 0.5 every 10%.
P2 - partial evaluation (lecture)	PEU_W01, PEU_W02, PEU_W03	Test - written, containing open and test questions, checking the knowledge and skills of the lecture. The test is passed if the student obtains at least 50% of the maximum number of points. Later, the rating is increased by 0.5 every 10%. (condition: P1 is positive).
P – final evaluation		The P3 final score is calculated from the 70% P1 score and 30% of the P2 final score. The final grade P3 is positive when both component assessments are positive.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE (FOR ORACLE DBMS):

[1] https://docs.aws.amazon.com/, AWS documentation.

[2] Sequeira, Anthony J. AWS Certified Cloud Practitioner (CLF-C01) Cert Guide. Pearson IT Certification, 2019.

[3] Anthony, Albert. AWS: Security Best Practices on AWS: Learn to secure your data, servers, and applications with AWS. Packt Publishing Ltd, 2018.

SECONDARY LITERATURE:

[4] Golden, Bernard. Amazon web services for dummies. John Wiley & Sons, 2013.

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

Rafał Palak, rafal.palak@pwr.edu.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Architektura komputerów
Name of subject in English: Computer Architecture
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic / practical*
Level and form of studies: 1st level / full-time
Kind of subject: obligatory
Subject code INZ004404
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	Crediting with grade*	Examination / crediting with grade*	Crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark final course with (X)					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes	0		2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,2		1,2		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of computer systems organization and design of combinational and sequential circuits.
2. Programming skills at a basic level

SUBJECT OBJECTIVES

C1 Acquainting students with the architecture of modern computers, including the memory organization, and evaluation of their performance
C2 Acquisition of skills to design and construct simple combinational and sequential circuits
C3 Acquisition of programming skills in assembly language of selected processor at a basic level

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge:

PEK_W01 Knows different computer architectures including the architecture of the parallel computers
PEK_W02 Knows the computer memory organization, especially memory cache
PEK_ W03 Knows the basics of pipeline processing, including how to solve the problems associated with this type of processing

PEK_W04 Knows the basic methods of evaluating the performance of parallel computers

Relating to skills:

PEK_U01 Is able to write simple programs in assembly language of selected processor

PEK_U02 Can design and build simple combinational and sequential circuits

PROGRAM CONTENT

	Lectures	**Number of hours**
Lec 1	Introduction to computer architecture, taxonomy of computer architectures, Harvard, Princeton and Harvard-Princeton architectures, Instruction Set Architecture (ISA).	2
Lec 2	Data representation in computer systems, integer and floating point coding, IEEE 754 standard, Little and Big Endian.	2
Lec 3	RISC vs CISC architecture, similarities, differences, exemplary realizations of them. Architecture and organization of the chosen RISC processor.	2
Lec 4	Introduction to low-level programming. Compilation, assembling, linking. Program organization in assembler.	2
Lec 5	Programming in assembly language I.	2
Lec 6	Programming in assembly language II.	2
Lec 7	Organization of the stack in RISC architecture.	2
Lec 8	Advanced assembly programming techniques.	2
Lec 9	Memory organization, memory hierarchy, cache memory – methods if it's realization (associative, direct mapped, set-associative) – examples, virtual memory – paging, segmentation.	2
Lec 10	Organization of RISC computers: pipeline processing, hardware control unit. Delay branches, branch prediction schemas.	2
Lec 11	Security of computer architectures, buffer overflow attacks. Multiprocessor and multicomputer systems – distributed and shared memory, vector processors.	2
Lec 12	Parallel systems evaluation: performance metrics, scalability of parallel system.	2
Lec 13	Static and dynamic interconnection networks, used topologies, routing mechanisms.	2
Lec 14	Final test.	2
Lec 15	New trends in computer architecture.	2
	Total hours	30

	Laboratory	**Number of hours**
Lab 1	Presentation of lab scope, presentation of grading principles, training from health and safety at work. Familiarization with laboratory tool used for the realization of combinational and sequential circuits.	2
Lab 2	Introductory laboratory - the analysis of the chosen circuit.	2
Lab 3	Designing of combinational circuits I.	2
Lab 4	Designing of combinational circuits II.	2
Lab 5	The analysis of systems with static hazard.	2

Lab 6	The analysis of the synchronous circuit.	2
Lab 7	The synthesis of the synchronous circuit.	2
Lab 8	Introduction to the lab in assembly language programming, familiarization with the working environment.	2
Lab 9	Implementation of a simple program in assembler, running it in different execution modes, observing the contents of the registers during program execution.	2
Lab 10	Implementation of a program that uses conditional branches.	2
Lab 11	Familiarization with the implementation of different iteration instructions in assembly language.	2
Lab 12	Familiarization with arrays implementation in assembly language.	2
Lab 13	Familiarization with procedures implementation in assembly language.	2
Lab 14	Implementation of a program that used nested procedures.	2
Lab 15	Implementation of a program with floating point operations.	2
	Total hours	30

TEACHING TOOLS USED

N1. Lecture supported by multimedia presentations (slideshow)
N2. SPIM and MIPS32 Simulator - http://pages.cs.wisc.edu/ ~ Larus / spim.html
N3. MARS (MIPS Assembler and Runtime Simulator) - http://courses.missouristate.edu/KenVollmar/MARS/
N4. Mounting plates allowing realization of combinational and sequential circuits

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1 – (lecture)	PEK_W01 PEK_W02 PEK_W03 PEK_W04	Quizzes during the lecture, student activity during the lecture, students answering on questions during lecture
F2 – (switching theory laboratory) - (Lab1- Lab7)	PEK_U01	Checking of student preparation for exercise realization, assessment (points allocated) the reports of the exercises
F3 – (assembly programming laboratory) - (Lab8- Lab15)	PEK_U02	Evaluation of the quality of submitted by students' programs, implementation during the laboratory additional tasks formulated during the laboratory (on-line programing
P - credits: independent for F1 and combined F2 / F3. The condition for passing the laboratory part is obtaining at least 40% of points from each activity: F2, F3.		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] D. Patterson, J. Hennessy, Computer Organization and design, Elsevier
[2] D. Harris, S. Harris „Digital Design and Computer Architecture", Morgan Kaufman, 2012

SECONDARY LITERATURE:

[1] D. Patterson, J. Hennessy, "Computer Architecture – a Quantitave Approach", Elsevier, 2012
[2] G. Ifrah, "The Universal History of Computing: From the Abacus to the Quantum Computer", Wiley, 2002

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

Jan Kwiatkowski, jan.kwiatkowski@pwr.wroc.pl
Radosław Michalski, radoslaw.michalski@pwr.edu.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: **Grafika komputerowa**
Name of subject in English: **Computer Graphics**
Main field of study (if applicable): **Applied Computer Science**
Specialization (if applicable):
Profile: academic *
Level and form of studies: 1st, uniform magister studies, full-time
Kind of subject: optional
Subject code INZ004437
Group of courses YES

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	120				
Form of crediting	Crediting with grade	Examination / crediting with grade*	Crediting with grade	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark final course with (X)	X				
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,2		1,2		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows elementary notions and computational methods of linear algebra and geometry in 2D and 3D
2. Is fluent in Java programming and knows basic general purpose algorithms and data types
3. Knows one of popular development environments for C++ or Java

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SUBJECT OBJECTIVES

C1 The students should know and understand the methods of 2D image rendering and 3D visualization, deeply understand how they work and what are their features and limitations.
C2 The students should know how to use practically standard software components supporting 2D and 3D CG application development in Java environment
C3 The students should be able to select appropriate methods and software components according to the particular needs related to the CG application domain and build CG application that renders plain image or 3D scene view using these software components

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEK_W01 Knows color spaces used in CG and understands differences between them
PEK_W02 Knows principles of transformation composition in homogenous coordinates
PEK_W03 Understands principles of curves modeling in 2D

PEK_W04 Knows properties of commonly used 3d rendering methods
PEK_W05 Knows and understands stages of typical 3D rendering pipeline

relating to skills:
PEK_U01 Can implement procedural pattern rendering of regular 2D using raster and vector approach
PEK_U02 Is able to design and implement graphical UI using standard software components available in Java
PEK_U03 Can construct the transformation matrix in homogenous coordinates corresponding to visually specified transformation
PEK_U04 Can implement simple CG applications for 3D rendering based on OpenGL usage

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec 1	Introduction, defining the scope of computer graphics, relation to other computer engineering domains, basic definitions and notions, raster graphics and vector graphics	2
Lec 2	CG program architecture, components for GUI building in Java2D and Swing	2
Lec 3	Color spaces in CG	2
Lec 4	Transformations in homogenous coordinates, general principles and advantages, affine transformation, derivation of transformation matrices for scaling rotation and translation	2
Lec 5	Derivation of transformation matrix for compound transformations in homogenous transformations, transformation superposition, examples	2
Lec 6	Bilinear interpolation of image attributes, application in image transformations, Gouraud shading	2
Lec 7	Curves modeling in 2D, Lagrange and Bezier curves, piecewise defined curves, B-splines	2
Lec 8	Introduction to 3D image synthesis, basic notions, scene description elements, lighting model, local and global illumination	2
Lec 9	3D scene geometry description, boundary representation, CSG, implicit surfaces, metaballs, volumetric representations, lighting models, Phong lighting model	2
Lec 10	Rendering pipeline, geometric transformations in 3D, observer coordinate system, projections from 3D to 2D	2
Lec 11	Visibility analysis methods, algorithms based on face sorting z-buffer algorithm, displaying transparent objects with z-buffer	2
Lec 12	OpenGL library, core functionality, rendering program organization for OpenGL, examples of visual effects available in OpenGL programs	2
Lec 13	Providing geometry to OpenGL, defining geometric transformations, application of transformation matrix stack, defining observer parameters, analysis of exemplary programs	2
Lec 14	Other 3D rendering component packages review: Direct3D and Java3D.	2

Lec 15	Brief review of advanced 3D rendering methods, backward ray tracing, radiosity, photon mapping	2
	Total hours	**30**

Form of classes - laboratory		**Number of hours**
Lab1	Lab scope safety regulations grading policy presentation, installation of IDE, short introduction to CG packages in Java	2
Lab2	Procedural rendering of 2D patterns using BufferedImage class	2
Lab3	Vector graphics components usage in interactive graphics, simple animation using vector graphics components	2
Lab4	GUI implementation using Swing components	2
Lab5	Image composition using affine transformations	4
Lab6	Bilinear and bicubic color interpolation, application to image scaling	2
Lab7	Implementation of Gouraud shading - displaying polygons with Gouraud shading	2
Lab8	Simple rendering of 3D scenes with Phong lighting model	2
Lab9	3D shape modeling by curve rotation and translation - conversion to triangle mesh, implementation of wireframe display of triangle meshes	4
Lab10	Scene rendering program based on OpenGL or java3D	2
Lab11	3D visualization program with observer interactive setting	4
Lab12	Summary, final grading	2
	Total hours	30

TEACHING TOOLS USED

N1. Multimedia presentation used in lectures
N2. Compilers and development environment for Java and C++
N3. Freeware and open source programs for 3D scene modeling
N4. E-learning system used to publish presentations, documents and other data related to the lecture and lab assignments

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation(F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1 - Lab2	PEK_U01	Each assignment Lab2-Lab11 will be evaluated in the scale 2.0 - 5.0. The elements being evaluated: conformance with the assignment specification, ability to make small extensions and modifications to home-prepared code, relevance of used methods, efficiency, ability to predict results of processing of specified input data set , code clarity
F2 - Lab3	PEK_U01 PEK_U02	As in the case of grading of assignment in Lab2
F3 - Lab4	PEK_W02 PEK_U02	As in the case of grading of assignment in Lab2
F4 - Lab5	PEK_W01 PEK_W02 PEK_U03	As in the case of grading of assignment in Lab2, scoring: 0 – 3.

F5 - Lab6	PEK_W01 PEK_U02	
F6 - Lab7	PEK_W04 PEK_W05	As in the case of grading of assignment in Lab2, scoring: 0 – 3.
F7 - Lab8	PEK_W01 PEK_W04 PEK_W05	As in the case of grading of assignment in Lab2
F8 - Lab9	PEK_W03 PEK_U04	As in the case of grading of assignment in Lab2
F9 - Lab10	PEK_W04 PEK_W05 PEK_U02 PEK_U04	As in the case of grading of assignment in Lab2
F10 - Lab11	PEK_W04 PEK_U02 PEK_U04	As in the case of grading of assignment in Lab2, scoring: 0 – 3.

P1 – final laboratory grade computed according to the following scale
0.00 - 8.99 - unsatisfactory
8.00 – 9.99 - satisfactory
10.00 – 11.99 - satisfactory plus
12.00 - 13.99 - good
10.00 - 14.99 - good plus
14.99 - 16.00 - very good

P2 – final lecture grade will be based on written exam results. The exam consists in solving a number of test queries and computational problems. Each query is assigned a number of scores. The final grade is based on total scores percentage according to the following scale
0 - 50% - unsatisfactory
51 - 60% - satisfactory
61 - 70% - satisfactory plus
80 - 89% - good
90 - 95% - good plus
96 - 100% - very good

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Foley J.D. et al. Computer Graphics, Principles and Practice, Third Edition, Addition-Wesley, 2013
[2] Klawonn F., Introduction to Computer Graphics: Using Java 2D and 3D, Second edition, Springer 2012
[3] Shreiner D. et al., OpenGL Programming Guide: The Official Guide to Learning OpenGL, Version 4.3 (8th Edition)

SECONDARY LITERATURE:

[1] Ammerall L., Zhang K., Computer Graphics for Java Programmers, John Wiley & Sons, 2007
[2] McReynolds T., Blythe D., Advanced Graphics Programming Using OpenGL, Elsevier 2005

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

Jerzy Sas, jerzy.sas@pwr.wroc.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Sieci komputerowe
Name of subject in English: Computer Networks
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic *
Level and form of studies: 1st/ ~~2nd~~ level~~, uniform magister studies~~*, full-time / ~~part-time~~ studies*
Kind of subject: obligatory / ~~optional~~ / ~~university-wide~~*
Subject code INZ004407
Group of courses ~~YES~~ / 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)	110		90		
Form of crediting	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark final course with (X)					
Number of ECTS points	4		3		
including number of ECTS points for practical (P) classes			3		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	2,4		1,8		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. K1INF_W01 - Has basic knowledge in the field of linear algebra, analytical geometry and mathematical analysis, necessary to solve computational problems of engineering character from technical and non-technical disciplines
2. K1INF_W02 - Has basic knowledge in the field of discrete mathematics, mathematical logic, probability theory and mathematical statistics, necessary to solve IT engineering problems.
3. K1INF_W07 - Has basic knowledge in the field of computer structure, organization and architecture.

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SUBJECT OBJECTIVES

C1. Acquiring knowledge in the field of layered computer networks, construction and functionality of network protocols, principles of network protocols cooperation in the stacks.
C2. Acquiring knowledge in the field of architectures, operations, construction and services of computer networks.

C3. - Acquiring basic skills of network devices configuration, as well as analysis of their operation and detection of errors in computer networks.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01 - Has basic and systematic knowledge in the field of layered computer networks, structure and functionality of network protocols, principles of cooperation of network protocols in stacks.

PEK_W02 - Has basic knowledge in the field of architectures, operations, construction and services of computer networks.

relating to skills:

PEK_U01 - Has basic skills in the configuration of network devices, as well as analysis of their operation and detection of basic errors in computer networks.

PROGRAM CONTENT

	Lectures	**Number of hours**
Lec1	Plan of the lecture. Explanation of the assessment method. Introduction to computer networks. The benefits and threats of global digitization and unlimited communication. The physical layer of the ISO-OSI model. Physical media. Description of the construction and use of passive and active devices. Description of purpose, arrangement and numbering of different interfaces. Description of tools for testing and making computer cables.	3
Lec2	Data link layer of the ISO-OSI model. Ethernet protocol.	3
Lec3	Network layer of the ISO-OSI model. IPv4 and IPv6 protocols.	3
Lec4	Network layer of the ISO-OSI model. Addressing, subnetting with fixed and variable mask length.	3
Lec5	The transport layer of the ISO-OSI model. TCP and UDP protocols.	3
Lec6	Network devices architecture. Introduction to the configuration of network devices.	3
Lec7	Introduction to administration in computer networks. Security, configuration management, network operating system management, connection encryption.	3
Lec8	Static routing.	3
Lec9	Dynamic routing on example of RIP protocol.	3
Lec10	Basic operation and configuration of the switch.	3
Lec11	VLANs and trunk connections.	3
Lec12	Routing between VLANs.	3
Lec13	DHCP service in IPv4 and IPv6 networks.	3
Lec14	NAT and PAT service.	3
Lec15	Other services supporting the operation of computer networks. Traffic management. Basic access control lists. Directions of computer network development. New generations of computer networks. New concepts of management and network configuration.	3

	Total hours	45
Laboratory		**Number of hours**
Lab1	Organizational classes. Explanation of the assessment method. Principles of health and safety. Presentation of the network topology in the laboratory and the deployment of network devices. Presentation of various types of media, passive devices and tools for making cables. Construction of active devices, description of interfaces.	2
Lab2	Physical media. Communication media. Sockets, terminals, patch panels, shielding. Making cables: straight, crossover, console.	2
Lab3	Data link layer: Types of interfaces. Laboratory topology. Basic IP configuration. Connection tests between computers. Wireshark application. Ethernet frame. Arp protocol. Additional: check for mac addresses table on the switch.	2
Lab4	Network layer: IPv4, IPv6 addressing. Special addresses. Subnetting with fixed mask. Subnetting with variable mask – VLSM.	2
Lab5	Network layer: IP configuration in Windows and Linux. Connections between computers. ICMP protocol. Tracking network path (tracert, traceroute, pathping). Analysis of response times. DNS address, nslookup command.	2
Lab6	Transport layer: TCP (FTP). UDP protocol (TFTP, DNS, DHCP). Wireshark. The netstat command.	2
Lab7	Architecture of active devices: Differentiation of interfaces. Console connection. Network connection. CLI interface. Basic configuration. IPv4 and IPv6 configuration. Communication tests. Remote configuration via telnet.	2

Lab8	Securing devices against unauthorized access, configuration management and operating system: Router protection. Switch protection. Analysis of the telnet and SSH connection in Wireshark: Collecting information about the network. Configuration backup (Startup, TFTP, USB, Terminal). Password recovery procedure on the router. Password recovery procedure on the switch.	2
Lab9	Static routing: Deafult Gateway. Cisco IPv4 routers. Cisco IPv6 routers. Detection of configuration errors (troubleshooting). Additional: routing using Windows and Linux systems.	2
Lab10	Dynamic routing: RIPv1. RIPv2. Network summation, passive interfaces. RIPv2 IPv6.	2
Lab11	Configuration of advanced switch options: Protecting the switch. Change of the management VLAN. Port configuration and securing.	2
Lab12	VLAN networks: VLAN. Trunk (connection options). Routing between VLANs: Routing through dedicated ports. Routing using a trunk connection. Additional: Analysis of the 802.1Q Ethernet frame.	2
Lab13	Configuration of the DHCP server: DHCP on the local router. DHCP on the remote router. DHCP on the switch. DHCP IPv6: SLAAC, stateless (SLAAC + DHCPv6), statefull (DHCPv6).	2
Lab14	NAT: Static NAT. Dynamic NAT. PAT.	2
Lab15	Ancillary services: CDP, LLDP. NTP. Syslog.	2
	Total hours	30
TEACHING TOOLS USED		

N1. - Lecture supported by multimedia presentations and a simulator.
N2. - Various types of network software.
|N3. - Simulator enabling creation, configuration and testing of various topologies of computer networks.
N4. - Quizzes and knowledge tests.
N5. - A real environment for creating, configuring and testing various topologies of computer networks.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1-F14 - partial grades obtained at labs La2-15	PEK_U01	Student's presence. Theoretical preparation for the lab (quiz, test, other) on a point, percentage or traditional scale. Evaluation of the lab tasks on a point or traditional scale.
P1 – concluding lab grade	PEK_U01	An average of the F1-14 forming grades
F15 - forming lecture grade	PEK_W01, PEK_W02	Observation of student activity. Solving sample problems and tasks.
P2 – concluding lecture grade	PEK_W01, PEK_W02	Exam – in form of computer test, containing questions of various types (multiple and single choice, computational, open, other) checking knowledge in the field of lecture. The test is given a positive evaluation, if the student scores at least 51% of the maximum number of points. Later, the rating is increased by 0.5 every 10%. A positive P2 rating can be adjusted by rating F15. The condition for obtaining a positive P2 rating is to obtain a positive P1 rating.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Andrew S. Tanenbaum, David J. Wetherall, "Computer Networks, 5th Edition", Published by Pearson, Sep 27, 2010
[2] J. Woźniak, K. Nowicki, „Sieci LAN, MAN i WAN - protokoły komunikacyjne", Wydawnictwo - FPT, Kraków 2000
[3] Training materials of the Cisco Network Academy
[4] Wendell Odom, "CCENT/CCNA ICND1 100-105 Official Cert Guide:, Cisco Systems; Auflage: Har/Dvdr (17. Mai 2016)
[5] Wendell Odom, "CCNA Routing and Switching ICND2 200-105 Official Cert Guide: Official Cert Guid / Learn, prepare, and practice for exam success", Cisco Systems; Auflage: Har/Cdr (4. Juli 2016)

SECONDARY LITERATURE:

[1] http://www.freebookcentre.net/Networking/Free-Computer-Networking-Books-Download.html
[2] CCNA Exploration Companion Guide books

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

Kamil Nowak, kamil.nowak@pwr.edu.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Organizacja Systemów Komputerowych (GK)
Name of subject in English: Computer System Organization (GK)
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic ~~/ practical*~~
Level and form of studies: 1st~~/ 2nd level, uniform magister studies*~~, full-time ~~/ part-time studies*~~
Kind of subject: obligatory ~~/ optional / university-wide*~~
Subject code INZ004400
Group of courses YES ~~/ 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	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark final course with (X)	X				
Number of ECTS points	1	2			
including number of ECTS points for practical (P) classes	0	0			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0,6	1,2			

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student lists and describes the basic computer components.
2. The student defines the basic functional characteristics of the computer.

SUBJECT OBJECTIVES

C1. Knowledge of ways of representing fixed-point numbers and the basics of arithmetic for these numbers.
C2. Understanding methods for simplifying Boolean expressions.
C3. Knowledge of simple combinational and sequential circuits.
C4. Acquiring basic knowledge in the field of designing simple digital circuits.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01 A student knows ways of representing numbers in fixed-point systems, methods of number conversion and ways of implementing arithmetic operations.
PEK_W02 A student knows the basic methods for simplifying Boolean expressions,
PEK_W03 A student knows basic combinational and sequential circuits,
PEK_W04 A student knows the basic principles of designing the simplest digital circuits.

relating to social competences:
PEU_K01 A student is aware of the importance of non-technical aspects of the activity of the engineer-computer scientist; understands the need to ensure high quality and availability of IT systems, taking into account the needs of different user groups.

PROGRAM CONTENT		
Lectures		**Number of hours**
Lec 1	Introduction. Basic concepts. Structure and computer architecture. A brief history of computers - evolution, performance, and computer compatibility. Analog and digital signals; bit, byte,	2
Lec 2	Computer arithmetic, number systems: binary, octal, hexadecimal, Natural Binary Code.	2
Lec 3	Representation of natural numbers and integers, sign-module system, two's complement, number conversions.	2
Lec 4	Arithmetic of integers (binary) - negation, addition and subtraction, multiplication, division.	2
Lec 5	Arithmetic of integers (decimal) - negation, addition and subtraction, multiplication, division.	2
Lec 6	Floating-point representation, IEEE 754-2008 Standard, Floating-point arithmetic	2
Lec 7	Boole's algebra, truth table, Boolean Algebraic Identities, De Morgan's laws, Boolean functions	2
Lec 8	Logic Gates	2
Lec 9	Minimization of combinational functions (logic) - A formal transformation method, Karnaugh map and Quine–McCluskey Method (prime implicants).	2
Lec 10	Examples of connections and applications of logic gate, definition of a combination circuit, simple combinational circuits, arithmetic circuits: adders, comparators	2
Lec 11	Combinational Logic Circuits, Transistor Transistor Logic (TTL) Circuits	2
Lec 12	Sequential Logic Circuits: definition, types of flip-flops, excitation table, state diagram	2
Lec 13	Designing combinational circuits - a way to design a combinational system, static gambling.	2
Lec 14	Designing synchronous sequential circuits - definition of a sequential circuit (Mealy and Moore Machines), additionally designing counters.	2
Lec 15	Colloquium	2
	Total hours	**30**
Classes		**Number of hours**
Cl 1	Discussion of the organization and the program of activities. Introduction to the issues of exercises - basic arithmetic operations in positional numerical systems.	1
Cl 2	Numerical conversion methods for various fixed-point number systems.	2
Cl 3	Ways of coding numbers. Binary, BCD and complement codes,	2

Cl 4	Fixed-point arithmetic of binary numbers, BCD and in the complement notation.	2
Cl 5	Test	2
Cl 6	Fixed-point arithmetic - multiplication and division of numbers.	2
Cl 7	Basics of Boole's algebra. Methods for simplifying Boolean expressions.	2
Cl 8	Test	2
	Total hours	15

TEACHING TOOLS USED

LECTURE:
N1. Informative lecture with elements of the problem lecture, supported by multimedia presentations.
EXERCISES:
N2. Exercises at the blackboard.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEK_W01 PEK_W02 PEK_W03	Colloquium in written or oral form
F2	PEK_W01 PEK_W02	Exercises and tests
P = F1 + F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] C. Zieliński: Podstawy projektowania układów cyfrowych, Wydawnictwo Naukowe PWN, 2012
[2] B. Pochopień: Arytmetyka systemów cyfrowych, WPŚ, Gliwice 2002.

SECONDARY LITERATURE:

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

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FACULTY of Information and Communication Technology

SUBJECT CARD

Name in Polish: Cyberbezpieczeństwo
Name in English: Cybersecurity
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Level and form of studies: 1st/ ~~2nd~~* level, full-time / ~~part-time~~*
Kind of subject: obligatory / ~~optional~~ / ~~university-wide~~*
Subject code INZ004418
Group of courses ~~YES~~ / 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	Examination / ~~crediting with grade~~*	Examination / crediting with grade*	~~Examination~~ / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark final course with (X)					
Number of ECTS points	3		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,8		1,2		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Probability theory
2. Discrete mathematics
3. Computer networks.

SUBJECT OBJECTIVES

C1Understanding the current problems related to data security and information systems
C2 Understanding the methods and examples of solutions related to guaranteeing a high level of security.
C3 Understanding the methods of security design for information systems.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEK_W01 Has knowledge about security threats
PEK_W02 Has knowledge of selected issues in cryptology
PEK_W03 Has knowledge about methods of ensuring security
relating to skills:
PEK_U01 Is able to identify threats to IT security
PEK_U02 Is able to identify needs in the field of IT systems protection
PEK_U03 Is able to choose protection methods to ensure IT security

relating to social competences:
PEK_K01 Understand the need to protect IT systems
PEK_K02 Understand the impact of IT security threats on the functioning of the electronic economy

PROGRAM CONTENT

	Lectures	**Number of hours**
Lec 1	Introduction to cybersecurity. Basic terms and notions.	2
Lec 2	Basic problems related to cryptology	2
Lec 3	Symmetrical encryption algorithms	2
Lec 4	Elements of cryptanalysis	2
Lec 5	Stream ciphers	2
Lec 6	Asymmetric algorithms	2
Lec 7	Cryptographic hash functions and electronic signature	2
Lec 8	Authentication	2
Lec 9	Vulnerabilities and threats in network communication	2
Lec 10	Secure communication protocols	2
Lec 11	Anonymity and privacy in the Internet	2
Lec 12	Security in Web networks	2
Lec 13	Security in IoT and mobile systems	2
Lec 14	Cybersecurity in the electronic economy	2
Lec 15	Current problems in cybersecurity and repetition	2
	Total hours	30

	Laboratory	**Number of hours**
Lab 1	Introduction. Requirements and the lab environment configuration.	2
Lab 2	Historical ciphers	2
Lab 3	Cryptanalysis of historical algorithms	2
Lab 4	Modern symmetric algorithms	2
Lab 5	Asymmetric algorithms	2
Lab 6	Passwords security	2
Lab 7	Secure communication –VPN	2
Lab 8	Detection of security incidents - IDS systems	2
Lab 9	Network traffic filters - firewall systems	2
Lab 10	Detection of vulnerabilities in systems	2
Lab 11	Operating system level security	2
Lab 12	Security of web systems	2
Lab 13	Examples of attack scenarios	2
Lab 14	Open source intelligence	2
Lab 15	Repetition and consolidation of knowledge acquired during the semester.	2
	Total hours	30

TEACHING TOOLS USED

N1.Lectures
N2.Labs

N3.Own Work

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEK_W01, PEK_W02, PEK_W03, PEK_K01, PEK_K02.	Assessment of the degree of preparation for the laboratory exercises
F2	PEK_U01, PEK_U02, PEK_K03.	Evaluation of laboratory tasks
P	PEK_W01, PEK_W02, PEK_W03, PEK_K01, PEK_K02.	Final exam
C		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Schneier, Bruce. Applied cryptography: protocols, algorithms, and source code in C. john wiley & sons, 2007.

[2] Stallings, William. Cryptography and network security: principles and practice. Pearson Education India, 2003.

[3] Anderson, Ross. Security engineering. John Wiley & Sons, 2008.

[4] Ferguson, Niels, Bruce Schneier, and Tadayoshi Kohno. Cryptography engineering: design principles and practical applications. John Wiley & Sons, 2011.

SECONDARY LITERATURE:

[5] Katz, Jonathan, et al. Handbook of applied cryptography. CRC press, 1996.

[6] Boneh, Dan, and Victor Shoup. "A graduate course in applied cryptography." http://cryptobook. net (2008).

[7] Smart, Nigel P. Cryptography Made Simple. Heidelberg: Springer, 2016.

[8] OWASP : https://www.owasp.org/

[9] ENISA · Publications : http://www.enisa.europa.eu

[10] NIST · Special Publications (NIST-SP) : http://www.nist.gov/publication-portal.cfm

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

Grzegorz Kołaczek, Grzegorz.Kolaczek@pwr.edu.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: **Danologia**
Name of subject in English: **Data Science**
Main field of study (if applicable): **Applied Computer Science**
Specialization (if applicable):
Profile: academic / practical*
Level and form of studies: 1st~~/ 2nd level, uniform magister studies*,~~ full-time ~~/ part-time studies*~~
Kind of subject: ~~obligatory~~ / optional / ~~university-wide*~~
Subject code INZ002040
Group of courses YES ~~/ 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)	120				
Form of crediting	Crediting with grade	Examination / crediting with grade*	Crediting with grade	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark final course with (X)	X				
Number of ECTS points	2		3		
including number of ECTS points for practical (P) classes			3		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,2		1,8		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the basics of mathematical statistics.
2. Basic programming skills

SUBJECT OBJECTIVES

C1 Students are familiarized with methods of design and development of advanced data analysis processes.
C2 Students are familiarized with methods and tools of statistical data analysis, data mining, machine learning.
C3 Students are familiarized with methods and tools to analyse large data sets, ensure and verify data quality and social media analysis.

SUBJECT EDUCATIONAL EFFECTS

Related to knowledge:
PEK_W01 A student knows and describes the methods and tools of statistical data analysis, data mining, machine learning.
PEK_W02 A student knows and describes the methods and tools for the analysis of large data sets, ensuring and verifying the quality of data and social media analyses.

relating to skills:

PEK_U01 Student is able to design and develop advanced data analysis processes.
PEK_U02 Student is able to apply methods of statistical data analysis, data mining, machine learning.
PEK_U03 Student is able to apply methods of analysis of large data sets, assurance and verification of data quality and social media analysis.

PROGRAM CONTENT

	Lectures	**Number of hours**
Lec1	Introduction to Data Science 1. Lecture plan and grading policy 2. Basic concepts and relations between them: data science, data mining, machine learning, statistics 3. Big data – characteristics and main challenges. Data science and Big data 4. Structured and unstructured data. Network data 5. Interdisciplinary of data science. The influence of data science on other sciences	3
Lec2	Mathematical foundations of data processing 1. Representation of signals - classical approaches: time series and frequency responses - time-frequency representation 2. Signal analysis - data sources (sensors, google analytics) - sampling theorem	3
Lec3	Machine learning methods 1. Statistical foundations of machine learning - maximum likelihood method - the Bayes method - linear regression - k-NN classifier, linear classifier, neural classifier 2. Model selection - criteria AIC, BIC - cross-validation	3
Lec4	Computational Computational Network Science 1. Graph theory and basic concepts. Random graphs. Network models. Random walk. Scale-free networks. Small words. 2. Groups/communities in networks. Network motifs. 3. Applications	3
Lec5	Association rules generation – market basket analysis 1. Market basket analysis – introduction, the role of human-understandable knowledge in KDD processes, applications 2. Basic concepts 3. Frequent patterns and evaluation measures (support, confidence, lift, Conviction) 4. Apriori algorithm 5. Market basket analysis	3

	6. Practical samples	
Lec6	Social media analysis 1. Characteristics of social media: sample from basics to business values. 2. Social media systems, e.g. Wikipedia, Facebook, Opineo, Twitter 3. Methods of collecting and processing of social media data.	3
Lec7	Data science in software Engineering 1. Data science in software engineering - example applications 2. Case Study 3. Introduction to R (RStudio) for the purposes of the case study	3
Lec8	Big data 1. Characteristics of big data vs traditional data bases 2. Storage and processing methods, Dedicated file systems. 3. Parallel processing. Map-Reduce model	3
Lec9	Data Quality 1. Data providing and validating (quality monitoring, data scoring). 2. Data integration and cleaning, aggregation and reduction, metadata 3. Data quality metrics 4. Detecting anomalies (outliers), inconsistency, error propagation, error detection and correction	3
Lec10	Invited lecture	3
	Total hours	**30**

Laboratory		**Number of hours**
La1	Setting up the data processing environment 1. Grading policy 2. Installation and configuration of laboratory environment 3. Python fundamentals 4. R fundamentals	3
La2	Mathematical foundations of data processing 1. The *scipy.signal* library 2. Signal analysis - period and non-period signals - noisy data	3
La3	Machine learning methods 1. Python fundamentals - the *Scikit learn* library 2. Regression and classification - fitting data with generalized linear models - classification using k-NN method	3
La4	Computational Network Science 1. Introduction to Python and R modules - NetworkX package - graph-tool package - igraph package 2. Generation of networks according to models - random networks, small world, power-law	3

	- networks based on real data 3. Working with real data sets - network creation and network properties analysis - visualization	
La5	Association rules generation – market basket analysis 1. Introduction to PYTHON or R modules 2. Introduction to sample data and its preparation 3. Association rules generation with different minSupport and minConfidence values. 4. Visualization of results	3
La6	Social media analysis 1. Basics API for social platforms 2. Import of data and creation of data structures for processing, usage of Pandas module 3. Clustering, classification, prediction in graphs and social media data	3
La7	Data science in software engineering 1. Predictive models in R and their empirical evaluation - a case study Data science in software Engineering	3
La8	Big data 1. Setting up a testing environment for big data processing 2. Running sample project of data analyses 3. Developing adjustments to the sample project in Map-Reduce 4. Running, saving and evaluation of results of the analysis	3
La9	Data Quality 1. Data Integration and cleaning methods 2. Quality data report	3
La10	Presentation and discussion of best solutions developed as part of laboratory classes.	3
	Total hours	**30**

TEACHING TOOLS USED
N1. Lectures, lecture notes N2. Consultations N3. Student's independent work N4. Exercises on laboratory N5. R/Python modules

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F01..F08 – laboratory	PEK_U01, PEK_U02, PEK_U03	Evaluation of exercises from La2 to La9.

P01 – lecture	PEK_W01, PEK_W02	Written test. The test is given a positive evaluation, if the student scores at least 50% of the maximum number of points. Optional for students with positive laboratory grades.
P02 - laboratory	PEK_U01, PEK_U02, PEK_U03, PEK_W01, PEK_W02	Average of F01 .. F08.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Field Cady: The Data Science Handbook, Wiley, 2017.
[2] Brian Steele, John Chandler, Swarna Reddy: Algorithms for Data Science. Springer, 2016
[3] Marek Gągolewski, Programowanie w języku R Analiza Danych. Obliczenia. Symulacje, wyd.2, 2016
[4] Max Kuhn, Kjell Johnson, Applied Predictive Modeling. Springer 2013.
[5] Przemysław Biecek, Wizualizacja i modelowanie, Uniwersytet Warszawski, 2015. Ebook http://www.biecek.pl/R/#Analiza
[6] Data Mining Concepts and Techniques. Third Edition. Jiawei Han, Micheline Kamber, Jian Pei. Morgan Kaufmann Pub., Elsevier, 2012.
[7] Jose Unpingco - "Python for Probability, Statistics, and Machine Learning", Springer 2016
[8] Koronacki J., Cwik J., Statystyczne systemy uczące się., EXIT, Warszawa, 2008
[9] Albert-László Barabási: Network Science. Cambridge University Press, 2016. http://barabasi.com/networksciencebook/
[10] Anjana Gosain, Heena, Literature Review of Data Model Quality Metrics of Data Warehouse, Procedia Computer Science, Volume 48, 2015, Pages 236-243.

SECONDARY LITERATURE:

[11] Advances in Knowledge Discovery and Data Mining (American Association for Artificial Intelligence) Paperback – February 1, 1996, by Usama M. Fayyad (Editor), Gregory Piatetsky-Shapiro (Editor), Padhraic Smyth (Editor)
[12] Benjamin S. Baumer, Daniel T. Kaplan, Nicholas J. Horton: Modern Data Science with R. CRC Press, 2017
[13] Joel Grus: Data Science from Scratch: First Principles with Python. O'Reilly, 2015.
[14] Hadley Wickham: R for Data Science. O'Reilly, 2017
[15] Cole Nussbaumer Knaflic: Storytelling with Data. Wiley, 2015.
[16] Cathy O'Neil: Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy. Crown Publishers, 2016.

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

Artur Wilczek, artur.wilczek@pwr.wroc.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Algorytmy i Struktury Danych
Name of subject in English: Data Structures and Algorithms
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic / practical*
Level and form of studies: 1st/ ~~2nd~~ level, ~~uniform magister studies~~*, full-time / ~~part-time~~ studies*
Kind of subject: obligatory / ~~optional~~ / ~~university-wide~~*
Subject code INZ004403
Group of courses YES / ~~NO~~* (lecture, classes), NO (laboratory)

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15	30		
Number of hours of total student workload (CNPS)	90	30	90		
Form of crediting	Examination / ~~crediting with grade~~*	Examination / ~~crediting with grade*~~	~~Examination~~ / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark final course with (X)	X				
Number of ECTS points	4		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	2.4		1.2		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of a programming language (Java).
2. Knowledge of object programming basics

SUBJECT OBJECTIVES

C1. Gaining basic knowledge on abstract data types and dynamic data structures and their implementation.
C2. Knowledge of how to evaluate and compare algorithms and knowledge of basic algorithms from various application areas.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01. Knows abstract data types and dynamic data structures.
PEK_W02. Understands the asymptotic notation and knows basic algorithms from various areas of algorithmics.

relating to skills:

PEK_U01. He can create an implementation of abstract data types and algorithms from various areas of algorithms.

PROGRAM CONTENT		
Lectures		**Number of hours**
Lec1	Complexity (1/4), iterators.	2
Lec2	Complexity (2/4), linked lists.	2
Lec3	Complexity (3/4), stack and FIFO queues.	2
Lec4	Complexity (4/4), problem solving techniques	2
Lec5	Comparators, simple sortings.	2
Lec6	Effective sorting. Binary Heap.	2
Lec7	Linear and binary searches, priority queues, hash tables.	2
Lec8	Dictionary, binary search tree (BST).	2
Lec9	Red black tree, B-Tree.	2
Lec10	Interval tree, binomial heap, forest of disjoint sets.	2
Lec11	Graph algorithms.	4
Lec12	Pattern matching, the unification algorithm.	2
Lec13	Huffman codes, knapsack problems, selected geometrical algorithms.	2
Lec14	Complexity classes: P, NP,NPC	2
	Total hours	**30**

Classes		**Number of hours**
Cl1	Defining simple classes and interfaces.	1
Cl2	Iterators.	2
Cl3	Lists, heaps, queues.	2
Cl4	Iterative and recursive list processing.	2
Cl5	Sorting – algorithms analysis and comparison.	2
Cl6	BST tree and hash tables processing.	2
Cl7	B-trees and hash tables.	2
Cl8	Graphs.	2
	Total hours	15

Laboratory		**Number of hours**
Lab1	Creation and use of own iterators.	4
Lab2	An implementation using dynamic data structures – lists, heaps,	6
Lab3	Implementation and testing of selected sorting algorithms.	4
Lab4	Implementation and use of hash tables and binary trees.	4
Lab5	Implementation of binomial heap, forest of disjoint sets	4

Lab6	Implementation of graph algorithms.	4
Lab7	Implementation of pattern matching algorithms	4
	Total hours	30

TEACHING TOOLS USED
N1. Multimedia lecture. N2. Blackboard for a written presentation of solutions. N3. Computer didactic laboratory with development environment. N4. An e-learning system used for the publication of teaching materials, tests and communication

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1 - final score of the classes	PEK_U01	The condition for admission to the exam is participation in the exercises - one unjustified absence is allowed and a minimum of 5 points is obtained. A maximum of 25 points can be earned.
F2 - exam score	PEK_W01,PEK_W02	Scoring in the range [0,90] is issued based on the results of the exam.
P=Min(100,F1+F2)		Grade based on scores: [0; 50) - 2.0 [50; 62) - 3.0 [62; 73) - 3.5 [73; 84) - 4.0 [84; 95) - 4.5 [95; 100] - 5.0
PL - laboratory	PEK_U01	Implementation of tasks indicated by the teacher. Final grade depends of partial scores.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, “Introduction in algorithms”. The MIT Press; 2 edition (September 1, 2001), 1184 pages,
[2] Kenneth A. Berman, Jerome L. Paul, “Algorithms: Sequential, Parallel, and Distributed”, Course Technology; 1 edition (October 11, 2004), 992 pages.
[3] Robert Sedgewick “Algorithms in Java, Parts 1-4”, Addison-Wesley Professional; 3 edition (August 2, 2002), 768 pages.

SECONDARY LITERATURE:

[1] Harel D., Algorithmics. The Spirit of Computing, Addison Wesley, 2004.
[2] Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, Data Structures and Algorithms, Addison-Wesley, 1983.

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

Dariusz Konieczny, dariusz.konieczny@pwr.edu.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name in Polish: **Hurtownie Danych**
Name in English: **Data Warehouses**
Main field of study (if applicable): **Applied Computer Science**
Specialization (if applicable):
Level and form of studies: 1st level, full-time
Kind of subject: obligatory
Subject code INZ002031
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	Examination	Examination / crediting with grade*	crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark final course with (X)					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes	0		2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,2		1,2		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of database system, with a particular focus on the relational model.
2. At least basic knowledge of SQL query language

SUBJECT OBJECTIVES

C1. Has basic knowledge and skills of using SQL grouping operators, and SQL aggregation and grouping functions.
C2. Has basic knowledge and skills in the area of transaction oriented processing (OLTP) and analytic oriented processing (OLAP).
C3. Has basic knowledge and skills of using data warehouses.
C4. Knows basics of MS PowerPivot, MS SQL Analysis Services, MS SQL Integration Services and MS SQL Reporting Services.
C5. Has basic knowledge and skills in data integration, reporting and visualization.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEK_W01 has basic knowledge on data warehouse usage and data warehouse organization – logical and physical
PEK_W02 has basic knowledge on ETL process, reporting and data analysis

relating to skills:

PEK_U01 can use SQL grouping operators and SQL grouping and aggregating functions PEK_U02 can design and implement a ETL process PEK_U03 can design and implement a simple data warehouse and use it to generate basic reports, using different data visualization methods PEK_U05 can use basic MDX queries

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec 1	Course details. Introduction to Business Intelligence.	2
Lec 2	SQL grouping operators. SQL aggregating and grouping functions.	2
Lec 3	Transaction vs analytic needs, processes and data sources	2
Lec 4	Multidimensional data model – logical organization	2
Lec 5	Data warehouses – basics	2
Lec 6	ETL proces	2
Lec 7	Data warehouse – logical organisation	2
Lec 8	Data warehouses – architecture	2
Lec 9	MDX queries	2
Lec 10	MDX queries	2
Lec 11	Multidimensional data model – physical organisation	2
Lec 12	Reporting	2
Lec 13	Data visualisation	2
Lec 14	Data warehouse – design basics	2
Lec 15	Web dashboards	2
	Total hours	30
Form of classes - laboratory		**Number of hours**
Lab 1	Course details (Health and Safety Training, Course requirements). MS PowerPivot; pivot tables and pivot graphs	2
Lab 2	SQL aggregation and SQL grouping functions. SQL grouping operators	2
Lab 3	MS SQL Integration Services – data cleansing	2
Lab 4	MS SQL Integration Services – data integration	2
Lab 5	MS SQL Analysis Services – basics	2
Lab 6	MS SQL Analysis Services – design and implementation	2
Lab 7	MS SQL Analysis Services – advanced topics	2
Lab 8	MS SQL Analysis Services – MDX basics	2
Lab 9	MS SQL Analysis Services – advanced MDX	2
Lab 10	MS SQL Reporting Services – simple reporting	2
Lab 11	MS SQL Reporting Services – advanced reporting	2
Lab 12	Business Intelligence applications – web dashboard systems (QlikView)	2
Lab 13	Business Intelligence applications – ETL tools, OLAP servers (group presentation)	2
Lab 14	Business Intelligence applications – reporting tools (group presentation)	2

Lab 15	Test	2
	Total hours	30

TEACHING TOOLS USED

N1. Lecture – traditional method with multimedia content
N2. Consultations
N3. To get to know with basic items and expanded literature by the student
N4. Project exercises in the computer laboratory
N5. Student's own work - preparation for laboratory classes
N6. Develop reports of project

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F- laboratory	PEK_U01 – PEK_U04	Student assessment – individual discussion including result presentation, conclusions, etc.
P - lecture	PEK_W01 PEK_W02	Exam
P - laboratory	PEK_U01 – PEK_U04	Average note from part notes

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

1. Jensen C.S., Pedersen T.B., Thomsen C., Multidimensional Databases and Data Warehousing, Morgan & Claypool Publishers series SYNTHESIS LECTURES ON DATA MANAGEMENT, 2010
2. Rainardi V., Building a Data Warehouse With Examples in SQL Server, Apress, 2008
3. Harinath S., Pihlgren R., Lee D.G.-Y., Sirmon J., Bruckner R.M., PROFESSIONAL MICROSOFT® SQL SERVER® 2016 ANALYSIS SERVICES WITH MDX AND DAX, John Wiley & Sons, Inc., 2016
4. Microsoft SQL Server 2012 Integration Services, APN Promise, 2012
5. Inmon W., Building the Data Warehouse, John Wiley & Sons, New York 2002
6. Kimball R., Caserta J., The Data Warehouse ETL Toolkit, Wiley Publishing, Inc, 2004

SECONDARY LITERATURE:

1. Aspin A., SQL Server 2012 Data Integration Recipes, Apress, 2012
2. Leonard A., Masson M., Mitchell T., Moss J.M., Ufford M., SQL Server 2012 Integration Services Design Patterns, Apress, 2012
3. Claudia Imhoff, Nicholas Galemmo, Jonathan G. Geiger, Mastering Data Warehouse Design, Wiley Publishing, Inc., 2003
4. MacLennan J., Tang ZH., Crivat B., Data Mining with SQL Server 2008, Wiley Publishing, Inc, 2009

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

Bernadetta Maleszka, bernadetta.maleszka@pwr.edu.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Programowanie baz danych
Name of subject in English: Database programming
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic
Level and form of studies: 1st~~/ 2nd~~ level, ~~uniform magister studies~~*, full-time ~~/ part-time studies~~*
Kind of subject: ~~obligatory~~ / optional ~~/ university-wide~~*
Subject code INZ004470
Group of courses YES

	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			90	
Form of crediting	~~Examination /~~ crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	~~Examination /~~ crediting with grade*	Examination / crediting with grade*
For group of courses mark final course with (X)	X				
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,2			1,2	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the rules of the projecting and building relation databases.
2. Skill in defining simple SQL queries.
3. Competences in the field of the structural and object-oriented programming paradigm.

SUBJECT OBJECTIVES

C1. Gain basic knowledge of programming environment of the chosen relational database.
C2. Gain basic knowledge of SQL language.
C3. Gain basic knowledge about the advanced SQL queries.
C4. Gain basic knowledge of database programming language on server side.
C5. Gain basic knowledge of the object-oriented extensions of relational database.
C6. Acquiring basic programming skills in the use of the programming environment of the chosen relational database.
C7. Acquiring basic programming skills in the use of SQL language.
C8. Acquiring basic skills in the use of advanced SQL queries.
C9. Acquiring basic programming skills in the use of database programming language on the server side.

C10. Acquiring basic programming skills in the use of relational database object-oriented extensions for the database schema and for the programming on the database server side.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 He has a basic knowledge about the programming environment of the chosen relational database.
PEU_W02 He has knowledge of the basics of the SQL language.
PEU_W03 He has knowledge necessary for building advanced SQL language queries.
PEU_W04 He knows the structures of database programming language on the server side.
PEU_W05 He has knowledge of object-oriented relational database extensions.

relating to skills:

PEU_U01 He can navigate in the programming environment of the chosen relational database
PEU_U02 He can construct basic SQL language queries.
PEU_U03 He can construct advanced SQL language queries.
PEU_U04 He can program the database on the server side.
PEU_U05 He can use the object-oriented extensions of the relational database, both in the definition of database scheme as well as programming on the server side.

PROGRAM CONTENT

	Lectures	**Number of hours**
Lec 1	Preliminary information on the chosen DBMS.	1
Lec 2	SQL language – basic queries.	2
Lec 3	SQL language - advanced queries.	2
Lec 4	Programming language on the server side - commands and their syntax.	2
Lec 5	Advanced mechanisms of programming language on the server side.	2
Lec 6	Object-oriented extensions of the relational database.	2
Lec 7	Test.	2
Lec 8	Repeating test.	2
Lec 9	Security mechanisms of the relational database, query optimization and optimizers - materials provided by the teacher.	
	Total hours	**15**

	Project	**Number of hours**
Proj 1	Preview, health and safety course, introduction to the chosen DBMS programming environment.	2
Proj 2	Discussion and pass a project list No. 1 concerning the basic SQL queries.	2
Proj 3	Consultation to the project list No. 1 and its implementation.	2
Proj 4	Consulting to the project list No. 1, its implementation and reception.	2
Proj 5	Discussion and pass a project list No. 2, concerning advanced SQL queries.	2
Proj 6	Consultation to the project list No. 2 and its implementation.	2
Proj 7	Consulting to the project list No. 2, its implementation and reception.	2
Proj 8	Discussion and pass a project list No. 3, concerning database programming language on the server side. Test No. 1 concerning advanced SQL queries.	2
Proj 9	Consultation to the project list No. 3 and its implementation.	2
Proj 10	Consulting to the project list No. 3, its implementation and reception.	2

Proj 11	Discussion and pass a project list No. 4 concerning the object-oriented extensions of the relational database. Test No. 2 concerning database programming language on the server side.	2
Proj 12	Consultation to the project list No. 4 and its implementation.	2
Proj 13	Consultation to the project list No. 4 and its implementation	2
Proj 14	Consulting to the project list No. 4, its implementation and reception.	2
Proj 15	Reception of arrears. Credits.	2
	Total hours	**30**

TEACHING TOOLS USED

N1. Lecture using the projector.
N2. Projects as a project task lists.
N3. Consultation.
N4. Student's own work - preparation of project tasks lists and self-refer to the topics identified by the teacher.
N5. Test (project).
N6. Test (lecture).

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_W01,PEU_W02, PEU_U01, PEU_U02	Subject effects are achieved through the implementation of project list No. 1 confirmed by the oral answer. Criteria for the diversification of evaluation: – Implementation of project list No. 1. Point scale - up to 15% of the total number of points which one can obtain during the whole project.
F2	PEU_W03, PEU_U03	Subject effects are achieved through the implementation of project list No. 2 confirmed by the oral answer. Criteria for the diversification of evaluation: – Implementation of project list No. 2. Point scale - up to 15% of the total number of points which one can obtain during the whole project. – Test No. 1. Point scale - up to 20% of the total number of points which one can obtain during the whole project.
F3	PEU_W04, PEU_U04	Subject effects are achieved through the implementation of project list No. 3 confirmed by the oral answer Criteria for the diversification of evaluation: – Implementation of project list No. 3. Point scale - up to 15% of the total

		number of points which one can obtain during the whole project. – Test No. 2. Point scale - up to 20% of the total number of points which one can obtain during the whole project.
F4	PEU_W05, PEU_U05	Subject effects are achieved through the implementation of project list No. 3 confirmed by the oral answer. Criteria for the diversification of evaluation: – Implementation of project list No. 4. Point scale - up to 15% of the total number of points which one can obtain during the whole project.
P1 - partial evaluation (lecture)	PEU_W02,PEU_W03, PEU_W04,PEU_W05, PEU_U02, PEU_U03, PEU_U04, PEU_U05	Subject effects are achieved by earning at least a half points for the test. Evaluation determined on the basis of the number of points gained (the percentage of the total number of points available) according to the formula: < 0%, 50%) → ndst (2.0) <50%, 60%> → dst (3.0) (60%, 70%> → dst+ (3.5) (70%, 80%> → db (4.0) (80%, 90%> → db+ (4.5) (90%, 100%> → bdb (5.0)
P2 - partial evaluation (project)	PEU_W01,PEU_W02, PEU_W03,PEU_W04, PEU_W05, PEU_U01, PEU_U02, PEU_U03, PEU_U04, PEU_U05	Subject effects are achieved through the implementation of all project lists. A prerequisite for obtaining credit (rating 3.0 and higher) is achieving all of subject effects. Otherwise, the student gets a failing grade (rating 2.0). Higher rating is determined on the basis of the total number of points scored in the evaluations forming F1, F2, F3 and F4 (the percentage of the total number of points to obtain the project) according to the formula: <0%, 68%> → dst (3.0) (68%, 76%> → dst+ (3.5) (76%, 84%> → db (4.0) (84%, 92%> → db+ (4.5) (92%, 100%> → bdb (5.0)
P – final evaluation	PEU_W01,PEU_W02, PEU_W03,PEU_W04, PEU_W05, PEU_U01, PEU_U02, PEU_U03, PEU_U04, PEU_U05	Subject effects are achieved through obtaining a positive partial evaluation (at least 3.0) of both P1 and P2. The final evaluation is the arithmetic average of the partial evaluations P1 and P2.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE (FOR ORACLE DBMS):

[1] J. Price, Oracle Database 12c i SQL. Programowanie, Wydawnictwo Helion, Gliwice 2015.
[2] L. Barney, M. McLaughlin, Oracle Database 12c. Programowanie w języku PL/SQL, Wydawnictwo Helion, Gliwice 2015.
[3] K. Loney, Oracle Database 11g. Kompendium administratora, Wydawnictwo Helion, Gliwice 2010.
[4] A. Pelikant, Programowanie serwera Oracle 11g SQL i PL/SQL. eBook, Wydawnictwo Helion, Gliwice 2012.
[5] F. Steven, Oracle PL/SQL. Najlepsze praktyki, Wydawnictwo Naukowe PWN, Warszawa 2009.
[6] Materials provided by the lecturer.

SECONDARY LITERATURE:

[1] T. Connolly, C. Begg, Systemy baz danych, T. 1 i 2, Wydawnictwo RM, Warszawa 2004.
[2] H. Ladanyi, SQL, Księga eksperta, Wydawnictwo Helion, Gliwice 2000.

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

Zbigniew Staszak, zbigniew.staszak@pwr.edu.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Projektowanie baz danych
Name of subject in English: Database Design
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic / practical*
Level and form of studies: 1st level, full-time *
Kind of subject: optional
Subject code INZ004424
Group of courses YES

	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			90	
Form of crediting	crediting with grade*			crediting with grade*	
For group of courses mark final course with (X)	X				
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,2			1,2	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed the „Databases" course.

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SUBJECT OBJECTIVES

C1 Introduce the methods of databases design and implementation to students
C2 Gather knowledge of available databases design and implementation tools
C3 Applying the acquired knowledge during the design of relational and object databases

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEK_W01 Student has a basic knowledge of methods and available tools for databases design
PEK_W02 Student is able to present all phases of databases design

relating to skills:
PEK_U01 Student is able to prepare all phases of databases design
PEK_U02 Student is able to implement a database
PEK_U03 Student is able to choose proper tools for databases design

relating to social competences:
PEK_K01 Student is able to search and reuse the primary and secondary literature listed below and is able to gather the proper knowledge
PEK_K02 Student understands the need for systematic and individual work in order to cover the scope of the course

PROGRAM CONTENT		
Lectures		**Number of hours**
Lec 1	Introduction to database system design methodology	1
Lec 2	Selected elements of UML	1
Lec 3	Entity-relationship schemas design	2
Lec 4	Relational schemas design	2
Lec 5	Conceptual model of a database	2
Lec 6	Logical model of a database	2
Lec 7	Physical model of a database	2
Lec 8	An overview of available tools for database design	1
Lec 9	Types and specification methods of integrity constraints	1
Lec 10	Test	1
	Total hours	**15**
Project		**Number of hours**
Proj 1	Introduction to database design (Power Designer, Visio)	2
Proj 2	Relational model: conceptual model of a database	2
Proj 3	Relational model: logical model of database	2
Proj 4	Relational model: physical model of database	2
Proj 5	Relational model: integrity constraints	2
Proj 6	Relational model: interface and report design, constraints	2
Proj 7	Object model: class diagrams	2
Proj 8	Object model: description of methods	2
Proj 9	Implementation of a database schema	4
Proj 10	Implementation of integrity constraints	4
Proj 11	Implementation of an interface	4
Proj 12	Implementation of reports, evaluation of projects	2
	Total hours	**30**

TEACHING TOOLS USED
N1. Traditional lecture N2. Labs N3. One-to-one consultancy during stuff hours N4. Student self-study

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P –	Learning outcomes number	Way of evaluating learning outcomes achievement

concluding (at semester end)		
P- project	PEK_U01-PEK_U03, PEK_K01-PEK_K02	Evaluation of the prepared tasks during labs, oral test
P- lecture	PEK_W01-PEK_W02 PEK_K01-PEK_K02	Test

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Beynon-Davies P., *Systemy baz danych*. WNT, W-wa, 2003
[2] Connolly T., Begg C., *Systemy baz danych*. RM 2004. T2
[3] Date C.J., *Wprowadzenie do baz danych*. WNT, W-wa, 2000.
[4] Szeląg A., *PHP, Microsoft IIS, SQL Server : projektowanie i programowanie baz danych*. Helion 2008
[5] Ullman J.D., *Systemy baz danych*. WNT, W-wa, 2003.
[6] Wrembel R., *Oracle : projektowanie rozproszonych baz danych : wiedza niezbędna do projektowania oraz zarządzania bazami danych*. Helion 2003.

SECONDARY LITERATURE:

[1]

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

Ngoc Thanh Nguyen, Ngoc-Thanh.Nguyen@pwr.wroc.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Bazy danych
Name of subject in English: Databases
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic / practical*
Level and form of studies: 1st, full-time
Kind of subject: obligatory
Subject code INZ002023
Group of courses YES (Lecture, Classes), NO (Laboratory)

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15	15		
Number of hours of total student workload (CNPS)	115		60		
Form of crediting	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark final course with (X)	X				
Number of ECTS points	4		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	2,4		1,2		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. None

SUBJECT OBJECTIVES

C1 Gaining the basic knowledge about databases, data models and their implementation in a DBMS
C2 Acquisition of the ability to define and process data stored in databases

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEK_W01 Describes the principles of data modeling at different levels of abstraction
PEK_W02 Presents basic transformation rules of data models and their verification
PEK_W03 Describes implementation rules of data models in a DBMS
PEK_W04 Presents the role and possibilities of using the SQL standard in a DBMS systems
PEK_W05 Defines the rules for defining architecture of database systems

relating to skills:
PEK_U01 Defines a conceptual data model using the UML
PEK_U02 Transforms conceptual data model into a physical model, taking into account the business rules and domain constraints

PEK_U03 Removes anomalies of data using the normalization process
PEK_U04 Defines queries using DML database languages and their implementation in a DBMS for searching and processing of data in databases
PEK_U05 Knows and applies safety rules of working

PROGRAM CONTENT

Lectures		**Number of hours**
Lec 1	Introduction - General Course Information – Concepts and Architecture	2
Lec 2	Data modeling at different levels of abstractions - aims, properties, languages of specifications	2
Lec 3	The Relational Data Model – definition, properties, constraints	2
Lec 4	The Relational Algebra	2
Lec 5	Functional Dependencies - Normal Forms - Normalization Process	2
Lec 6	Normalization Process cont.	2
Lec 7	Introduction to Data Definition Language (DDL)	2
Lec 8	Implementation of conceptual data models using the SQL standard DDL - basic information	2
Lec 9	DDL – Implementation of constraints	2
Lec 10	Introduction to Data Manipulation Language (DML), Transactions	2
Lec 11	DML - Data Modification (INSERT, UPDATE, DELETE)	2
Lec 12	DML Query - Joins, Subquery, Set Operations, Views	2
Lec 13	DML - Common Table Expressions, Stored Procedure, Triggers	2
Lec 14	NoSQL Databases	2
Lec 15	Test	2
	Total hours	30

Classes		**Number of hours**
Cl 1	Introduction – Data - Data Models - DBMS	2
Cl 2	Data modeling – UML/ERD- (P01)	2
Cl 3	Examples of simple databases, Basic rules of transformation of data models	2
Cl 4	The Relational Algebra Operations - (P02)	2
Cl 5	Normalization process – 1NF, 2NF, 3NF - (P03)	2
Cl 6	Normalization process – BCNF, 4NF - (P03)	2
Cl 7	Transactions – Concurrency Control Technics - (P04)	2
Cl 8	Test	1
	Total hours	15

Laboratory		**Number of hours**
Lab 1	Health and safety training. Conditions of the course. Organization of work, Introduction to DBMS (P08)	2
Lab 2	Analysis of exemplary databases	2
Lab 3	DDL – creating simple database –"Our University" (Student, Course, Teacher, etc.) – (P05)	2

Lab 4	DML - INSERT, UPDATE, DELETE – (P06)	2
Lab 5	DML Query - Joins, Subquery, Set Operations, Views (P06)	2
Lab 6	DML - Common Table Expressions (P06)	2
Lab 7	Programming - Stored Procedure, Triggers, User Defined Functions (UDF) – (P07)	2
Lab 8	Test	1
	Total hours	15

TEACHING TOOLS USED

N1. Lecture informative with elements of problem domains, supported by multimedia presentations and examples of solutions
N2. Database management systems
N3. E-learning system used for the publication of teaching materials and messages, and evaluate student work

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1 – laboratory grade	PEK_U01 - 05	Grade from laboratory exercises from within scale 0..100%
F2 – classes grade	PEK_U01 – 05	Grade from classes exercises from within scale 0..100%
F3 – lecture grade	PEK_W01 - 05	Grade from final test from within scale 0..100%
P1 – course final grade (lecture,classes) based on F2 and F3 (while F1 >=50%)		
P2 – laboratory final grade based on F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Connolly T., Begg C., Database Systems. A Practical Approach to Design, Implementation, and Management 4th ed., Addison Wesley, 2005
[2] Celko J., SQL for Smarties. Advanced SQL Programming, 3th ed., Elsevier, 2005
[3] Elmasri R., Navathe S., Fundamentals of Database Systems 5th ed., Addison Wesley, 2007
[4]Kifer M., Bernstein A., Lewis P., Database Systems. An Application-Oriented Approach 2nd ed., Addison Wesley, 2006

SECONDARY LITERATURE:

[1] Ben-Gan I., Microsoft SQL Server 2008, T-SQL Fundamentals, Microsoft Press, 2009
[2] The educational materials prepared by the teacher course on the basis of the documentation MS SQL, Oracle, and Internet resources

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

Marek Kopel marek.kopel@pwr.edu.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Aplikacje webowe na platformę .NET
Name of subject in English: Developing Web Applications with .NET
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: ~~academic~~ / practical*
Level and form of studies: 1st/ ~~2nd~~ level~~, uniform magister studies~~*, full-time / ~~part-time~~ studies*
Kind of subject: ~~obligatory~~ / optional / ~~university-wide~~*
Subject code INZ002028
Group of courses YES / ~~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	~~Examination~~ / crediting with grade*	~~Examination~~ / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark final course with (X)	X				
Number of ECTS points	**2**		2		
including number of ECTS points for practical (P) classes	2		2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,2		1,2		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Ability to object-oriented programming in Java.

SUBJECT OBJECTIVES

C1 The ability to develop an advanced web applications in C# and .NET Framework using Visual Studio IDE

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01: Students could list and describe the basic software components used in the implementation of desktop applications with the console on .NET platform

PEK_W02: Students could list and describe the basic software components used in the implementation of an advanced web applications on .NET platform.

relating to skills:

PEK_U01: Student is able to analyze and select the proper types and language constructs to support object-oriented programming paradigm on .NET platform.
PEK_U02: Student is able to implement a desktop application with a console interface.
PEK_U03: Student obtains information from various sources and is able to choose the right technology to implement an advance web application.

PROGRAM CONTENT		
Lectures		**Number of hours**
Lec 1	An introduction to the course and the principles of assessment. Basics of .NET Framework and Visual Studio IDE	2
Lec 2	Basics of C# - part 1: basic data types, variables, methods, value and reference types, operators, flow control	2
Lec 3	Basics of C# - part 2: classes, structs, members, interfaces, enumerated types, types and partial methods	2
Lec 4	Basics of C# - part 3: generics, collections	2
Lec 5	Basics of C# - part 4: inheritance, object lifetime, exceptions	2
Lec 6	Basics of C# - part 5: delegates, lambdas and events	2
Lec 7	Test 1	2
Lec 8	MVC pattern in ASP.NET, annotations.	2
Lec 9	Routing, controllers, data binding	2
Lec 10	Razor language and mechanisms for CSHTML page views	2
Lec 11	ADO .Net, Entity Framework Code-First, the basics of Fluent API	2
Lec 12	LINQ language, Entity Framework Base-First, Model-First	2
Lec 13	Authorization management, session, application publication	2
Lec 14	MS Cloud Azure	2
Lec 15	Test 2	2
	Total hours	30

Laboratory		**Number of hours**
Lab 1	Organizational classes. Presentation of the scope and principles of evaluation. To familiarize students with the principles of health and safety. Define and run demo applications in the Visual Studio environment	2
Lab 2	Define and run demonstration projects of console applications in the Visual Studio environment	2
Lab 3	Console applications using structures and classes.	2
Lab 4	Console applications using generic collections	2
Lab 5	Console applications with generic types	2
Lab 6	Console applications with collections	2
Lab 7	Console applications with inheritance	2
Lab 8	Console applications with lambda expressions and events	2
Lab 9	A simple web application with the MVC pattern.	2

Lab 10	Web application with data binding and own routing	2
Lab 11	Web application with Razor pages and own templates	2
Lab 12	Web application with a database using EF Code-First	2
Lab 13	Web application with a database using LINQ / Fluent API	2
Lab 14	Web application with a database with permissions and a session.	2
Lab 15	Grading and the questionnaire of the course	2
	Total hours	30

TEACHING TOOLS USED
N1. Multimedia lecture. N2. Computer didactic laboratory with development environment. N3. An e-learning system used for the publication of teaching materials, tests and communication

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
FL – points from laboratory	PEK_U01 PEK_U02 PEK_U03	Implementation of tasks indicated by the teacher. The final score in the range [0; 50]
FW – points from classes	PEK_W01 PEK_W02	Solving tasks from two tests. The final score in the range [0; 50]
P=FL+FW, Final grade according to the scale: [0;50) - 2.0 [50;62) - 3.0 [62;73) - 3.5 [73;84) - 4.0 [84;95) - 4.5 [95;100] - 5.0		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE:
[1] J. Albahari, B. Albahari. C# 7.0 w pigułce. Wydanie VII. Helion 2018 [2] K. Żydzik, T. Rak. C# 6.0 i MVC 5. Tworzenie nowoczesnych portali internetowych, Helion 2015
SECONDARY LITERATURE:
[1] Ch. Nagal. Professional C# 6 and .NET Core 1.0. John Wiley & Sons, Inc., Indianapolis, 2016
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FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Techniki przetwarzania mediów cyfrowych
Name of subject in English: Digital Media Processing Techniques
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic / ~~practical~~*
Level and form of studies: 1st~~/ 2nd level, uniform magister studies~~*, full-time / ~~part-time~~ studies*
Kind of subject: ~~obligatory~~ / optional / ~~university-wide~~*
Subject code INZ004439
Group of courses YES / ~~NO~~*

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

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of Discret Fourier Transform, Discret Cosine Transform and reverse transformations
2. Basic knowledge in acoustics: nature of acoustic waves, parameters describing the wave.
3. Basic knowledge in optics

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SUBJECT OBJECTIVES

C1 Acquiring knowledge on digitalization of analog multimedia information and methods of digital media processing for typical applications
C2 Acquiring skills of creating, processing and mixing digital media using specialized software.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 Student is able to list and describe a proces of digitalisation of analog multimedia information, he/she knows distortions that occure in this proces and the methods of removing them
PEU_W02 Student knows selected methods of multimedia compression
PEU_W03 Student knows the methods od digital sound processing

PEU_W04 Student i s able to list and describe selected methods of sound synthesis; he/she has basic knowledge about MIDI system
PEU_W05 Student is able to list and describe models and color systems, he/she knows the difference between vector graphics and raster image
PEU_W06 Student can list and desribe typical operations used in digital image porcessing, he/she knows their applications
relating to skills:
PEU_U01 Student is able to use specialized software to create, edit and mix digital media

PROGRAM CONTENT

Lectures		**Number of hours**
Lec 1	Intorduction. Nature of sound. Parameters of accoustic wave. Basics of psychoacoustics.	2
Lec 2	Digitalization of sound: steps, parameters, distortions: reasons, prevention and removing	2
Lec 3	Sound images in the time and frequency domain	1
Lec 4	Basic methods of digital sound processing.	3
Lec 5 Lec 6	Coding and compression of sound data: lossless methods, perceptual coding, MPEG compression algorithm, transmission codes	4
Lec 7	Sound synthesis	2
Lec 8	Basics of the MIDI system	2
Lec 9	Human perception of images. Models and color systems. Vector and raster images. Aquisition of digital images: steps, parameters and distortions	2
Lec 10	Digital image processing: context free operations, their applications	2
Lec 11	Digital image processing: context operations, linear and non linear filters, their applications	2
Lec 12	Feature detection in digital images	2
Lec 13	Digital image processing: morphological operations	2
Lec 14	Digital image processing: segmentation and tresholding	2
Lec 15	Digital image compression	2
	Total hours	

Laboratory		**Number of hours**
Lab 1	Organization of laboratory: introduction, organization and time table, conditions of passing the subject, OSH training	2
Lab 2, Lab 3	Simple edition of a sound file: recording own voice, removing noise, format conversion, cutting, pasting and mixing recordings, volume adjustment	4
Lab 4, Lab 5, Lab 6	Advanced edition of a sound file: use special effects (e.g. chorus, reverb etc.) to create full sound panorama. Modifications of own voice to get the voicw of another person.	6
Lab 7, Lab 8	Simple edition of digital image on the example of retouching an old photo	4
Lab 9- Lab 11	Advanced edition of digital images on the example of photomontage of the face and the whole character.	6

Lab 12, Lab 13, Lab 14	Design and implementation of the final task involving preparation of a multimedia presentation combining processed image and sound (for example instructional material on a given topic)	6
Lab 15	Presentation of the final task	2
	Total hours	30

TEACHING TOOLS USED

N1. Traditional lecture supported by the presentation
N2. E-learning – materials for the lecture
N3. E-learning: organization of laboratory, sharing exercise instructions and teaching aids, transfer of taks results and laboratory documentation (reports), use of forum, chat and e-mail to communicate with the teacher and other members of the group
N4. – E-learning – exam in the form of an electronic test

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01	Average marks for the implementation of individual exercises
F2	PEU_U01	Average marks for reports
F3	PEU_U01	Evaluation for the final task
P - Laboratory	PEU_U01	The final laboratory grade is the weighted average of the forming grades: `0,3*F1+0,3*F2+0,4*F3`
P - Lecture	PEU_W01 – PEU_W06	Exam result: to pass the exam it is necessary to get at least 50% of points that are possible to get in the test

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Chapman N., Chapman J., Digital Multimedia, Third Edition, John Wiley & Sons, Ltd., Chichester, 2009
[2] Malina W., Smiatacz M., Cyfrowe przetwarzanie obrazów, Warszawa: Akademicka Oficyna Wydawnicza EXIT, 2008.
[3] Gonzales R.,Woods R., Digital Image Processing, Prentice–Hall, New Jersey, 2001.
[4] Czyżewski A., Dźwięk Cyfrowy: wybrane zagadnienia teoretyczne, technologia, zastosowania, Wyd. 2, Warszawa: Akademicka Oficyna Wydawnicza EXIT, 2015.
[5] Nowak W., Homan W., Midi: muzyczny standard dla komputerów, Kraków: Wydawnictwo DMM, 1994.

SECONDARY LITERATURE:

[1] Petrou M., Petrou C., Image Processing: The Fundamentals, 2nd ed., Chichester: John Wiley & Sons, 2010.
[2] Goodall, D. P., Haas, O. C. L., Signal and Image Processing, Wrocław: Wrocław University of Technology ; Łódż : PRINTPAP, 2011.
[3] Speech and audio processing in adverse environments, Eds. Hänsler E., Schmidt G., Berlin ; Heidelberg : Springer-Verlag, cop. 2010.
[4] Zolzer U., Digital audio signal processing, Chichester: John Wiley and Sons, 1997.
[5] Pavlidis T., Grafika i przetwarzanie obrazów, WNT, Warszawa, 1987.
[6] Skarbek W., Metody reprezentacji obrazów cyfrowych, PLJ, Warszawa, 1993.
[7] Tadeusiewicz R., Korohoda P., Komputerowa analiza i przetwarzanie obrazów, FPT, Kraków, 1997.

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Zał. nr 5 do ZW 16/2020

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Matematyka Dyskretna
Name of subject in English: Discrete Mathematics
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic
Level and form of studies: 1st level, full-time
Kind of subject: obligatory
Subject code INZ004406
Group of courses YES

	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	crediting with grade				
For group of courses mark final course with (X)	X				
Number of ECTS points	2	3			
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	3				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of set theory.
2. Basic knowledge of formal logic (propositional logic and first-order logic).

SUBJECT OBJECTIVES

C1. A student is supposed to obtain fundamental knowledge of discrete mathematics understood as a set of formal tools needed to define and solve simple problems in the areas of knowledge representation and processing, discrete optimization, and information retrieval in the context of computer science.

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge:

PEK_W01 A student knows and understands basic concepts of discrete mathematics applicable to the construction and understanding of simple tasks of information and knowledge processing in the context of computer – based systems.

PEK_W02 A student knows and understands basic concepts of discrete mathematics applicable to the construction and understanding of simple tasks of information retrieval in the context of computer – based systems.

PEK_W03 A student knows and understands basic concepts of discrete mathematics applicable to the construction and understanding of simple problems of discrete optimization in the context of computer – based systems.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec01	Introduction. Set, union and intersection of sets, relative and absolute complement of a set, symetric difference of sets. Set algebra laws. Power set.	2
Lec02	Cartesian product. Properties of cartesian product. Introduction to the mathematical theory of relations. Binary relations.	2
Lec03	Application of first-order predicate calculus to defining and verifying properties of binary relations.	2
Lec04	Basic tasks of knowledge processing in discrete universe of objects with macrostructure (representation choice, object grouping, object retrieval).	2
Lec05	The universe of binary relations	2
Lec06	Directed graphs and binary relations. Operations on binary relations. Transitive reduct and transitive completion.	2
Lec07	The universe of sets.	2
Lec08	The universe of equivalence relations.	2
Lec09	Approximation space and rough sets.	2
Lec10	Information system - basic concepts. Rough Sets Descriptions. Decision tables	2
Lec11	The universe of tolerance (similarity) relations and the universes of orders.	2
Lec12	Introduction to the theory of multisets. The theory of fuzzy sets. Linguistic variables.	2
Lec13	Discrete models of semantic relations in knowledge processing systems and wordnets. Classical and extended thesauri for information retrieval tasks.	2
Lec14	An overview of alternative universes of complex discrete objects.	2
Lec15	Final test	2
	Total hours	30

Form of classes - class		Number of hours
Tut01	Sets, operations on sets (union and intersection of sets, relative and absolute complement of a set, symetric difference of sets). Power set. Characteristic function of the set.	2
Tut02	Proving the set algebra theorems	2
Tut03	Cartesian product. Representation of binary relations.	2
Tut04	Application of first-order predicates to defininig and verifying of properties of binary relations. Types of binary relations.	2
Tut05	The tasks of representation choice, object grouping, and object retrieval in the universe of objects with macrostructure.	2
Tut06	The tasks of knowledge processing, optimization and object retrieval in the universe of binary relations.	2
Tut07	Operation in the universe of Binary relations. Algorithms of determinantion of transitive reduct and transitive completion of binary relations.	2
Tut08	Test 1.	2
Tut09	Similarity and distance functions in the universe of sets - definitions and applications.	2
Tut10	Similarity and distance functions in the universe of equivalence relations - definitions and applications.	2
Tut11	Set-based information retrieval language in information systems. Approximation space and functional dependency of information system attributes.	2
Tut12	Rough sets and decision tables.	2
Tut13	Binary relations in the universes of complex discrete objects.	2
Tut14	Test 2.	2
Tut15	Final test.	2
	Total hours	30

TEACHING TOOLS USED
N1. Traditional lecture. N2. Self study – literature studies. N3. Self study – problem solving. N4. Group tutorials – group problem solving and discussions of complex cases during regular meetings.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 PEK_W02 PEK_W03	Total point score F1 of the task completion obtained on the basis of the first written test planned in the schedule of tutorial classes, supplemented with a point-based assessment of any additional and documented achievements. Supplementary score may

		result from solving of additional computational tasks, and active and substantively correct participation in solving tasks during tutorial classes. The first test is claimed to be credited after obtaining a minimum of 50% of the maximum number of F_{MAX1} points assigned to the first test.
F2	PEK_W01 PEK_W02 PEK_W03	Total point score F2 of the task completion obtained on the basis of the second written test planned in the schedule of tutorial classes, supplemented with a point-based assessment of any additional and documented achievements. Supplementary score may result from solving of additional computational tasks, and active and substantively correct participation in solving tasks during tutorial classes. The second test is is claimed to be credited after obtaining a minimum of 50% of the maximum number of F_{MAX1} points assigned to the second test.
F3	PEK_W01 PEK_W02 PEK_W03	Provided that the conjunctive condition $F1 \geq ½F_{MAX1}$ and $F2 \geq ½F_{MAX2}$ is fulfilled, the total point score F3 is given as F3 = F1+F2. Provided that the conjunctive condition $F1 \geq ½F_{MAX1}$ and $F2 \geq ½F_{MAX2}$ is not fulfilled, the total point score F3 is obtained on the basis of the final written test planned in the schedule of tutorial classes. The final test is claimed to be credited after obtaining a minimum of 50% of the maximum number of points $F_{MAX3} = F_{MAX1} + F_{MAX2}$.
W	PEK_W01 PEK_W02 PEK_W03	Total point score W obtained on the basis of obtained on the basis of a written test planned in the schedule of lectures.

P2. The obligatory condition for obtaining a positive final grade is getting a pass of the exercise. If the condition is met, the basis for obtaining the assessment is the number F = W1 + F3. The assessment is based on the table:

$[F/F_{MAX}]$ %	40%	60%	70%	80%	90%
Grade	3.0	3.5	4.0	4.5	5.0

where: $F_{MAX} = W_{MAX} + F_{MAX3}$ and W_{MAX} is the maximum number of points possible to obtain on the basis of the test planned for in the schedule of lectures.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

1. Ross K.A., Wright Ch., *Matematyka Dyskretna.* PWN, Warszawa 2006.
2. Rasiowa H., *Wstęp do matematyki współczesnej.* PWN, Warszawa 2003.
3. Czogała E., Pedrycz W., *Elementy i metody teorii zbiorów rozmytych.* PWN, Warszawa 1985.

SECONDARY LITERATURE:

1. Bolc L., Borodziewicz W., Wójcik M., *Podstawy przetwarzania informacji niepewnej i niepełnej.* PWN, Warszawa 1991.
2. Daniłowicz C., *Modele systemów wyszukiwania informacji uwzględniające preferencje użytkowników końcowych.* Wydawnictwo Politechniki Wrocławskiej, Wrocław 1992.
3. Daniłowicz C., Nguyen N. T., Jankowski Ł., *Metody wyboru reprezentacji stanu wiedzy agentów w systemach multiagenckich.* Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2002.
4. Hand D., Mannila H., Smyth P., *Eksploracja danych.* WNT, Warszawa 2005.
5. Kuratowski K., *Wstęp do Teorii Mnogości i Topologii*. Państwowe Wydawnictwo Naukowe, Warszawa, 1982.
6. Lipski W., *Kombinatoryka dla programistów.* WNT, Warszawa 1982.
7. Lipski W., Marek W., *Analiza kombinatoryczna.* PWN, Warszwa 1986.
8. Majewski W., Albicki A., *Algebraiczna teoria automatów.* WNT, Warszawa 1980.
9. Mazur Z., *Modele i modyfikacje rozproszonych systemów wyszukiwania informacji opartych na tezaurusach z wagami.* Wydawnictwo Politechniki Wrocławskiej, Wrocław 1989.
10. Graham R. L., Knuth D. E., Patashnik O., *Matematyka Konkretna*. PWN, Warszawa 1996.
11. Reinglod E. M., Nievergelt J., Deo N., *Algorytmy kombinatoryczne*. PWN, Warszawa 1985.
12. Zadrożny S., *Zapytania nieprecyzyjne i lingwistyczne podsumowania baz danych.* Akademicka Oficyna Wydawnicza EXIT, Warszawa 2006.
13. Zakrzewski M., *Markowe Wykłady z Matematyki - matematyka dyskretna.* Oficyna Wydawnicza GiS s.c., Wrocław 2014.

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

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FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Rozproszone systemy informatyczne
Name of subject in English: Distributed computer systems
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic / practical*
Level and form of studies: 1st/ ~~2nd~~ level, ~~uniform magister studies~~*, full-time / ~~part-time studies~~*
Kind of subject: ~~obligatory~~ / optional / ~~university-wide~~*
Subject code INZ002035
Group of courses YES / ~~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		90		
Form of crediting	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark final course with (X)	X				
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,2		1,2		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge about the operation of computer operating systems.
2. Basic knowledge about the operation of computer networks.
3. Basic knowledge of programming in Java, C/C++, C#.

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SUBJECT OBJECTIVES

C1. Obtaining basic knowledge in the field of architecture of distributed systems, as well as technologies and techniques used in distributed systems.

C2 Acquiring the ability to implement applications for selected distributed processing environments.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Knows the basic basic architectures of distributed computer systems and examples of such systems.

PEU_W02 Describe selected technologies and techniques for implementing applications for a distributed processing environment.

relating to skills:
PEU_U01 Is able to implement basic applications in a distributed computing environment in selected technologies.

PROGRAM CONTENT		
Lectures		**Number of hours**
Lec 1	Presentation of the course organization and program. Introduction to the subject: basic features, purpose and design assumptions of multiprocessor and distributed systems.	2
Lec 2	Middleware services - mechanisms and selected remote procedure call (RPC) techniques.	2
Lec 3	Middleware services - distributed objects (DO). Selected implementation technique and universal worker model.	2
Lec 4	Web Services - concepts of SOA, REST, Web API, AJAX.	2
Lec 5	Application programming in the SOA concept.	2
Lec 6	Application programming in the REST and Web API concept.	2
Lec 7	Programming web clients of RIA type applications.	2
Lec 8	Microservices and component services (SCA architecture).	2
Lec 9	Streaming in distributed systems - selected application implementation techniques.	2
Lec 10	Selected problems of distributed processing - point-to-point communication, collective communication and communication costs.	2
Lec 11	Selected problems of distributed processing - coordination of processes in distributed systems.	2
Lec 12	Selected problems of distributed processing - distributed transactions.	2
Lec 13	Selected problems of distributed processing - reliability of processing in distributed systems.	2
Lec 14	Peer-to-Peer (P2P) systems.	2
Lec 15	Passing test.	2
	Total hours	**30**
Laboratory		**Number of hours**
Lab 1	Discussion of the organization and program of classes. OSH training. Presentation of teaching tools.	2
Lab 2	Programming RPC applications using XML RPC and/or JSON RPC standards.	2
Lab 3	Programming RPC applications using the gRPC framework.	2
Lab 4	Programming distributed applications using Java RMI.	2
Lab 5	Distributed applications in service-oriented architecture using Microsoft WCF - part 1 basics of programming.	2
Lab 6	Distributed applications in service-oriented architecture using Microsoft WCF - part 2. Asynchronous procedures and streaming.	2
Lab 7	Application programming under the SCA concept. Docker environment - part I.	2

Lab 8	Application programming under the SCA concept. Docker environment - part II.	2
Lab 9	REST style web services - part I.	2
Lab 10	REST-style web services - part II.	2
Lab 11	REST web application with a fat client.	2
Lab 12	Application using the WebSocket protocol.	2
Lab 13	Application implementing selected control mechanisms in a distributed system - part I.	2
Lab 14	Application implementing a selected control mechanisms in a distributed system - part II.	2
Lab 15	Summary and discussion of classes. Final passing the class and issuing grades.	2
	Total hours	**30**

TEACHING TOOLS USED

N1. Informative lecture supported by multimedia presentations.
N2. Printed or electronic laboratory exercises.
N3. Development software for implementing distributed applications for selected environments..
N4. An e-learning system for publishing teaching materials, tasks and announcements, and collecting and assessing student work, as well as for carrying out knowledge tests.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), C – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1 – La2	PEK_U01	Assessment of completeness and quality of task solution. Point scale 0÷3.
F2 – La3	PEK_U01	Assessment of completeness and quality of task solution. Point scale 0÷10.
F3 – La5	PEK_U01	Assessment of completeness and quality of task solution. Point scale 0÷10.
F4 – La6	PEK_U01	Assessment of completeness and quality of task solution. Point scale 0÷10.
F5 – La8	PEK_U01	Assessment of completeness and quality of task solution. Point scale 0÷10.
F6 – La9	PEK_U01	Assessment of completeness and quality of task solution. Point scale 0÷10.
F7 – La10	PEK_U01	Assessment of completeness and quality of task solution. Point scale 0÷10.
F8 – La11	PEK_U01	Assessment of completeness and quality of task solution. Point scale 0÷10.
F9 – La12	PEK_U01	Assessment of completeness and quality of task solution. Point scale 0÷10.
F10 – La14	PEK_U01	Assessment of completeness and quality of task solution. Point scale 0÷10.

C1 – final evaluation from the laboratory	PEK_U01	The grade is determined on the basis of sum of points from the grades F1 to F10 according to the formula: - below 50% of points – ndst (2.0) [50%, 60%) – dst (3.0) [60%, 70%) – dst+ (3.5) [70%, 80%) – db (4.0) [80%, 90%) – db+ (4.5) [90%, 100%) – bdb (5.0) 100% - discretionary (e.g. additional task)
C2 – final evaluation from the lecture	PEK_W01, PEK_W02.	Knowledge test - written or electronic test using an e-learning system. Grade based on the score obtained from the test. Rating scale as for C1.
C3 – final evaluation from the lecture	The final grade C3 is calculated on the basis of 50% of C1 and 50% of C2. The condition for obtaining a positive grade C3 is obtaining a positive grade for both C1 and C2 components.	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Tanenbaum A. S., van Steen M.: Distributed systems : principles and paradigms, Pearson Prentice Hall, 2007.
[2] M. P. Papazoglou: Web Services & SOA. Principles and Technology, Pearson Education Limited, 2012.
[3] Richardson L., Ruby S.: RESTful Web Services, O'Reilly Media, Inc., 2007.
[4] Buford J. Yu H., Lua E.K.: P2P Networking and Applications, Morgan Kaufman 2009
[5] Curry E.: Message-Oriented Middleware, Middleware Communications, 2004.
[6] Löwy J., Montgomery M.: Programming WCF Services. Design and Build Maintainable Service-Oriented Systems, O'Reilly Media, Inc., 2016.
[7] Krochmalski J.: Docker : projektowanie i wdrażanie aplikacji, Helion, 2017.
[8] Oracle electronic documentation - materials for the considered techniques, http://www.oracle.com

SECONDARY LITERATURE:

[9] Coulouris G., Dollimore J., Kindberg T.: Distributed systems : concepts and design, Addison-Wesley, 2005.
[10] Hasan J.: Expert Service-Oriented Architecture in C#: Using the Web Services Enhancements 2.0, Apress, 2004.
[11] Allamaraju S.: RESTful Web Services Cookbook, O'Reilly Media, Inc., 2010.
[12] R. Steinmetz, K. Wehrle: Peer-to-Peer Systems and Applications, LNCS 3485, Springer, 2005.
[13] Nagel C.: Professional C# 7 and .NET Core 2.0, John Wiley & Sons, 2018.
[14] Kane S. P., Matthias K.: Docker : praktyczne zastosowania, Helion, 2017.
[15] IBM Redbooks electronic documentation - materials for the considered techniques, http://www.ibm.com/redbooks

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

Mariusz Fraś, mariusz.fras@pwr.edu.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Techniki efektywnego programowania
Name of subject in English: Effective programming techniques
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic *
Level and form of studies: 1st~~/ 2nd level, uniform magister studies*,~~ full-time / ~~part-time studies*~~
Kind of subject: obligatory /~~ optional / university-wide*~~
Subject code: INZ004408
Group of courses ~~YES~~ / 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)	60		90		
Form of crediting	~~Examination /~~ crediting with grade*	Examination / crediting with grade*	~~Examination /~~ crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark final course with (X)					
Number of ECTS points	2		3		
including number of ECTS points for practical (P) classes			3		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,2		1,8		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic programming skills.
2. Basic knowledge of data structures and algorithms.
3. The ability to object-oriented programming in the basic level.

SUBJECT OBJECTIVES

C1 To familiarize students with the object-oriented programming paradigm in languages that require manual memory management.
C2 To familiazize students with memory addressing techniques and the practical use of pointers.
C3 Acquiring the skill of writing programs with manual memory management.
C4 Acquiring the skills of addressing memory and practical use of indicators.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEK_W01 Knows object-oriented programming mechanisms in languages requiring manual memory management
PEK_W02 Knows memory addressing techniques and the practical use of pointers.
Relating to skills:

PEK_U01 Is able to write effective programs in accordance with the object-oriented programming paradigm in languages requiring manual memory management.
PEK_U02 Is able to address memory and use the mechanisms offered by pointers in practice.

PROGRAM CONTENT

	Lectures	**Number of hours**
Lec 1	Object-oriented programming languages. Introduction to C ++, differences and benefits of using languages that allow you to manually manage your memory.	**2**
Lec 2	Dynamic memory allocation and deallocation - basics, pointers, tables.	**2**
Lec 3	Constructors and destructors, operator overloading, and memory management.	**2**
Lec 4	Advanced methods of object oriented programming. Polymorphism in C ++, important features of the template mechanism in C ++.	**2**
Lec 5	Advanced methods of object oriented programming. Inheritance and Multiply inheritance in C++.	**2**
Lec 6	Advanced methods of object oriented programming. Exemption handling.	**2**
Lec 7	Advanced methods of object oriented programming. Containers.	**2**
Lec 8	Test.	**1**
	Total hours	**15**

	Laboratory	**Number of hours**
Lab 1	Getting know with the teaching program, way of programs evaluation, health and safety training. Getting know the developer environment.	**2**
Lab 2	Allocation and deallocation of simple types, pointers, multiple pointers. Introductory exercise.	**2**
Lab 3	Static and dynamic allocation, constructors and destructors. Introductory exercise.	**2**
Lab 4	Static and dynamic allocation, constructors and destructors. Introductory exercise.	**2**
Lab 5	Error handling. Introductory exercise.	**2**
Lab 6	Relations between classes and objects, tree processing. Introductory exercise.	**2**
Lab 7	Using templates in C ++. Introductory exercise.	**2**
Lab 8	Implementation of smart pointer. Introductory exercise.	**2**
Lab 9	Chosen extensions C ++ 11 and C ++ 14. Introductory exercise.	**2**
Lab 10	Implementation of chosen classes that will be support a practical computational problem during following classes. A practical task.	**2**
Lab 11	Implementation of the optimization method. A practical task.	**2**
Lab 12	Implementation of the optimization method. A practical task.	**2**
Lab 13	Program optimization – searching and removing the bottlenecks. The introductory exercise.	**2**
Lab 14	Program optimization – searching and removing the bottlenecks. The extended program with modification.	**2**

Lab 15	The use of object-oriented mechanisms and memory management to implement the program on a given topic.	**2**
	Total hours	**30**

TEACHING TOOLS USED

N1. Lecturer's presentation at a blackboard, supported by a multimedia presentation using a laptop and a projector.
N2. MSVC programming environment
N3. STL library
N4. C++11 and C++14 libraries

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1(lecture)	PEK_W01 PEK_W02	Test during the lecture, the result obtained in the object-oriented programming competition, laboratory grade.
F2(laboratory)	PEK_U01 PEK_U02	Evaluation of students' preparation for the exercise, evaluation of the quality of the program presented, implementation of additional tasks formulated during the laboratory (on-line programming), result obtained in the object-oriented programming competition.

P - the final grade of the lecture will be issued based on the results of the test and the grade from the laboratory as follows. A student who has obtained at least 4.5 from the laboratory may request that it be rewritten as a lecture grade. Students who have received a lower grade from the laboratory, and all students who want to take part in the test as final grade will received grade from the test.
The final grade from the laboratory will be issued on the basis of partial grades (points) obtained from individual exercises.
Each grade (from the lecture and laboratory) can be raised by 0.5 if the student is one of the winners of the competition held as part of the lecture. Participation in the competition is voluntary. If the student did not get a credit, participation in the competition does not change this fact.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] B. Stroustrup, The C++ Programming language, Addison-Wesley Pub. 1993
[2] H.M. Deitel, P.J. Deitel, C++ How to program, Prentice Hall 2003
[3] B. Eckel, Thinking in C++, Pearson Education 2000.
[4] Documentation of the STL library

SECONDARY LITERATURE:

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

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Zał. nr 5 do ZW 16/2020

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Programowanie gier
Name of subject in English: Game programming
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic / practical*
Level and form of studies: 1st level, full-time
Kind of subject: optional
Subject code INZ004376
Group of courses YES

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	50		60		
Form of crediting	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark final course with (X)	X				
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,2		1,2		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of C# language

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SUBJECT OBJECTIVES

1 Using existing engins for programming 2D and 3D video games

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 Naming basic ideas used in design and development of video games

relating to skills:
PEU_U01 Programming a simple 2D/3D game using a chosen engine

PROGRAM CONTENT

	Lectures	**Number of hours**
Lec 1	History and classification of video games	2
Lec 2	Game engines. Introduction to Unity. First 2D game.	2

Lec 3	2D mechanics and animations	2
Lec 4	Game prototyping. GDD	2
Lec 5	Game level design	2
Lec 6	Supporting tools, e.g. Blender	2
Lec 7	Lighting, textures, materials. First 3D game.	2
Lec 8	Artificial intelligence in games.	2
Lec 9	Terrain modeling. Terrain generation. Blend trees.	2
Lec 10	Loading/saving data. Network communication	2
Lec 11	Designing games for different platforms.	2
Lec 12	Virtual Reality, VR support in Unity	2
Lec 13	Game testing	2
Lec 14	Optimization in Unity. Test	2
Lec 15	Test	2
	Total hours	**30**

Laboratory		**Number of hours**
La1	Introduction. Credit rules.	2
La2-3	First 2D game.	4
La4-5	2D mechanics.	4
La6-7	Level design.	4
La8-9	3D game. Graphics assets.	4
La10-11	3D game. Navigation and character animation. Managing object states. Artificial intelligence.	6
La12-14	Loading/saving data. User authentication. Network communication	4
La15	Spare class	2
	Total hours	30

TEACHING TOOLS USED

N1. Information lecture with elements of problem lecture, supported with multimedia presentations.
N2. Unity Engine, supporting tools, e.g. Blender
N3. E-learning system used for publishing teaching resources and announcements, submitting and grading student work.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
Fi	PEK_U01	Grade from laboratory exercises from within scale 0..10 (there shall be at least 6 exercises)
F1 – laboratory final grade	PEK_U01	Grade calculated as percentage of points from grades Fi < 50 → 2.0

		[50-60) → 3.0 [60-70) → 3.5 [70-80) → 4.0 [80-90) → 4.5 [90-98) → 5.0 [99-100] → 5.5
F2 – lecture final grade	PEK_W01	Writing exam composed of open questions, test questions, 'fill-in the gap' questions, verifying knowledge on lecture topics. Positive grade is obtained by student who scores at least 50% of maximum total points. Consecutive grades rise with every 10% of the points.
P – course final grade	PEK_U01 PEK_W01	Grade calculated with formula: P = 0.4 * F2 + 0.6 * F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] M. Geig, Unity 2018 Game Development in 24 Hours, Pearson 2018
[2] J. Hocking, Unity in Action. Multiplatform Game Development in C#, Manning Publications Co., 2015

SECONDARY LITERATURE:

[1] http://www.appwikia.com/
[2] Teaching resources prepared by course teacher.

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FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Interakcja Człowiek-Komputer
Name of subject in English: Human-Computer Interaction
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic / ~~practical~~*
Level and form of studies: 1st/ ~~2nd~~ level, ~~uniform magister studies*, full-time / part-time studies~~*
Kind of subject: ~~obligatory~~ / optional / ~~university-wide~~*
Subject code INZ002043
Group of courses ~~YES~~ / 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	~~Examination~~ / crediting with grade*	Examination / crediting with grade*	~~Examination~~ / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark final course with (X)					
Number of ECTS points	2		3		
including number of ECTS points for practical (P) classes			3		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,2		1,8		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

None

SUBJECT OBJECTIVES

C1 Acquainting with practical knowledge in the area of Human-Computer Interaction.
C2 Getting practice in application of usability and User Experience (User Experience) methods.
C3 To familiarize students with the methodology of user-oriented design.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01 student has practical knowledge in the field of Human-Computer Interaction
PEK_W02 student knows methods and tools for designing interactive systems
PEK_W03 student knows methods used for user modeling methods, personalization and adaptation of information systems
PEK_W04 student has knowledge in the field of UX testing methods, usability and accessibility of interactive systems

relating to skills:

PEK_U01 student is able to analyze the context of the use of the IT system
PEK_U02 student has the ability to plan and monitor the process of the user interface development
PEK_U03 student can design a user interface
PEK_U04 student is able to plan the process of usability and availability assessment, conduct it and develop conclusions regarding changes in the system under examination

relating to social competences:
PEK_K01 student is able to cooperate in a project group in which the roles of members responsible for UX have been defined
PEK_K02 student is aware of the impact of the IT system on the work and life environment of users and understands the importance of usability, UX and the accessibility of an IT system in this context

PROGRAM CONTENT

Lectures		**Number of hours**
Lec 1	The problems of the research in Human-Computer Interaction area and the applications of the user interface	3
Lec 2	Philosophy, psychology and ethics of User Experience (UX)	3
Lec 3	Aesthetics and UX design	3
Lec 4	User-oriented systems design	3
Lec 5	Usability assurance methods used for requirements determination and system design	3
Lec 6	Usability assurance methods used for prototyping and testing interactive systems	3
Lec 7	Designing graphic interfaces	3
Lec 8	Standards for the design of mobile interfaces	3
Lec 9	Voice interfaces	3
Lec 10	Directions of future development and the latest trends in ICK	3
	Total hours	30

Laboratory		**Number of hours**
Lab 1	Organizational classes and introduction to the subject of the course	3
Lab 2	Examples of user interfaces and heuristic analysis of the selected system	3
Lab 3	Formulation of a project task, which will be the thematic axis for further exercises and the selection of tools	3
Lab 4	Defining target users with Persona	3
Lab 5	Defining the functionality of the system with the use of user stories and use cases	
Lab 6	Design sprint for selected views	3
Lab 7	Development and testing of a paper user interface prototype	3
Lab 8	Development and testing of the first version of a clickable user interface prototype using design patterns	3
Lab 9	Presentation of the final version of the prototype and a report on the tests carried out	3
Lab 10	Summary of classes and retrospection from the realized project task	3

	Total hours	30

TEACHING TOOLS USED

N1. Lecture using slide presentations
N2. Consultations
N3. Familiarizing students with basic and extended literature
N4. Laboratory exercises in a computer lab
N5. Student's own work and in a group - preparation for laboratory classes
N6. Preparation of reports on laboratory tasks in digital form
N7. Selection tests carried out using the e-portal

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F	PEK_U01-PEK_U04, PEK_K01	Implementation of laboratory exercises and preparation of reports on their implementation
P	PEK_W01-PEK_W04 PEK_K02	Final test

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Marcin Sikorski, Interakcja Człowiek-Komputer. Wydawnictwo PJWSTK 2010.
[2] Chapman N., Chapman J., Digital media. Third edition. Ontario: John Wiley & Sons Ltd., 2009.
[3] International Standard ISO 9241 (1,2,10-17, 210) Ergonomic requirements for office work with visual display terminals (VDTs).
[4] Galitz W.O. Essential Guide to User Interface Design. Wiley Comp. Pub. 2007.
[5] Nielsen J. Projektowanie funkcjonalnych serwisów internetowych. Helion, 2003.
[6] Lazar, Jonathan, Jinjuan Heidi Feng, and Harry Hochheiser. Research methods in human-computer interaction. Morgan Kaufmann, 2017.
[7] Turner, Phil. *A psychology of user experience: Involvement, affect and aesthetics*. Springer, 2017.

SECONDARY LITERATURE:

[1] Mark Pearrow, Funkcjonalność stron internetowych. Gliwice: HELION 2002.
[2] Lull, Dave, Discussions in User Experience. Apress, Berkeley, CA, 2017.
[3] Federici S, Borsci S., Usability evaluation: models, methods, and applications. In: JH Stone, M Blouin, editors. International Encyclopedia of Rehabilitation, 2010

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

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Zał. nr 5 do ZW 16/2020

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Podstawy Internetu Rzeczy
Name of subject in English: Introduction to IoT
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic / ~~practical~~*
Level and form of studies: 1st/ ~~2nd level, uniform magister studies~~*, full-time / ~~part-time studies~~*
Kind of subject: obligatory / ~~optional / university-wide~~*
Subject code INZ002027
Group of courses YES / ~~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	Examination / ~~crediting with grade~~*	~~Examination / crediting with grade~~*	~~Examination~~ / crediting with grade*	~~Examination / crediting with grade~~*	~~Examination / crediting with grade~~*
For group of courses mark final course with (X)					
Number of ECTS points	2		3		
including number of ECTS points for practical (P) classes	0		3		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,2		1,8		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

The following academic courses are passed or the equivalent to them knowledge and skills are possessed:

1. Structural and Object Oriented Programming,
2. Computer Architecture,
3. Computer Networks.

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SUBJECT OBJECTIVES

C1. Acquiring basic knowledge about the theoretical foundations of the Internet of Things and programming devices functioning in it.
C2. Acquiring basic practical skills in the programming of Internet of Things devices.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge a student:

PEK_W01 - acquires basic knowledge about the theoretical foundations of the Internet of Things and programming devices functioning in it.

relating to skills:

PEK_U01 - acquires basic practical skills in the programming of Internet of Things devices.

PROGRAM CONTENT

	Lectures	**Number of hours**
Lec 1	Introduction to Internet of Things (IoT). Devices in Internet of Things: sensors, actuators, smart devices and embedded systems.	2
Lec 2	High-level languages in programming IoT devices and microcontrollers. Introduction to programming of microcontrollers in IoT devices: architecture, programming interfaces (JTAG, etc.), CPU, memory and access to memory.	2
Lec 3	Introduction to programming of microcontrollers in IoT devices: events, system clock, power management, startup and boot modes, system control and reset, watchdog timer (WDT), interrupts and programmable interrupt controllers, I/O ports, timers, real time counter (RTC).	2
Lec 4	Introduction to programming of microcontrollers in IoT devices: cryptographic engine, cyclic redundancy check (CRC) generator, analog to digital converter (ADC), digital to analog converter (DAC), analog comparator, embedded sensors (temperature, etc.).	2
Lec 5	Input and output devices: LED and LCD displays, programmable RGB LEDs, buttons, keyboard, potentiometers and quadrature encoders, etc.	2
Lec 6	Sensors of light, motion, ultrasonic, temperature, humidity, real time clocks, etc. Signaling elements and actuators: servomechanisms, relays, electronic switching circuits, etc.	2
Lec 7	Local communication interfaces and buses of Internet of Things devices: USB, UART, RS232, RS458, I2C, 1Wire, CAN, etc.	2
Lec 8	Wireless technologies for Internet of Things: Bluetooth, IEEE 802.15.4, IEEE 1901.2a, IEEE 802.11ah, LoRaWAN, NB-IoT, etc.	2
Lec 9	The IP protocol in the network layer of Internet of Things.	2
Lec 10	Architecture and design of Internet of Things.	2
Lec 11	Application protocols in Internet of Things.	2
Lec 12	Acquiring, storing and analyzing large amounts of data generated by Internet of Things devices.	2
Lec 13	Security and privacy in Internet of Things.	2
Lec 14	Internet of Things in practice - examples (part I).	2
Lec 15	Internet of Things in practice - examples (part II).	2
	Total hours	**30**

Laboratory		Number of hours
Lab 1	Introduction to the laboratory. OSH training.	2
Lab 2	Introduction to Arduino programming.	2
Lab 3 - Lab6	Selected input and output devices. Selected sensors, signaling and executive elements Communication using selected communication interfaces.	4 x 2
Lab 7 - Lab 8	Introduction to microcontroller programming in professional programming environments.	2 x2
Lab 9	Communication using computer networks based on the IP protocol (part I).	2
Lab 10	Communication using computer networks based on the IP protocol (part II).	2
Lab 11	Communication using wireless technology.	2
Lab 12	Programming for Internet of Things - programming task (part I).	2
Lab 13	Programming for Internet of Things - programming task (part II).	2
Lab 14	Programming for Internet of Things - programming task (part III).	2
Lab 15	Presentation of the results of the programming task. Final grading.	2
	Total hours	**30**

TEACHING TOOLS USED

N1. Traditional lecture.
N2. Laboratories.
N3. Consultations for students.
N4. Own work - preparation for laboratories.
N5. Own work - learning of theoretical foundations.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
C (lecture)	PEK_W01	To get credit for the lecture (pass), a student should be given more than half of the points for the theoretical exam. If the above is met, then the grading scale is as follows: P - the sum of obtained points in percent. Range P : Grade 100 - 91%: 5.0 (very good) 90 - 81%: 4.5 (good plus) 80 - 71%: 4.0 (good) 70 - 61%: 3.5 (satisfactory plus) 60 - 51%: 3.0 (satisfactory) 50 - 0%: 2.0 (unsatisfactory)
F1 (laboratory)	PEK_U01	Knowledge tests in the field of theoretical preparation for the laboratory and practical skills obtained at the laboratory.
F2 (laboratory)	PEK_U01	Evaluation of the effects of the programming task.

C (laboratory)		To get credit for the laboratory (pass), a student should be given more than half of the points possible to get on tests (F1) and for programming task (F2). The student’s absences may constitute the grounds for not crediting the course. The number of student's absences must not exceed the limit given by the lecturer. If the above are met, then the grading scale is as follows: P = F1 + F2 - the sum of points in percent. Range P : Grade 100 - 91%: 5.0 (very good) 90 - 81%: 4.5 (good plus) 80 - 71%: 4.0 (good) 70 - 61%: 3.5 (satisfactory plus) 60 - 51%: 3.0 (satisfactory) 50 - 0%: 2.0 (unsatisfactory)

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

1] Rob Barton, Gonzalo Salgueiro, David Hanes: IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, Cisco Press, 2017, ISBN: 9780134307091.
[2] Perry Lea: Internet of Things for Architects, Packt Publishing, 2018, ISBN: 9781788470599.
[3] Arvind Ravulavaru: Enterprise Internet of Things Handbook, Packt Publishing, 2018, ISBN: 9781788838399.
[4] Andrew Minteer: Analytics for the Internet of Things (IoT), Packt Publishing, 2017, ISBN: 9781787120730.
[5] Agus Kurniawan: Smart Internet of Things Projects, Packt Publishing, 2016, ISBN: 9781786466518.
[6] Amir Vahid Dastjerdi, Rajkumar Buyya: Internet of Things, Morgan Kaufmann, 2016, ISBN: 9780128093474.
[7] Elliot Williams: Make: AVR Programming, Maker Media, Inc, 2014, ISBN: 9781449355784,
in Polish: Programowanie układów AVR dla praktyków, Helion, 2014, ISBN: 97888324695010.
[8] Tomasz Francuz: Język C dla mikrokontrolerów AVR, Helion, 2015, (in Polish) ISBN: 9788324698141.

SECONDARY LITERATURE:

[1] Technical documentation of devices and microcontrollers used in the course on the websites of producers and distributors.

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

Krzysztof Chudzik, Krzysztof.Chudzik @ pwr.edu.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Wprowadzenie do zarządzania projektami informatycznymi
Name of subject in English: Introduction to IT Projects Management
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic / ~~practical*~~
Level and form of studies: 1st/ ~~2nd~~ level, ~~uniform magister~~ studies*, full-time ~~/ part-time~~ studies*
Kind of subject: ~~obligatory~~ / optional / ~~university-wide~~*
Subject code INZ002032
Group of courses YES / ~~NO~~* (lecture, classes), NO (laboratory)

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	1		2		1
Number of hours of total student workload (CNPS)	30		60		30
Form of crediting	~~Examination~~ / crediting with grade*	Examination / crediting with grade*	~~Examination~~ / crediting with grade*	Examination / crediting with grade*	~~Examination~~ / crediting with grade*
For group of courses mark final course with (X)	X				
Number of ECTS points	4				
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	2,4				

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

C1 To develop an awareness of the need for project planning and management
C2 To apply professional attitudes and techniques to managing a project

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SUBJECT OBJECTIVES

C1 Introduction to basic notions of management

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01 Explain the stages in the project development lifecycle; explain of key components of a project plan
PEK_W02 Understanding of steps needed to build a project plan, scheduling and cost estimation as well as the responsibility of the key staff of project
PEK_W03 Explain the procedures needed to monitor, control and report upon an IT development project

relating to skills:

PEK_U01 demonstrate an ability to prepare a project charter of simple project
PEK_U02 apply basic project planning techniques and resource assigning to project tasks

PEK_U03 apply basic project cost estimation techniques
PEK_U04 demonstrate an ability to analyze and to report project progress
PEK_U05 demonstrate ability to prepare a presentation and essay on given subject…

PROGRAM CONTENT

Lectures		Number of hours
Lec 1	Basic notions in project management. Feasibility study	1
Lec 2	Project planning and scheduling techniques for plan driven methods	2
Lec 3	Project planning and scheduling techniques for agile driven methods	2
Lec 4	Project resources;examples. Team management (organization and decision-making, roles and responsibilities in a software team).	2
Lec 5	Project cost estimation techniques	2
Lec 6	Project monitoring and tracking. Software quality. Software Quality Assurance methods and techniques.	3
Lec 7	Methodologies of software project management- review (PRINCE2,DSDM,Scrum..)	2
Lec 8	Test	1
	Total hours	15

Laboratory		Number of hours
Lab 1	Introductory lab: safety regulation; introduction to MSProject 2016.	2
Lab2-3	Project scope definition; requirements specification; Project charter.	4
Lab 3-4	Traditional project planning and scheduling	4
Lab 5-6	Agile project planning and scheduling	4
Lab 7-8	Project Resource definition and assignments	4
Lab 9-10	Project cost estimation;	4
Lab11	Project task tracking	2
Lab12	Using Reports in MsProject 2016	4
Lab13	Reports of own project planning results	2
	Total hours	30

Seminar		Number of hours
Sem 1	Introductory seminar; topics assignments	1
Sem 2	Conceptualizing and Initializing the IT Project; Developing the Project Charter	2
Sem3-4	Developing the Project Plan and Schedule; Resource problems	4
Sem 5	The Human Side of Project Management	2
Sem 6	Managing Change, Resistance and Conflicts	2
Sem 7	Progress monitoring, project control and reporting	2
Sem 8	Software quality	2
	Total hours	15

TEACHING TOOLS USED

N1. Informative lecture supporting with PowerPoint presentations
N2. Examples of managerial documentation of projects published on e-learning system
N3. Software for software project management
N4. An e-learning system used for the publication of teaching materials and announcements as well as for collecting and assessing student work..

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEK_U05	Grade based on student participation in discussion, prepared MsPowerPoint presentation and essay
F2	PEK_U01-PEK_U04	Grade based on completeness, on time and quality of laboratory assignments
F3	PEK_W01-PEK_W03	Grade based on multichoice test result

Final course grade will be based upon the following weights for categories of assessments:
- Presentation and essay 20% of F1
- laboratory assignments 40% of F2
- Final test 40% of F3

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Cobb Ch., *Zrozumieć Agile Project Management- Równowaga kontroli i elastyczności*, APN Promise Warszawa 2012
[2] Chatfield C., Johnson T., *MS Project 2013 - Krok po kroku*, APN Promise, Warszawa 2013
[3] Schwaber K., *Sprawne zarządzanie projektami metodą Scrum.* APN Promise, Warszawa, 2005
[4]Żmigrodzki M., *Zarządzanie projektami dla początkujących*, Wyd. II Helion 2018.
[5] Microsoft Project 2016.

SECONDARY LITERATURE:

[1] Materiały przygotowane przez prowadzącego kurs.
[2] *PMBOK® Guide:* A Guide to the Project Management Body of Knowledge. Fifth Edition, 2012
[3] Prince2 (materiały z Internetu)

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

Iwona Dubielewicz, iwona.dubielewicz@pwr.edu.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Problemy społeczne i zawodowe informatyki
Name of subject in English: IT Social and Professional Problems
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic / practical*
Level and form of studies: 1st~~/ 2nd~~ level, ~~uniform magister studies*~~, full-time / part-time studies*
Kind of subject: obligatory ~~/ optional / university-wide~~*
Subject code INZ004391
Group of courses ~~YES~~ / 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	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark final course with (X)					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,2				

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. None

SUBJECT OBJECTIVES

C1. Educating skills in solving social and legal problems related to Computer Science and the profession of Computer Science specialist. Education of competences in the field of copyright, related rights and patent law. Providing knowledge about the nature of copyright law, its subject and object part. The acquisition of practical knowledge in the field of personal and property copyright in relation to products of an information nature.
C2. To educate awareness of the importance and understanding of non-technical aspects and effects of the engineer-computer science, including its legal effects and impact on the environment, and the related responsibility for decisions

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01 The student has knowledge of the protection of intellectual and industrial property related to the Computer Science product. The student has knowledge of copyright and patent law, with detailed knowledge of solutions in the field of personal and property

rights. The student has knowledge in the field of risk assessment related to the protection of intellectual and industrial property. The student has practical knowledge in the field of implementing protection of Computer Science works created as part of individual and group work. The student has the competence to understand and formulate the license. Has knowledge of the transfer of property copyrights. Understands the essence of fair use and public use.

relating to social competences:

PEK_K01 The student has the ability to see the social aspects of the profession. Has the skills of creative thinking and applying the law in both individual and group work.

PROGRAM CONTENT

Lectures		**Number of hours**
Lec 1	Basic concepts. Introduction.	2
Lec 2	Preparation, design, manufacturing and exploitation of software in a social and legal context.	2
Lec 3	The intellectual property, definitions, legal settlements, examples.	2
Lec 4	Object and subject of copyright. Special legal regulations in the field of subjects and entities related to Computer Science.	2
Lec 5	Authorship of individual and collective works. Personal copyright, protection method and scope of use.	2
Lec 6	Personal copyright. Duration of personal copyrights. Attributes of personal copyright and the scope of their protection.	2
Lec 7	Economic part of copyright and its use. Examples in the field of computer product protection.	2
Lec 8	Permitted use. Public use. Exclusions from protection.	2
Lec 9	Copyright law in scientific and educational institutions.	2
Lec 10	Creating software and documentation with respect for copyright.	2
Lec 11	Criminal liability for infringement of copyright. Computer crimes. Forensic examinations.	2
Lec 12	The right to protect industrial property. Definitions. The scope of application.	2
Lec 13	Patents. Trademarks. Registration. Regulations regarding the protection of industrial property in Poland and Europe. Industrial property law and copyright law in an ethical and social context.	2
Lec 14	The final test.	2
Lec 15	Licenses. Collective management of copyright. Occupational risk. Reliability and legal security of the software.	2
	Total hours	30

TEACHING TOOLS USED

N1. Lecture using the multimedia slide projector.
N2. Consultation.
N3. Own work of the student.
N4. Electronic using educational platforms.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P –	Learning outcomes number	Way of evaluating learning outcomes achievement

concluding (at semester end)		
F1	PEK_W01, PEK_K01	questions and discussion, the final test
C=F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Cohen J. E.: Copyright in a global information economy. Aspen Publishers 2010.
[2] Okediji C. L. & Orourke: Copyright Law. Aspen Publishers 2010.
[3] Thies Ch.: Computer Law and Ethics. Mercury Learning & Information 2013.
[4] Ustawa o prawie autorskim z dnia 4 lutego 1994 r. o prawie autorskim i prawach pokrewnych. Dz. U. 1994 nr 24 poz. 83 (z późniejszymi zmianami)

SECONDARY LITERATURE:

[1] McJohn S. M.: Examples & Explanantions: Copyright. Aspen Publishers 2012.

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

Arkadiusz Liber, Arkadiusz.Liber@pwr.edu.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Administrowanie serwerami Linux (GK)
Name of subject in English: Linux Server Administration (GK)
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic / ~~practical~~*
Level and form of studies: 1st/ ~~2nd level, uniform magister studies~~*, full-time / ~~part-time studies~~*
Kind of subject: ~~obligatory~~ / optional / ~~university-wide~~*
Subject code INZ004415
Group of courses YES / ~~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	~~Examination~~ / crediting with grade*	~~Examination / crediting with grade~~*	~~Examination~~ / crediting with grade*	~~Examination / crediting with grade*~~	~~Examination / crediting with grade*~~
For group of courses mark final course with (X)	X				
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes	0		2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,2		1,2		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge about the principles of the modern operating systems.
2. Knowledge about the principles of the computer networks based on the TCP / IP protocol suite.

SUBJECT OBJECTIVES

C1. Acquiring basic knowledge and practical skills in the Linux server and user's workstation administration.
C2. Acquiring basic knowledge and practical skills in the administration of network infrastructure and network services using the Linux system.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge a student:

PEK_W01 - acquires basic knowledge in the administration of Linux server and workstation and basic knowledge in the administration of network infrastructure and network services using Linux.

relating to skills:

PEK_U01 - acquires practical skills in the administration of Linux server and workstation and basic knowledge in the administration of network infrastructure and network services using Linux.

PROGRAM CONTENT

	Lectures	**Number of hours**
Lec 1	Distributions of the Linux system. System architecture. System installation.	2
Lec 2	Text console: shells, basic commands, scripts.	2
Lec 3	User and group account management.	2
Lec 4	Disks and file system management.	2
Lec 5	Data compression. Backup. Scheduling of administrative tasks.	2
Lec 6	System update. Installing, updating and uninstalling additional software. Use of installation packages.	2
Lec 7	Printing in Linux. Graphic environment - X Window.	2
Lec 8	Managing network connections. Routing.	2
Lec 9	Firewalls and network traffic management.	2
Lec 10	Configuration and management of DHCP and DNS servers.	2
Lec 11	Configuration and management of the file server (NFS, Samba, FTP).	2
Lec 12	Configuration and management of the web server. Content management systems (CMS).	2
Lec 13	Virtualization in Linux systems.	2
Lec 14	Securing the server. Remote system administration. The knowledge test (1 term).	2
Lec 15	The knowledge test (2 term).	2
	Total hours	30

	Laboratory	**Number of hours**
Lab 1	Introduction to the laboratory. OSH training.	2
Lab 2	Installation of the Linux system.	2
Lab 3	Text console: shells, basic commands, scripts.	2
Lab 4	Practical management of accounts and user groups.	2
Lab 5	Practical disk and file system management.	2
Lab 6	Performing data compression. Backing up and recovering data. Operations scheduling.	2
Lab 7	System upgrade, installation, upgrade and uninstallation of additional software using installation packages and software repositories.	2
Lab 8	Configuring printing in the Linux environment. Graphic environment - X Window. Practical test - Management of the server and workstation operating system.	2

Lab 9	Managing network connections. Routing.	2
Lab 10	Firewalls and network traffic management.	2
Lab 11	Configuration and management of DHCP and DNS servers.	2
Lab 12	Configuration and management of the file server (NFS, Samba, FTP).	2
Lab 13	Configuration and management of the web server. Content management systems (CMS).	2
Lab 14	Configure and run virtual machines on Linux systems. Securing the server. Remote system administration.	2
Lab 15	Practical test - Management of the network infrastructure and network services.	2
	Total hours	30

TEACHING TOOLS USED

N1. Traditional lecture.
N2. Laboratories with full administrative access to Linux systems.
N3. Consultations for students.
N4. Own work - preparation for laboratories.
N5. Own work - learning of theoretical foundations.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEK_W01	Test of theoretical knowledge (max 50% of points).
F2	PEK_U01	Practical test - Management of the server and workstation operating system (max 25% of points).
F3	PEK_U01	Practical test - Management of the network infrastructure and network services. (max 25% of points).
C	To get credit for this group of courses (pass), a student should be given more than half of the points for the theoretical test (F1 > 25%) and over half of the points possible to get on both practical tests (F2 + F3 > 25%). The student’s absences may constitute the grounds for not crediting the course. The number of student's absence must not exceed the limit given by the lecturer. If the above are met, then the grading scale is as follows: The sum of points in percent P = F1 + F2 + F3. <u>Range P : Grade</u> 100 - 91%: 5.0 (very good) 90 - 81%: 4.5 (good plus) 80 - 71%: 4.0 (good) 70 - 61%: 3.5 (satisfactory plus) 60 - 51%: 3.0 (satisfactory) 50 - 0%: 2.0 (unsatisfactory)	

PRIMARY AND SECONDARY LITERATURE

<u>PRIMARY LITERATURE:</u>

[1] William E. Shotts, Jr., Linux Command Line, No Starch Press, 2019.
[2] Osamu Aoki, Debian Reference, https://www.debian.org/doc/manuals/debian-reference/, Retrieved 2018.
[3] Raphaël Hertzog & Roland Mas, https://debian-handbook.info/, Retrieved 2018.

SECONDARY LITERATURE:

[4] Brian Ward, How Linux Works, What Every Superuser Should Know, No Starch Press, Second edition, 2014.

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

Krzysztof Chudzik, Krzysztof.Chudzik @ pwr.edu.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name in Polish:	**Logika dla informatyków**
Name in English:	**Logic for IT Specialists**
Main field of study (if applicable):	**Applied Computer Science**
Specialization (if applicable):	**n/a**
Level and form of studies:	**First level**
Kind of subject:	**obligatory**
Subject code	**INZ004402**
Group of courses	**YES**

	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				
Form of crediting	Examination	Crediting with grade*			
For group of courses mark (X) final course	X				
Number of ECTS points	5				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	3				

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

Knowledge of mathematics at the high school level in the expanded range.

SUBJECT OBJECTIVES

C1. Gaining knowledge of the set theory and the classical propositional and predicate calculi.
C2. Gaining knowledge about the usage of classical logic to formally define some elements of programming languages.

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge:

PEK_W01: Students know and understand the concept of a set and operations on sets, the concept of relations and functions.
PEK_W02: Students know and understand the concept of logical syntax and semantics of propositional logic and predicate calculus, and selected proving systems.
PEK_W03: Students know and understand the concept of mathematical induction and structural definition of recursive sets and functions, graphs and methods of their representation.

Relating to skills:

PEK_U01: Students can apply propositional and predicate calculi.
PEK_U02: Students can conduct a simple and moderately difficult proofs by mathematical and structural induction.
PEK_U03: Students can use language of set theory interpreting problems in different areas of mathematics and science.

Relating to social competences:
PEK_K01: Students can precisely formulate questions to deepen their understanding of the topic and find the missing pieces of reasoning.
PEK_K02: Students can independently search the bibliographic databases and study the literature available there.
PEK_K03: Students know the limits of their own knowledge and understand the need for further education

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Lec 1	Basic logical notions: truth and false, simple and compound propositions. Basic set-theoretical notions: a set, definitions of sets, operations on sets.	2
Lec 2	Cartesian product, relations and their properties, equivalence and ordering relations.	2
Lec 3	Functions, composition of functions. Equinumerosity of sets, cardinal numbers. Sequences and operations on sequences.	2
Lec 4	Graphs, formal languages, free-context grammars.	2
Lec 5	Accepting finite automata, finite automata with outputs	2
Lec 6	Syntax and semantics of propositional calculus.	2
Lec 7	Zero-one method of formulas proving. Proving system based on semantic equivalence of formulas.	2
Lec 8	Proving system for the propositional calculus based on Gentzen's sequents.	2
Lec 9	Complete sets of logical connectives. Meta-logical properties of the propositional calculus – decidability, consistency and completeness of proving systems.	2
Lec 10	Syntax of the predicate calculus.	2
Lec 11	Semantics of the predicate calculus.	2
Lec 12	Proving system for the predicate calculus based on Gentzen's sequents – its consistency and completeness.	2
Lec 13	Formulas in canonical forms.	2
Lec 14	Proving system based on resolution rule.	2
Lec 15	Elements of programming in logic.	2
	Total hours	30

Form of classes - class		**Number of hours**
Cl 1	Basic logical notions: truth and false, simple and compound propositions.	2

Cl 2	Methods of definitions of sets, operations on sets.	2
Cl 3	Cartesian product, relations defining and checking their properties.	2
Cl 4	Proving properties of equivalence and ordering relations.	2
Cl 5	Checking equinumerosity of sets. Operations on sequences.	2
Cl 6	Defining of exemplary formal languages.	2
Cl 7	Test 1.	2
Cl 8	Many-sorted algebras as models for data types.	2
Cl 9	Application of zero-one method and transformational method for formulas proving.	2
Cl 10	Application of Gentzen system for proposition formulas proving.	2
Cl 11	Informal interpretation of predicate formulas.	2
Cl 12	Application of Gentzen system for predicate formulas proving.	2
Cl 13	Canonical forms of predicate formulas.	2
Cl 14	Test 2. Application of resolution rule for formulas proving.	3
Cl 15	Corrective test.	1
	Total hours	30

TEACHING TOOLS USED

N1. Lecturer's presentation at a blackboard, supported by a multimedia presentation using a laptop and a projector.
N2. Individual search and study of literature and Internet sources.
N3. Access to teaching materials published in the local area network.
N4. Individual consultations.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 PEK_W02 PEK_U01 PEK_U02 PEK_K01	During each class students are awarded 1 or 2 points for an individual solution of a task from the announced list of tasks.
F2	PEK_W02 PEK_W03 PEK_U02 PEK_U03 PEK_K01	Students are oblige to participate in two tests at the middle and at the end of a semester. During each test students are awarded up to 10 points.
F3	PEK_W01 PEK_W02 PEK_W03 PEK_U01 PEK_U02 PEK_U03	Final mark for the classes is determined on the base of total number of points resulted from activity during classes (F1) and points for the tests (F2). Detailed rules for final mark evaluation are as follows: Let

		c_i the number of points scored for activity during classes in the i-th part of semester, for $i = 1, 2$; t_i the number of points scored during the i-th test, for $i = 1, 2$; t_{popr} the number of points scored during corrective test; $P_i = min(10, c_i + t_i)$ for $i = 1, 2$; $P = P_1 + P_2$. For passing classes without corrective test the following condition should be satisfied: $P \geq 10$ and ($P_i \geq 4$ for $i = 1, 2$). If the condition is satisfied the mark is calculated according to the table: The students which have passed the classes without corrective test and have got at least mark 4 are exempted from examination with the same mark.

P	10	12	14	16	18
Mark	3.0	3.5	4.0	4.5	5.0

C: The final evaluation of the course is determined based on the results of the examination. The examination lasts two hours and consists of a set of tasks, with the total number of 20 points. The condition for a positive assessment of the final exam is to get 10 points and a positive final evaluation of the exercise.
The final evaluation of the examination is determined in accordance with the following table:

Points	10	12	14	16	18
Mark	3.0	3.5	4.0	4.5	5.0

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] HUZAR Z., Elementy logiki i teorii mnogości dla informatyków, Oficyna Wydawnicza Politechniki Wrocławskiej, 2007.
[2] BEN-ARI M., *Logika matematyczna w informatyce*, WNT, 2005.
[3] MAREK W., ONYSZKIEWICZ J., *Elementy logiki i teorii mnogości w zadaniach*, PWN, 2001.

SECONDARY LITERATURE:

[1] RASIOWA H., Wstęp do matematyki współczesnej, PWN, 1998.
[2] ŁAWROW I. A., MAKSIMOWA Ł. L., 2004, *Zadania z teorii mnogości, logiki matematycznej i teorii algorytmów*, PWN, 2004.
STANOSZ B., *Ćwiczenia z logiki*, PWN, 2002.

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

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Ngoc-Than Nguyen, ngoc-than.nguyen@pwr.edu.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: **Zarządzanie infrastrukturą IT**
Name of subject in English: **Managing IT infrastructure**
Main field of study (if applicable): **Applied computer science**
Specialization (if applicable):
Profile: **practical**
Level and form of studies: **1st level, full-time**
Kind of subject: **optional**
Subject code **INZ004468Wl**
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	Crediting with grade		Crediting with grade		
For group of courses mark (X) final course	X				
Number of ECTS points	2		2		
including number of ECTS points for practical classes (P)	0		2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,2		1,2		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge on design of contemporary operating systems.
2. Knowledge on computer networks using TCP/IP protocol stack.

SUBJECT OBJECTIVES

C1 Gain knowledge on management of complex, distributed IT environment, including:
- C1.1 single machine administration
- C1.2 using directory services to centralize of administration tasks
- C1.3 administration of network services

C2 Develop the conscience of the value of lifelong self-learning.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 knows basic local resources (user accounts, groups, files, printers) and how to manage them

PEU_W02 knows directory services and knows how to use it to centralize administrative efforts

PEU_W03 knows selected services supporting computer networks and network security

relating to skills:

PEU_U01 can configure users' access to local resources

PEU_U02 can administer directory services
PEU_U03 is able to configure selected network services

relating to social competences:
PEU_K01 can search for additional external knowledge sources to extend course content.

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Contemporary IT environment. System installation.	2
Lec 2	Accounts and group management.	2
Lec 3	Disk management.	2
Lec 4	Printing	2
Lec 5	Scripting administration tasks	2
Lec 6	Directory services.	2
Lec 7	Centralized management using directory services.	2
Lec 8	Distributed environment with directory services.	2
Lec 9	System monitoring.	2
Lec 10	DHCP and DNS servers.	2
Lec 11	Routing and remote access.	2
Lec 12	PKI infrastructure.	2
Lec 13	Securing network traffic.	2
Lec 14	Web server configuration.	2
Lec 15	Final test	2
	Total hours	**30**

Laboratory		Number of hours
Lab 1	Getting used to lab environment. Safety regulations.	2
Lab 2	System installation.	2
Lab 3	User accounts and groups administration.	2
Lab 4	Disk resources management.	2
Lab 5	Scripting administrative tasks.	2
Lab 6	Practical test 1.	2
Lab 7	Directory services installation. Users and groups in directory.	2
Lab 8	Environment administration using directory services.	2
Lab 9	Directory services in distributed environment.	2
Lab 10	Practical test 2.	2
Lab 11	System monitoring.	2
Lab 12	DNS and DHCP servers configuration.	2
Lab 13	Routing and remote access configuration.	2
Lab 14	PKI infrastructure configuration. Web server configuration.	2

Lab 15	Practical test 3.	2
	Total hours	**30**

TEACHING TOOLS USED

N1. Lecture.
N2. Laboratory.
N3. Self-learning and studying.
N4. Practical self-learning using virtual machines.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F1	PEK_U01-PEK_U03	Graded activities on labs.
F2	PEK_U01-PEK_U03	Graded practical tests on labs.
F3	PEK_W01-PEK_W03	Graded tests.
P (lecture) = F3		
P (labs) = W1×F1+W2×F2, W1 and W2 weights will be available at the start of the course.		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] T.Limoncelli, C.Hogan, S.Chalup, *The practice of System and Network Administration*, vol. 1., 3rd ed., Addison Wesley, 2017.

[2] J. Krause, *Mastering Windows Server 2019: The complete guide for IT professionals to install and manage Windows Server 2019 and deploy new capabilities*, 2nd ed., Packt Publishing, 2019.

SECONDARY LITERATURE:

[1] C. Zacker, *Exam Ref 70-740 Installation, Storage and Compute with Windows Server 2016*, Microsoft Press, Redmond, 2017.

[2] A. Warren, *Exam Ref 70-741 Networking with Windows Server 2016*, Microsoft Press, Redmond, 2017.

[3] A. Warren, *Exam Ref 70-742 Identity with Windows Server 2016*. Microsoft Press, Redmond, 2017.

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

Wojciech Thomas, wojciech.thomas/at/pwr.edu.pl

Zał. nr 5 do ZW 16/2020

FACULTY of Information and Communication Technology

SUBJECT CARD

Name in Polish: Metaheurystyki w rozwiązywaniu problemów
Name in English: Metaheuristics in problems solving
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Level and form of studies: 1st/ ~~2nd~~* level, full-time / ~~part-time~~*
Kind of subject: ~~obligatory~~ / optional / ~~university-wide~~*
Subject code INZ002042
Group of courses ~~YES~~ / 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	~~Examination~~ / crediting with grade*	Examination / crediting with grade*	~~Examination~~ / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark (X) final course	-	-	-	-	-
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes	-		2	-	-
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,2		1,2		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. K1INF_W15 Has basic knowledge about modeling, and knows methods and techniques used in decision supporting systems
2. K1INF_U16 Can effectively use methods and tools of information storing, information processing, information searching and knowledge acquisition

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SUBJECT OBJECTIVES

C1 To teach students about various approaches and metaheuristics used in machine learning tasks
C2 To get a skill of metaheuristics selection suitable to given task
C3 To get a skill of validation of metaheuristics in real world applications

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEK_W02: Has knowledge of approaches and methods used in machine learning
PEK_W02: Has knowledge of various metaheuristics applications
PEK_W03: Has knowledge of selected data preprocessing techniques
PEK_W04: Has knowledge of metaheuristics results validation
PEK_W05: Has knowledge of effective implementation of metaheuristics

relating to skills:
PEK_U01: Can select a proper metaheuristic for given task
PEK_U02: Can design and implement application
PEK_U03: Can prepare and do an empirical experiments to examine metaheuristics effectiveness and usability
PEK_U04: Can prepare results analysis and do report of done experiments
relating to social competences:
PEK_K01

PROGRAMME CONTENT

	Form of classes - lecture	**Number of hours**
Lec1	Introduction to metaheuristics	2
Lec2	Introduction to Evolutionary Algorithms (EA)	2
Lec3	Solving problems and tasks by metaheuristics – research methodology	2
Lec4	Other metaheuristics: HillClimbing (HC), Tabu Search (TS), Simulated Annealing (SA)	2
Lec5	Introduction to EA specialization and extensions	2
Lec6	Specialization of EA: representation, fitness function and genetic operators	2
Lec7	Types and extensions of EA	4
Lec9	Hybrid metaheuristics	2
Lec10	Selected swarm-based metaheuristics: Ant Colony Optimization, Bee Colony Optimization, Particle Swarm Optimization	2
Lec11	Other selected metaheuristics	4
Lec12	Methods of metaheuristics efficiency improvement	4
Lec13	Summary and recent directions	2
	Total hours	30

	Form of classes - laboratory	**Number of hours**
Lab 1	Organization issues	2
Lab 2	L1. Application of Evolutionary Algorithms to given problem A	6
Lab 3	L2 Tabu Search (TS) usage to selected problem A	4
Lab 4	L3 Simulated Annealing (SA) application to selected problem A	4
Lab 5	L4 Comparison of EA, TS and SA implementation effectivency for selected problem A	4
Lab 6	L5 Hybrids EA+SA and EA+TS used for A problem solving	2

Lab 7	L6 Selected metaheuristics implementation, e.g. Ant Colony Optimization solving A problem	8
	Total hours	30

TEACHING TOOLS USED
N1. Multimedia PowerPoint presentation N2. Laboratory exercises description N3. e-learning system

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1 – L1 realization	PEK_W01; PEK_U01; PEK_U03; PEK_U04;	L1 realization is worth 10 points. For each working week delay penalty -20% is used. In each laboratory, a student can present only one exercise realization. The exercise realization is: exercise specification reading, given method analysis, and implementation, application verification and effectivency research. The whole process is described in the report. There are included implementation details, research methodology, summary results and emerged problems. Such a report is uploaded to the e-learing portal. It is suggested implementation in a non-interpret programming language. Using interpret language (such as Java, python) decreases points -20%. The C/C++ usage is preferred.
F2 – L2 realization	PEK_W01; PEK_U02; PEK_U03; PEK_U04;	Like F1
F3 – L3 realization	PEK_W01; PEK_U02; PEK_U03; PEK_U04;	Like F1
F3 – L4 realization	PEK_W01; PEK_U02; PEK_U03; PEK_U04;	Like F1
F3 – L5 realization	PEK_W01; PEK_U02; PEK_U03; PEK_U04;	Like F1
F3 – L6 realization	PEK_W01; PEK_U02;	Like F1

	PEK_U03; PEK_U04;	
C - summay	PEK_U01; PEK_U02; PEK_U03; PEK_U04; PEK_U01;	The final mark is given as follows: 0 – 29 points gives ndst 30 - 34 points gives dst 35 - 40 points gives dst+ 41 - 45 points gives db 45 - 50 points gives db+ 51 - 60 points gives bdb No more than 2 absences are allowed. More fails the course.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

1. Goldberg D. “Algorytmy genetyczne i ich zastosowanie”, WNT 1998.
2. Kwaśnicka H. “Obliczenia ewolucyjne w sztucznej inteligencji”, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław, 1999.
3. Michalewicz Z. “Algorytmy genetyczne + struktury danych = programy ewolucyjne”, WNT 2010.
4. Michalewicz Z., Fogel D.B. “Jak to rozwiązać, czyli nowoczesna heurystyka”, WNT 2006

SECONDARY LITERATURE:

[1] Arabas J. “Wykłady z algorytmów ewolucyjnych”, WNT, Warszawa 2004.

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

Paweł Myszkowski, pawel.myszkowski@pwr.edu.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Aplikacje mobilne na platformę Android
Name of subject in English: Mobile applications for Android platform
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic*
Level and form of studies: 1st/ ~~2nd~~ level, ~~uniform magister studies~~*, full-time / ~~part-time studies~~*
Kind of subject: ~~obligatory~~ / optional / ~~university-wide~~*
Subject code INZ002029
Group of courses YES / ~~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		90		
Form of crediting	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark final course with (X)	X				
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,2		1,2		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of programming in Java.
2. Basic knowledge about the operation of computer operating systems.

SUBJECT OBJECTIVES

C1 Obtaining basic knowledge of the architecture of mobile applications for the Android platform and methods to implement the functionality of typical applications.

C2. Acquiring practical skills in implementing mobile applications for the Android platform.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Knows the basic elements of mobile application architecture for the Android platform.

PEU_W02 Describes how to implement solutions for Android applications regarding the basic functionalities of typical applications.

relating to skills:
PEU_U01 Is able to implement mobile applications for the Android platform in the field of selected basic functionalities implemented in typical applications.

PROGRAM CONTENT

	Lectures	**Number of hours**
Lec 1	Presentation of the course organization and program. Introduction to subject matter. Presentation of the Android platform and development tools.	2
Lec 2	Elements of the Android application architecture and the basics of application design. Life cycles of the discussed app components.	2
Lec 3	Basics of application graphical interface - layouts, controls for handling interface input events.	2
Lec 4	Triggering of actions and data transfer - intentions, interaction of activities, use of system activities. Configuration change support.	2
Lec 5	Creating application menu items.	2
Lec 6	Interface elements that require a content adapter.	2
Lec 7	Fragments - operating principle, management, operating patterns.	2
Lec 8	Persistent data support. Built-in database mechanism.	2
Lec 9	Advanced interface support - bookmarks, scrolling views, etc.	2
Lec 10	Streaming media support in Android.	2
Lec 11	Sensor support and location mechanisms.	2
Lec 12	Mobile application communication functions.	2
Lec 13	Background tasks. Services.	2
Lec 14	Applications for non-smartfon devices with the Android environment.	2
Lec 15	Passing test.	2
	Total hours	**30**

	Laboratory	**Number of hours**
Lab 1	Discussion of the organization and program of classes. OSH training. Presentation of teaching tools.	2
Lab 2	Configuration of the Android production environment. Creating a basic application project.	2
Lab 3	Application I - activities (windows), graphic layouts and controls. Triggering activity.	2
Lab 4	Application II - advanced interface elements - part I.	2
Lab 5	Application II - advanced interface elements - part II.	2
Lab 6	Application III - application menu.	2
Lab 7	Application IV - fragments and bookmarks - part I.	2
Lab 8	Application IV - fragments and bookmarks - part II.	2
Lab 9	Application VI - support for selected streaming media.	2
Lab 10	Application V - sensors and location.	2
Lab 11	Application VII - background tasks.	2
Lab 12	Application VIII - communication functions.	2

Lab 13	Application IX - programming the application for a selected non-smartphone/tablet device (e.g. Android TV) - part I.	2
Lab 14	Application IX - programming the application for a selected non-smartphone/tablet device (e.g. Android TV) - part II.	2
Lab 15	Summary and discussion of classes. Final passing the class and issuing grades.	2
	Total hours	**30**

TEACHING TOOLS USED
N1. Informative lecture supported by multimedia presentations. N2. Printed or electronic laboratory exercises. N3. Development software for the Android platform. N4. Devices (smartphones, tablets) and emulators to run developed applications. N5. An e-learning system for publishing teaching materials, tasks and announcements, and collecting and assessing student work, as well as for carrying out knowledge tests.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), C – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1 – La2	PEK_U01	Assessment of completeness and quality of task solution. Point scale 0÷3.
F2 – La3	PEK_U01	Assessment of completeness and quality of task solution. Point scale 0÷10.
F3 – La5	PEK_U01	Assessment of completeness and quality of task solution. Point scale 0÷10.
F4 – La6	PEK_U01	Assessment of completeness and quality of task solution. Point scale 0÷10.
F5 – La8	PEK_U01	Assessment of completeness and quality of task solution. Point scale 0÷10.
F6 – La9	PEK_U01	Assessment of completeness and quality of task solution. Point scale 0÷10.
F7 – La10	PEK_U01	Assessment of completeness and quality of task solution. Point scale 0÷10.
F8 – La12	PEK_U01	Assessment of completeness and quality of task solution. Point scale 0÷10.
F9 – La13	PEK_U01	Assessment of completeness and quality of task solution. Point scale 0÷10.
F10 – La14	PEK_U01	Assessment of completeness and quality of task solution. Point scale 0÷10.
C1 – final evaluation from the laboratory	PEK_U01	The grade is determined on the basis of sum of points from the grades F1 to F10 according to the formula: - below 50% of points – ndst (2.0) [50%, 60%) – dst (3.0) [60%, 70%) – dst+ (3.5) [70%, 80%) – db (4.0) [80%, 90%) – db+ (4.5)

		[90%, 100%) – bdb (5.0) 100% - discretionary (e.g. additional task)
C2 – final evaluation from the lecture	PEK_W01, PEK_W02.	Knowledge test - written or electronic test using an e-learning system. Grade based on the score obtained from the test. Rating scale as for C1.
C3 – final evaluation from the lecture	The final grade C3 is calculated on the basis of 50% of C1 and 50% of C2. The condition for obtaining a positive grade C3 is obtaining a positive grade for both C1 and C2 components.	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Phillips, B.: Programowanie aplikacji dla Androida, Helion 2018.
[2] Annuzzi, J.: Android: wprowadzenie do programowania aplikacji, Helion, 2016.
[3] Deitel, P. J.: Android 6 dla programistów: techniki tworzenia aplikacji, Helion, 2016.
[4] Dokumentacja elektroniczna Open Handset Alliance: http://developer.android.com

SECONDARY LITERATURE:

[1] Murphy, M. L.: The Busy Coder's Guide to Android Development, CommonsWare, 2015.
[2] Płonkowski, M.: Android Studio : tworzenie aplikacji mobilnych, Helion, 2018.

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

Mariusz Fraś, mariusz.fras@pwr.edu.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Aplikacje mobilne a platformę IOS
Name of subject in English: Mobile Applications for IOS
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic
Level and form of studies: 1st/ ~~2nd level, uniform magister studies~~*, full-time / ~~part-time~~*
Kind of subject: ~~obligatory /~~ optional / ~~university-wide~~*
Subject code INZ002030
Group of courses YES ~~/ 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	Crediting with grade*	Examination / crediting with grade*	Crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark (X) final course	X				
Number of ECTS points	2		2		
including number of ECTS points for practical classes (P)			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,2		1,2		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of basic programming techniques for Android.
2. Basic knowledge of design and programming of mobile applications.
3. Basic knowledge of graphical software.
4. Awareness of mobile and multimedia technologies for the society.

SUBJECT OBJECTIVES

C1. Transfer of knowledge about usage of Apple devices.
C2. Introduction to programming in Swift.
C3. Design and implementation of a mobile application in Swift.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 Knows and understands the specificity of mobile applications.
PEU_W02 Knows how to design and implement mobile applications.
PEU_W02 Knows programming tools.

relating to skills:
PEU_U01 Defines a set of functional requirements of a mobile application, and – based on the definition – designs a mobile application.

PEU_U02 Implements a mobile application in accordance to the design.
PEU_U03 Publishes a mobile application.

relating to social competences:
PEU_K01 Cooperates with a potential user of a mobile application to define a set of functional requirements.
PEU_K02 Includes specific requirements in the user-interface design process.

PROGRAMME CONTENT

	Lecture	**Number of hours**
Lec 1	Introduction. Review of selected mobile applications. Introduction to Apple devices and Mac OS.	2
Lec 2-3	UI and UX. Interactions. Touch screens. Material design. Human Interface guidelines. Voice communication. Siri.	4
Lec 4	Tools for multimedia processing. Gathering multimedia data. Copyright.	2
Lec 5	Implementation rules in Xcode. The structure of application written in Swift.	2
Lec 6-7	Presentation of basic elements of Swift by examples. Core libraries.	4
Lec 8	Apple Human Interface Guideline by examples.	2
Lec 9	Libraries and frameworks supporting creation of multimedia applications. Short characteristics of Kotlin language.	2
Lec 10	Applications of augmented reality. Code analysis of application with augmented reality mechanisms.	2
Lec 11	Games review. Connections between games and the progress of algorithms and programming languages.	2
Lec 12	Multimedia data compression. Compression formats. Video and audio streaming.	2
Lec 13	Multimedia in mobile systems. Cameras. Recommended frameworks.	2
Lec 14	Interaction mechanisms – review. New technologies and multimedia devices.	2
Lec 15	Summary. Perspectives of multimedia techniqes.	2
	Total hours	**30**

	Laboratory	**Number of hours**
Lab 1-2	Introduction. Introduction to Android Studio. Animate program. Implementation of a puzzle game.	4
Lab 3-4	Implementation of photo gallery with animation and audio effects in AS 3.0.	4
Lab 5-6	Implementation of photo gallery with animation and audio effects in Swift and Xcode.	4
Lab 7-8	Implementation of an interactive game with animations and audio in Android Studio (Swift UI).	4
Lab 9-10	Implementation of photo gallery with animation and audio effects in Swift and Xcode.	
Lab 11-14	Design and implementation of a virtual museum.	8
Lab 15	Demonstration of virtual museum implementation with the use of modern multimedia techniques.	2
	Total hours	30

TEACHING TOOLS USED

N1. Lectures in the form of multimedia presentations.
N2. Introduction to the laboratories in the form of multimedia presentation.
N3. Collections of additional materials (links, papers).
N4. Individual meetings.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F1	PEU_W01 PEU_W02 PEU_W03 PEU_U01 PEU_U02 PEU_U03	Students have to realize 9 laboratory tasks. For each they can get from 0-2 points.
F2	PEU_W01 PEU_W02 PEU_W03 PEU_U01 PEU_U02 PEU_U03 PEU_K01 PEU_K02	Design and implementation of a multimedia application for 0-4 points.

P is calculated based on the formula given below. The highest grade requires the F2 is greater than zero.

Points	10-11	12-13	14-15	16-17	18-20	21-22
P	3,0	3,5	4,0	4,5	5,0	5,5

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Carmen Delessio, Lauren Darcey, Shane Conder, Android Studio w 24 godziny. Wygodne programowanie dla platformy Android, Helion 2017.
[2] Andrzej Stasiewicz, Android. Podstawy tworzenia aplikacji, Helion 2014.
[3] Kathy Sierra, Bert Bates, Rusz głową. JAVA, Wydanie 2, Helion 2011.
[4] Matthew Mathias, John Gallagher, Programowanie w języku Swift. BIG NERD RANCH GUIDE, Helion 2017.

SECONDARY LITERATURE:

[1] Randi L. Derakhshani, Dariusz Derakhshani, Autodesk 3ds Max 2014. Oficjalny podręcznik, Helion 2014.
[2] Dariusz Derakhshami, MAYA 2011. Wprowadzenie, Helion 2011.
[3] Cameron Chapman, Podręcznik genialnych pomysłów. Od inspiracji po realizację, Helion 2012.

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

Krzysztof Waśko, krzysztof.wasko@pwr.edu.pl

Zał. nr 5 do ZW 16/2020

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: **Sieci Neuronowe**
Name of subject in English: **Neural Networks**
Main field of study (if applicable): **Applied Computer Science**
Specialization (if applicable):
Profile: academic
Level and form of studies: 1st/ ~~2nd level, uniform magister studies*,~~ full-time / ~~part-time studies*~~
Kind of subject: ~~obligatory~~ / optional ~~/ university-wide*~~
Subject code INZ002041
Group of courses YES / ~~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)	120				
Form of crediting	~~Examination~~ / crediting with grade*	Examination / crediting with grade*	~~Examination~~ / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark final course with (X)	X				
Number of ECTS points	2		3		
including number of ECTS points for practical (P) classes			3		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,2		1,8		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1.K1INF_U02 Good programming skills in a high level programming language
2.K1INF_W01 Basic knowledge in differential and matrix calculus

SUBJECT OBJECTIVES

C1. Knowledge in the neural network development
C2 Knowledge of various neural networks structures and the way of training.
C3 Skills in neural network development

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 Knowledge in neural networks theory of architectures, training methods and the way of processing information
relating to skills:
PEU_U01 Is able to design and implement a neural network model
PEU_U02 Is able to conduct experiments and prepare reports

PROGRAM CONTENT		
Lectures		**Number of hours**
Lec 1	Introduction. Presentation of the course content, course organization and rules of assessment. Principles of neural network design. Simple neural networks – simple perceptron.	3
Lec 2	Simple neural networks - Adaline. Backpropagation method – intuitions	3
Lec 3	Backpropagation in matrix. Multilayered networks, choice of the neural networks architecture, hiperyparameters, the way of input output encoding	3
Lec 4	Regularization, Autoencoder, Multilayerd networks – examples of applications	3
Lec 5	Fundamentals of convolutional networks	3
Lec 6	Unsupervised training CP – Counterpropagation network, SOM neural network, RBM network	3
Lec 7	Associative memories – Hopfielda and BAM networks	3
Lec 8	Boltzmann Machine. Test	3
Lec 9	Survey of deep neural networks and their applications i ich zastosowań	2
Lec 10	Survey of students. Test	3
	Total hours	
Laboratory		**Number of hours**
Lab 1	Introduction. Presentation of organization and assessment rules. OSH training. Short presentation of simple neuron. Implementation of the network and its training rule.	3
Lab 2	Assessment of Task1 implementation. Conducting experiments and preparing a report.	3
Lab 3	Project and implementation of MLP – Task 2	3
Lab 4	Conducting experiments for various number of neurons in the hidden layer, various learning coefficient and for sigmoid activation function. Report preparation.	3
Lab 5	Changes in activation function, increasing the number of layers, various methods of learning coefficient optimization	3
Lab 6	Implementation of simple convolutional network – Task 3	3
Lab 7	Continuing implementation of Task 3. Testing the network.	3
Lab 8	Conducting experiments with convolutional network. Report preparation	3
Lab 9	Discussions on obtained results	3
Lab 10	Assessment of the results and survey of students	3
	Total hours	30

TEACHING TOOLS USED
N1. Lecture supported by multimedia presentations N2. Specification of documents necessary to be assessed during the lab. N3. Examples of documentations from lab.

N4. e-learning platform used to collect didactic materials.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01	Punctuality, fulfilment of all orders in the task descriptions and the code quality are the criteria of assessment (0-10 points).
F2	PEU_U02	The quality of conducting experiments, the result analysis and the way of presentation are the main criteria of report evaluation. Scale: 1-10 points
	PEU_U01	Punctuality, fulfilment of all orders in the task descriptions and the code quality are the criteria of assessment (0-20 points).
	PEU_U02	The quality of conducting experiments, the result analysis and the way of presentation are the main criteria of report evaluation. Scale: 1-10 points.
	PEU_U01,	Punctuality, fulfilment of all orders in the task descriptions and the code quality are the criteria of assessment (0-20 points).
F3	PEU_U02	The quality of conducting experiments, the result analysis and the way of presentation are the main criteria of report evaluation. Scale: 1-10 points.

C
The lecture is evaluated on the basis of test with open questions with a given points F_w.
The final note is calculated on the basis of the sum (F_p+F_w) of points from lab F_p and the test F_w as follows:
(50%, 60%] → dst
(60%, 70%] → dst+
(70%, 80%] → db
(80%, 90%] → db+
(90%, → bdb
Remark: Each number of points (F_p;F_w) must be higher than 50% to pass the course.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] S.Osowski: Sieci neuronowe w ujęciu algorytmicznym, WNT 1996
[2] I. Goodfellow, Y. Bengio, A. Courville: Deep learning, MIT 2016
[3] Sieci neuronowe w zastosowaniach, pod red. U. Markowskiej Kaczmar, H. Kwaśnickiej, Oficyna Wydawnicza PWr. 2005
[4] Michael Nielsen: Neural Network and Deep Learning,książka dostępna pod adresem http://neuralnetworksanddeeplearning.com/

SECONDARY LITERATURE:

[1] Biocybernetyka i inżynieria biomedyczna 2000 Tom 6 Sieci neuronowe (redaktorzy tomu (Włodzisław Duch, Józef Korbicz, Leszek Rutkowski, Ryszard Tadeusiewicz); Akademicka Oficyna Wydawnicza EXIT

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

Urszula, Markowska-Kaczmar, urszula.markowska-kaczmar@pwr.edu.pl

Zał. nr 5 do ZW 16/2020

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Systemy Operacyjne
Name of subject in English: Operating Systems
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic / ~~practical~~*
Level and form of studies: 1st/ ~~2nd level, uniform magister studies~~*, full-time / ~~part-time studies~~*
Kind of subject: obligatory / ~~optional / university-wide~~*
Subject code INZ004405
Group of courses ~~YES~~ / 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	~~Examination~~ / crediting with grade*	Examination / crediting with grade*	~~Examination~~ / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark final course with (X)					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,2		1,2		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic programming

SUBJECT OBJECTIVES

C1 General knowledge about structure, mechanisms and applications of modern operating systems
C2 General knowledge about resource management in computer systems

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 – Student knows operating systems' architectures
PEU_W02 – Student knows organizational principles of distributed operating systems
relating to skills:
PEU_U01 – Student is able to simulate standard resource allocation algorithms
PEU_U02 – Student is able to assess how resource allocation algorithms impact operating systems' effectiveness
relating to social competences:

PEU_K01 – Student understands the need to implement access control mechanisms in operating systems

PEU_K02 – Student understands contemporary research trends in operating systems, and how they influence organization of information systems

PROGRAM CONTENT

Lectures		Number of hours
Lec 1	Introduction. History of operating systems. Monitors, virtual machines, client-server architecture	2
Lec 2	Process management. Resource allocation problems	2
Lec 3	Process coordination, semaphores, critical sections, inter-process communication	2
Lec 4	Synchronization. Deadlock avoidance and management	2
Lec 5	Memory management. Memory allocation algorithms. Paging and segmentation	2
Lec 6	Virtual memory	2
Lec7	Disk space allocation.	2
Lec8	File systems. Implementation and hardware requirements	2
Lec9	Protection in operating systems. Access control mechanisms	2
Lec10	Distributed systems. Hardware, software, communication	2
Lec11	Clock synchronization in distributed systems. Election algorithms. Transactions	2
Lec12	Process and processors management in distributed systems. Fault tolerance, resource allocation	2
Lec13	Distributed file systems	2
Lec14	Shared memory and distributed systems. Consistency models. Paging	2
Lec15	Operating systems in GRID architectures. Perspectives of operating systems	2
	Total hours	30

Laboratory		Number of hours
Lab 1	UNIX shell, shell scripts	6
Lab 2	Access control in Unix system	4
Lab 3	CPU scheduling – methods and algorithms	6
Lab 4	Memory management – methods and algorithms	6
Lab 5	Resource management in distributed systems	8
	Total hours	30

TEACHING TOOLS USED

N1.Lecture
N2. Laboratory tasks
N3. Individual work

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), C – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEK_W01	Evaluation of preparation for completing laboratory taks

	PEK_W02 PEK_U01 PEK_U02 PEK_K01 PEK_K02	
F2	PEK_W01 PEK_W02 PEK_U01 PEK_U02 PEK_K01 PEK_K02	Evaluation of laboratory tasks
C Final Test		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

A. Silbershatz, J.L. Peterson, P.B. Galvin, *Podstawy systemów operacyjnych*, WNT 1993.
A.S. Tannenbaum, *Rozproszone systemy operacyjne*, Wyd. Nauk. PWN, 1997.
A.M. Lister, R.D. Eager, *Wprowadzenie do systemów operacyjnych*, WNT, 1994.
M.J Bach, *Budowa systemu operacyjnego UNIX*, WNT, 1995

SECONDARY LITERATURE:

W.R. Stevens, *Programowanie zastosowań sieciowych w systemie UNIX*, WNT, 1995.
Gabassi, *Przetwarzanie rozproszone w systemie UNIX*, Wyd. Lupus.

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

Krzysztof Juszczyszyn, krzysztof.juszczyszyn@pwr.wroc.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Techniki prezentacji
Name of subject in English: Presentation techniques
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable): not applicable
Profile: academic / ~~practical*~~
Level and form of studies: 1st/ ~~2nd level, uniform magister studies~~*, full-time / ~~part-time studies*~~
Kind of subject: obligatory / ~~optional / university-wide*~~
Subject code SCZ001115S
Group of courses ~~YES~~ / 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	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	E~~xamination~~ / crediting with grade*
For group of courses mark final course with (X)					
Number of ECTS points					2
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)					1,2

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. None

SUBJECT OBJECTIVES

C1 Familiarizing students with the basic issues related to interpersonal communication and its applications in science and business.
C2 Improvement of students' competences in the field of creating and implementing various types of speeches and presentations in business practice.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 Student knows the basic concepts and psychological mechanisms related to interpersonal communication and self-presentation.
PEU_W02 Student knows the techniques and tools used to present their own and team solutions and scientific, technical and business achievements.
relating to skills:
PEU_U01 Student is able to prepare various types of presentations and presentations of own solutions and achievements.

PEU_U02 Student is able to critically analyze the speeches and presentations of other people, organizations and institutions.
relating to social competences:
PEU_K01 He can set priorities in his own work and in cooperation with others.
PEU_K02 It presents assertiveness and courage in passing on and defending one's own achievements and views.

	Seminar	**Number of hours**
Sem 1	Basics of interpersonal communication: basic concepts and models	2
Sem 2	Basics of interpersonal communication: principles of creating an effective message, credibility of the sender	2
Sem 3	The role of verbal communication (dictionary, grammar, functions of words, sentences and questions)	2
Sem4	The role of non-verbal communication (voice and its characteristics, facial expressions and gestures, distance)	2
Sem5	Types of messages and their functions in various areas of social communication	2
Sem6	The specificity of communication in various areas of social communication - matching messages to the auditorium	2
Sem7	Mechanisms of self-presentation in interpersonal communication	2
Sem8	Rules for the development of effective multimedia presentations	2
Sem9	Rules for the development of effective multimedia presentations – case studies	2
Sem10	Principles of effective data presentation	2
Sem11	Elevator pitch - development of a brief speech and presentation	2
Sem12	Stress related to public speeches and methods of coping with it	2
Sem13	Analysis of students' own speeches and presentations	2
Sem14	Analysis of students' own speeches and presentations, cont.	2
Sem15	Analysis of students' own speeches and presentations, cont. Summary of classes. Final test.	2
	Total hours	30

TEACHING TOOLS USED

N1. Lecture
N2. Group exercises
N3. Case analysis
N4. Presentation prepared by students
N5. Discussion of problems and results of work

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1 Activity during classes	PEU_W01 - 02 PEU_U01 - 02 PEU_K01- 02	Oral feedback

F2 Work prepared individually and in groups	PEU_W01 - 02 PEU_U01 - 02 PEU_K01- 02	Work evaluation; oral feedback
C Own presentation of the student assessed by the teacher; final test		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Jonathan Schwabish (2016) Better Presentations. A Guide for Scholars, Researchers, and Wonks.
[2] Maurizio La Cava (2015) Lean PresentationDesign. How to create presentations that everybody loves.
[3] Carmine Gallo (2014) Talk Like TED. The 9 Public-Speaking Secrets of the World's Top Minds

SECONDARY LITERATURE

[1] Keith Schreiter, Tom Schreiter (2017) The One-Minute Presentation: Explain Your Network Marketing Business Like A Pro. Fortune Network Publishing
[2] Stephen Haunts (2017) A Gentle Introductiont o Speaking in Public

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

Anna Borkowska, anna.borkowska@pwr.edu.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name in Polish: Paradygmaty Programowania
Name in English: Programming Paradigms
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: ~~academic /~~ practical*
Level and form of studies: 1st~~/ 2nd~~ level~~, uniform magister studies~~*, full-time ~~/ part-time~~ studies*
Kind of subject: obligatory ~~/ optional / university-wide*~~
Subject code INZ004409L
Group of courses ~~YES /~~ 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	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark final course with (X)					
Number of ECTS points			2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)			1,2		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of object-oriented programming and the ability to write simple programs.
2. Knowledge of basic algorithms and data structures.

SUBJECT OBJECTIVES

C1 Ability to use programming techniques typical of chosen programming paradigm.
C2 Ability to merge constructs from different paradigms in one program.

SUBJECT EDUCATIONAL EFFECTS

relating to skills:

PEK_U01 Implement programs in accordance with the given specification.
PEK_U02 Select the programming paradigm that best suits the problem in hand.
PEK_U03 Choose appropriate constructs available in programming language depending on the problem to be solved.
PEK_U04 Use the standard documentation of programming languages.
PEK_U05 Use a modern programming environment (e.g. IntelliJ) and programming tools.

PROGRAM CONTENT

Laboratory		Number of hours
Lec 1	Grading policy. Safety rules. Introduction to the programming environment used.	2
Lec 2	Functional programming in interactive environment.	2
Lec 3	Simple functions with pattern matching.	2
Lec 4	Higher-order functions.	2
Lec 5	Functions with algebraic data types (e.g. trees).	2
Lec 6	Functions on lazy lists and/or trees.	2
Lec 7	Functions with computational effects.	2
Lec 8	Using modules.	2
Lec 9	Object-oriented program with class hierarchy.	2
Lec 10	Object-oriented program with traits and mixins.	2
Lec 11	Object-oriented program with generic classes. Variance properties.	2
Lec 12	Concurrent programming with threads.	2
Lec 13	Concurrent programming. Actors and message passing.	2
Lec 14	Program with event handling or reactive programing	2
Lec 15	Grading.	2
	Total hours	30

TEACHING TOOLS USED
N1. Modern programming environment and programming tools. N2. E-learning system used to publish teaching materials and messages

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEK_U01 PEK_U02 PEK_U03 PEK_U04 PEK_U05	Grading programs written on-line during labs.
C The overall grade for labs according to the rules announced during the first lab.		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Handouts provided by the teacher
[2] R. Martin, Clean Architecture, Pearson Education 2018
[3] M. Odersky, L.Spoon, B.Venners, Programming in Scala, Artima 2016
[4] J. Hickey, Introduction to Objective Caml, Internet

SECONDARY LITERATURE:

[1] E. Chailloux, P.Manoury, B.Pagano, Developing Applications with Objective Caml, Internet
[2] K.D. Lee, Foundations of Programming Languages, Springer 2017
[3] A.Prokopec, Learning Concurrent Programming in Scala, Packt 2017
[4] R. W.Sebesta, Concepts of Programming Languages, Addison-Wesley 2012.
[5] P. Van Roy, S.Haridi, Concepts, Techniques, and Models of Computer Programming, MIT 2004

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

Michał Szczepanik, michal.szczepanik@pwr.edu.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name in Polish: Paradygmaty programowania
Name in English: Programming Paradigms
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic ~~/ practical*~~
Level and form of studies: 1st~~/ 2nd~~ level~~, uniform magister studies~~*, full-time ~~/ part-time~~ studies*
Kind of subject: obligatory ~~/ optional / university-wide*~~
Subject code INZ004409Wc
Group of courses YES ~~/ 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)	80	60			
Form of crediting	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark final course with (X)	X				
Number of ECTS points	5				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	3				

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of object-oriented programming and the ability to write simple programs.
2. Knowledge of basic algorithms and data structures.

SUBJECT OBJECTIVES

C1 Basic understanding of fundamental programming paradigms and programming-language constructs.
C2 Ability to use programming techniques typical of chosen programming paradigm.
C3 Ability to merge constructs from different paradigms in one program.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEK_W01 Enumerate and characterize the basic programming paradigms.
PEK_W02 Know which programming languages support these paradigms.
PEK_W03 Know typical for basic paradigms programming mechanisms.
PEK_W04 Know common abstractions and mechanisms that support those abstractions in programming languages.

relating to skills:
PEK_U01 Implement programs in accordance with the given specification.
PEK_U02 Select the programming paradigm that best suits the problem in hand.
PEK_U03 Choose appropriate constructs available in programming language depending on the problem to be solved.
PEK_U04 Use the standard documentation of programming languages.

PROGRAM CONTENT

	Lectures	**Number of hours**
Lec 1	Introduction. Functional programming in interactive environment.	2
Lec 2	Basics of functional programming: curried and uncurried form, tail recursion, pattern matching.	2
Lec 3	Higher-order functions. Higher-order programming.	2
Lec 4	Algebraic data types: definitions and usage.	2
Lec 5	Eager and lazy evaluation. Streams. Parameter passing.	2
Lec 6	Computational effects. Imperative programming.	2
Lec 7	Abstract data types, monads, functional programming summary	2
Lec 8	Object-oriented programming I. Reminder of known programming constructs.	2
Lec 9	Object-oriented programming II. New programming constructs: traits, mixins, case classes and others.	2
Lec 10	Variance properties and bounded polymorphism	2
Lec 11	Concurrent programming. Threads and shared memory.	2
Lec 12	Concurrent programming. Actors and message passing.	2
Lec 13	Reactive Programming	2
Lec 14	Handling events. GUI programming.	2
Lec 15	Basics of logic programming.	2
	Total hours	30

	Classes	**Number of hours**
Cl 1	Administrative class. Grading policy.	1
Cl 2	Basics of functional programming. Pattern matching.	2
Cl 3	Higher-order functions. Algebraic data types.	2
Cl 4	Eager and lazy evaluation. Computational effects.	2
Cl 5	Abstract data types. Basics of object-oriented programming.	2
Cl 6	More advanced object-oriented mechanisms. Generic classes and variance properties.	2
Cl 7	Concurrent programming with threads.	2
Cl 8	Concurrent programming with actors and message passing. Handling events. Reactive programming	2
	Total hours	15

TEACHING TOOLS USED

N1. Lecture supported by multimedia presentations.
N2. E-learning system used to publish teaching materials and messages.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEK_W01 PEK_W02 PEK_W03 PEK_W04 PEK_U01 PEK_U02 PEK_U03 PEK_U04	Grading homework exercises solved at classes and declared as solved.
F2	PEK_W01 PEK_W02 PEK_W03 PEK_W04	Written examination.
C The overall grade of the course is the grade for written exam, possibly modified by 0,5 up or down depending on the activity during classes.		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Handouts provided by the teacher
[2] R. Martin, Clean Architecture, Pearson Education 2018
[3] M. Odersky, L.Spoon, B.Venners, Programming in Scala, Artima 2016
[4] J. Hickey, Introduction to Objective Caml, Internet

SECONDARY LITERATURE:

[1] E. Chailloux, P.Manoury, B.Pagano, Developing Applications with Objective Caml, Internet
[2] K.D. Lee, Foundations of Programming Languages, Springer 2017
[3] A.Prokopec, Learning Concurrent Programming in Scala, Packt 2017
[4] R. W.Sebesta, Concepts of Programming Languages, Addison-Wesley 2012.
[5] P. Van Roy, S.Haridi, Concepts, Techniques, and Models of Computer Programming, MIT 2004

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

Michał Szczepanik, michal.szczepanik@pwr.edu.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Programowanie aplikacji multimedialnych
Name of subject in English: Programming multimedia aplications
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic
Level and form of studies: 1st/ ~~2nd level, uniform magister studies~~*, full-time / ~~part-time~~*
Kind of subject: ~~obligatory /~~ optional / ~~university-wide~~*
Subject code INZ004438Wl
Group of courses YES ~~/ 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	Crediting with grade*	Examination / crediting with grade*	Crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark (X) final course	X				
Number of ECTS points	2		2		
including number of ECTS points for practical classes (P)			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,2		1,2		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of basic programming techniques for Android or iOS platform
2. Basic knowledge of design and programming of user interface
3. Basic knowledge of graphical software
4. Awareness of mobile and multimedia technologies for the society

SUBJECT OBJECTIVES

C1. Transfer of knowledge about the application areas of modern multimedia techniqes
C2. Presentation of programming tools for multimedia processing.
C3. Design and implementation of a mobile application.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 Knows and understands the specificity of multimedia applications.
PEU_W02 Knows how to design and implement multimedia applications.
PEU_W02 Knows programming tools for multimedia processing.

relating to skills:
PEU_U01 Defines a set of functional requirements of a multimedia application, and – based on the definition – designs a multimedia application.

PEU_U02 Implements a multimedia application in accordance to the design.
PEU_U03 Creates and processes multimedia.

relating to social competences:
PEU_K01 Cooperates with a potential user of a multimedia application to define a set of functional requirements.
PEU_K02 Includes specific requirements in the user-interface design process.

PROGRAMME CONTENT

Lecture		**Number of hours**
Lec 1	Introduction. Review of selected multimedia applications.	2
Lec 2-3	UI and UX. Interactions. Touch screens. Material design. Human Interface guidelines. Voice communication.	4
Lec 4	Tools for multimedia processing. Gathering multimedia data. Copyright.	**2**
Lec 5	Implementation rules in Android Studio. The structure of android application. Implementation of user-interfce.	2
Lec 6	Apple XCode environment. The structure of application written in Swift. Introduction to Swift language.	2
Lec 7	2D and 3D animations. Introduction to the 3ds Max and Maya programs. Implementation of animations in ActionScript 3.0 and Lingo.	2
Lec 8	Scene planning. Non-linear assembly of video – Adobe Premiere, After Effects.	**2**
Lec 9	Libraries and frameworks supporting creation of multimedia applications. Short characteristics of Kotlin language.	**2**
Lec 10	Applications of augmented reality. Code analysis of application with augmented reality mechanisms.	**2**
Lec 11	Games review. Connections between games and the progress of algorithms and programming languages.	**2**
Lec 12	Multimedia data compression. Compression formats. Video and audio streaming.	**2**
Lec 13	Multimedia in mobile systems. Cameras. Recommended frameworks.	**2**
Lec 14	Interaction mechanisms – review. New technologies and multimedia devices.	**2**
Lec 15	Summary. Perspectives of multimedia techniqes.	**2**
	Total hours	**30**

Laboratory		**Number of hours**
Lab 1-2	Introduction. Introduction to Android Studio. Animate program. Implementation of a puzzle game.	4
Lab 3-4	Implementation of photo gallery with animation and audio effects in AS 3.0.	4
Lab 5-6	Implementation of photo gallery with animation and audio effects in Swift and Xcode.	4
Lab 7-8	Implementation of an interactive game with animations and audio in Android Studio (Swift UI).	4
Lab 9-10	Implementation of photo gallery with animation and audio effects in Swift and Xcode.	
Lab 11-14	Design and implementation of a virtual museum.	8

Lab 15	Demonstration of virtual museum implementation with the use of modern multimedia techniqes.	2
	Total hours	20

TEACHING TOOLS USED

N1. Lectures in the form of multimedia presentations.
N2. Introduction to the laboratories in the form of multimedia presentation.
N3. Collections of additional materials (links, papers).
N4. Individual meetings.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F1	PEU_W01 PEU_W02 PEU_W03 PEU_U01 PEU_U02 PEU_U03	Students have to realize 9 laboratory tasks. For each they can get from 0-2 points.
F2	PEU_W01 PEU_W02 PEU_W03 PEU_U01 PEU_U02 PEU_U03 PEU_K01 PEU_K02	Design and implementation of a multimedia application for 0-4 points.

P is calculated based on the formula given below. The highest grade requires the F2 is greater than zero.

Points	10-11	12-13	14-15	16-17	18-20	21-22
P	3,0	3,5	4,0	4,5	5,0	5,5

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Carmen Delessio, Lauren Darcey, Shane Conder, Android Studio w 24 godziny. Wygodne programowanie dla platformy Android, Helion 2017.
[2] Andrzej Stasiewicz, Android. Podstawy tworzenia aplikacji, Helion 2014.
[3] Kathy Sierra, Bert Bates, Rusz głową. JAVA, Wydanie 2, Helion 2011.
[4] Matthew Mathias, John Gallagher, Programowanie w języku Swift. BIG NERD RANCH GUIDE, Helion 2017.

SECONDARY LITERATURE:

[1] Randi L. Derakhshani, Dariusz Derakhshani, Autodesk 3ds Max 2014. Oficjalny podręcznik, Helion 2014.
[2] Dariusz Derakhshami, MAYA 2011. Wprowadzenie, Helion 2011.

[3] Cameron Chapman, Podręcznik genialnych pomysłów. Od inspiracji po realizację, Helion 2012.
SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)
Krzysztof Waśko, krzysztof.wasko@pwr.edu.pl

Zał. nr 5 do ZW 16/2020

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Routing i przełączanie w sieciach
Name of subject in English: Routing and Switching
Main field of study (if applicable): Applied of Computer Science
Specialization (if applicable):
Profile: academic / practical*
Level and form of studies: 1st/ ~~2nd~~ level, ~~uniform magister studies~~*, full-time / ~~part-time~~ studies*
Kind of subject: ~~obligatory~~ / optional / ~~university-wide~~*
Subject code INZ002026
Group of courses YES / ~~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	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark final course with (X)	X				
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes	0		2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,2		1,2		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. K1INF_W01 - Has basic knowledge in the field of linear algebra, analytical geometry and mathematical analysis, necessary to solve computational problems of engineering character from technical and non-technical disciplines
2. K1INF_W02 - Has basic knowledge in the field of discrete mathematics, mathematical logic, probability theory and mathematical statistics, necessary to solve IT engineering problems.
3. K1INF_W07 - Has basic knowledge in the field of computer structure, organization and architecture.
4. K1INF_W10 - Has basic knowledge in the field of computer networks and their architectures.
5. 5. K1INF_U08 - Is able to configure basic devices and network software in computer networks.

SUBJECT OBJECTIVES

C1 Acquiring knowledge in the field of functionality and application of protocols operating in switched Ethernet networks.

C2. Acquiring knowledge in the field of functionality and the use of routing protocols intended for work inside and between autonomous areas of computer networks (IGP - Interior Gateway Routing Protocol, EGP - Exterior Gateway Routing Protocol).
C3. Acquiring knowledge in the field of functionality and application of protocols and services supporting the computer networks.
C4. Acquiring knowledge in the field of operation, management and configuration of network operating systems.
C5. Acquiring the ability to configure network devices (network operating systems) and protocols in the level of 2 and 3 layer od ISO-OSI model as well as the skills of monitoring , management and diagnostic of computer networks.

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge:

PEK_W01 - Has basic and structured knowledge about the functionality and operation of protocols and services supporting computer networks.

PEK_W02 - Has basic and structured knowledge in the field of configuration and operation of network operating systems.

Relating to skills:

PEK_U01 - Has skills related to basic configuration of various types of network protocols, network services, network operating systems, as well as analysis of their operation and detection of basic errors in computer networks.

PROGRAM CONTENT

	Lectures	**Number of hours**
Lec1	Plan of the lecture. Explanation of the assessment method. Introduction to computer networks. The benefits and threats of global digitization and unlimited communication. Protocols and services supporting switched networks. Explanation of operation and application of VTP (VLAN Trunking Protocol) and DTP (Dynamic Trunking Protocol) protocols.	2
Lec2	Protocols and services supporting switched networks. Explanation of the operation and application of the Spanning Tree Protocol (STP).	2
Lec3	Protocols and services supporting switched networks. Explanation of operation and application of the EtherChannel protocol. Explanation of the operation and application of the switch port monitoring protocol (port mirroring). SPAN (Switched Port Analyzer) service.	2
Lec4	Protocols that provide redundancy of the default gateway (FHRP - First Hop Redundancy Protocols). Description of the operation of HSRP (Hot Standby Router Protocol) and GLBP (Gateway Load Balancing Protocol) protocols.	2
Lec5	Vector routing protocols on the example of EIGRP in IPv4 and IPv6 networks.	2
Lec6	Parameterization of the EIGRP protocol in the IPv4 and IPv6 networks.	2

Lec7	Link-state routing protocols on the example of OSPF protocol in the IPv4 and IPv6 networks.	2
Lec8	Parameterization of the OSPF protocol in the IPv4 and IPv6 networks.	2
Lec9	Multi-area routing. Routing in a multi-access network. Information exchange between different routing protocols.	2
Lec10	PPP (Point To Point) protocol and its variations (PPPoE).	2
Lec11	Virtual networks and VPN tunnels.	2
Lec12	EGP routing protocols on the example of BGP protocol.	2
Lec13	Access control in computer networks. Extended access control lists.	2
Lec14	Securing, monitoring and diagnostics of computer networks. Protocols and services (SNMP, syslog, netflow, others).	2
Lec15	Directions of computer network development. New generations of networks and ways to configure them. Software defined network SDN (Software Defined Network).	2
	Total hours	30

Laboratory		**Number of hours**
Lab1	Organizational cLabsses. ExpLabnation of the assessment method. Principles of health and safety. Presentation of the network topology in the Labboratory and the deployment of network devices. Construction of active devices, description of interfaces.	2
Lab2	Configuring and testing VTP (VLABN Trunking Protocol) and DTP (Dynamic Trunking Protocol) protocol operations.	2
Lab3	Configuring and testing the Spanning Tree Protocol (STP).	2
Lab4	Configuring and testing the various EtherChannel variants. Configuration and testing port mirroring protocol operation.	2
Lab5	Configuring and testing a group of protocols that create a redundant default gateways - FHRP (First Hop Redundancy Protocols).	2
Lab6	Basic configuration and testing of the EIGRP protocol in the IPv4 and IPv6 environment.	2
Lab7	Advanced configuration and testing of EIGRP in an IPv4 and IPv6 environment.	2
Lab8	Basic configuration and testing of the OSPF protocol in the IPv4 and IPv6 environment.	2
Lab9	Advanced configuration and testing of OSPF in an IPv4 and IPv6 environment. Parameterization of the protocol.	2
Lab10	Configuration and testing of OSPF protocol in an Ethernet multi-access network environment. Configuration and testing of OSPF in an environment that combines multiple areas managed by the OSPF protocol and other routing protocols.	2
Lab11	Configuration and testing of PPP protocol (EncapsuLabtion, PAP and CHAP authentication). Configuring and testing the PPPoE protocol.	2

Lab12	Configuration and testing virtual network connections - VPN tunnels (Virtual Private Network). Creation of GRE (Generic Routing EncapsuLabtion) tunnels. Configuration and application the BGP (Border Gateway Protocol) routing protocol.	2
Lab13	Configuration and use of extended access control lists (Extended ACLs)	2
Lab14	Network monitoring and diagnostics. Configuration and operation of the SNMP protocol. Configuration and application of IP SLAB service (Service Level Agreements). Configuration and application of the Syslog service.	2
Lab15	Additional cLabsses devoted to the implementation of selected issues not done or finished during the semester.	2
	Total hours	30

TEACHING TOOLS USED

N1. Lecture supported by multimedia presentations and network simulator.
N2. Various types of network software.
N3. Simulator enabling creation, configuration and testing of various topologies of computer networks.
N4. Quizzes and knowledge tests.
N5. A real environment for creating, configuring and testing various topologies of computer networks

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1-F14 - partial grades obtained at La2-15 laboratories	PEK_U01	Student's presence. Theoretical preparation for the lab (quiz, test, other) on a point, percentage or traditional scale. Evaluation of the lab tasks on a point or traditional scale.
P1 – concluding lab grade	PEK_U01	An average of the F1-14 forming grades.
F15 - forming lecture grade	PEK_W01, PEK_W02	Observation of student activity. Solving sample problems and tasks.
P2 – concluding lecture grade	PEK_W01, PEK_W02	A computer test, containing questions of various types (multiple and single choice, computational, open, other) checking knowledge in the field of lecture. The test is given a positive evaluation, if the student scores at least 51% of the maximum number of points. Later, the rating is increased by 0.5 every 10%. A positive P2 rating can be adjusted by rating F15.
P3 – grade concluding the group of courses	PEK_W01, PEK_W02, PEK_U01	Score summarizing the group of courses. Rating calculated as an average of P1 and P2 grade. The condition for passing the subject is positive evaluation of P1 and P2.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Andrew S. Tanenbaum, David J. Wetherall, "Computer Networks, 5th Edition", Published by Pearson, Sep 27, 2010

[2] J. Woźniak, K. Nowicki, „Sieci LAN, MAN i WAN - protokoły komunikacyjne", Wydawnictwo - FPT, Kraków 2000

[3] Training materials of the Cisco Network Academy

[4] Wendell Odom, "CCENT/CCNA ICND1 100-105 Official Cert Guide:, Cisco Systems; Auflage: Har/Dvdr (17. Mai 2016)

[5] Wendell Odom, "CCNA Routing and Switching ICND2 200-105 Official Cert Guide: Official Cert Guid / Learn, prepare, and practice for exam success", Cisco Systems; Auflage: Har/Cdr (4. Juli 2016)

SECONDARY LITERATURE:

[1] http://www.freebookcentre.net/Networking/Free-Computer-Networking-Books-Download.html

[2] CCNA Exploration Companion Guide books

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

Kamil Nowak, kamil.nowak@pwr.edu.pl

Zał. nr 5 do ZW 16/2020

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish:	**Języki skryptowe**
Name of subject in English:	**Script Languages**
Main field of study:	**Applied Computer Science**
Specialization:	
Profile:	**academic**
Level and form of studies:	**1st level, full-time**
Kind of subject:	**obligatory**
Subject code	**INZ002025**
Group of courses	**NO**

	Lecture	Classes	Lab	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	85		90		
Form of crediting	Examination		Crediting with grade		
For group of courses mark (X) final course					
Number of ECTS points	3		3		
including number of ECTS points for practical classes (P)			3		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.8		1.8		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge on structural and object oriented programming
2. Knowledge on data structures and algorithms

SUBJECT OBJECTIVES

C1 Understands the application area of script languages
C2 Understand and exploit the particularities of OOP in Script Languages.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 Student knows idiosyncrasy of scripting language development process
PEU_W02 Student know how scripted code can collaborate with IT environment

relating to skills:
PEU_U01 Student can develop an application that cooperate with the rest of operating system
PEU_U02 Student can create GUI application

relating to social competences:
PEU_K01 Student realizes need for self-directed learning

PROGRAMME CONTENT

Lecture	**Number of hours**

Lec 1	Introduction. Tools for developing an application.	**2**
Lec 2	Debugging application. Using input and output streams. Strings.	**2**
Lec 3	Lists and tuples. Using correct coding style.	**2**
Lec 4	Sets and dictionaries. Text files.	**2**
Lec 5	Binary and structured text files. Using exceptions.	**2**
Lec 6	Text processing. Regular expressions.	**2**
Lec 7	Using object oriented approach. Classes and objects.	**2**
Lec 8	Lambda expressions. Reading and writing CSV and XLS files.	**2**
Lec 9	Internet access. Using HTTP and SMTP protocols.	**2**
Lec 10	Testing code.	**2**
Lec 11	Reading and writing DOC files. Graphics processing.	**2**
Lec 12	Database access.	**2**
Lec 13	Building GUI applications.	**2**
Lec 14	Using threads and processes.	**2**
Lec 15	Elements of functional programming.	**2**
	Total hours	**30**

Laboratory		**Number of hours**
Lab 1	Introduction. Safety guidelines. Development environments and tools setup.	**2**
Lab 2	Standard input and output.	**2**
Lab 3	Basic data structures: lists, tuples.	**2**
Lab 4	File access. Dictionaries.	**2**
Lab 5	Error handling: exceptions, asserts.	**2**
Lab 6	Text processing. Regular expressions.	**2**
Lab 7	Object oriented programming: classes and objects.	**2**
Lab 8	Collaboration with OS environment. Using DOC, CSV and XLS files	**2**
Lab 9	Accessing web resources: e-mail, WWW, web API.	**2**
Lab 10	Code testing.	**2**
Lab11-12	Mini-project 1 – console application using database, web resources	**4**
Lab13-14	Mini project 2 – GUI application using database and web resources	**4**
Lab 15	Course review and summary	**2**
	Total hours	**30**

TEACHING TOOLS USED
N1. Lectures. Lecture notes in PDF format available on-line. N2. LMS systems with additional tools for online and collaborative work. N3. Laboratory equipped with necessary software and hardware

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation (F – forming during semester), P – concluding (at semester end)	**Learning outcomes code**	**Way of evaluating learning outcomes achievement**
F1	PEU_U01 PEU_U02	10 weekly assignments, graded on quality of the code and the punctuality of delivery
F2	PEU_U01 PEU_U02	2 mini projects, graded on creativity, originality, quality of the code and the punctuality of delivery
F3	PEU_W01	Exam 100% grade
P (Lab) = F1+F2 P (Lecture) = F3		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: [1] M Lutz, Learning Python, 5th ed, O'Reilly Media, 2013. [2] E. Matthes , Python Crash Course, 2nd ed, No Starch Press, 2019. [3] A. Sweigart, Automate the Boring Stuff with Python, 2nd ed, No Starch Press, 2019. **SECONDARY LITERATURE:** [1] J. Danjou, Serious Python, No Starch Press, 2018. [2] L. Vaughan, Impractical Python Projects, No Starch Press, 2018.

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)
Wojciech Thomas, wojciech.thomas/at/pwr.edu.pl,

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Projektowanie oprogramowania
Name of subject in English: Software Engineering
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic / ~~practical~~*
Level and form of studies: 1st/ ~~2nd~~ level, ~~uniform magister studies~~*, full-time / ~~part-time~~ studies*
Kind of subject: obligatory / ~~optional~~ / ~~university-wide~~*
Subject code INZ004419
Group of courses ~~YES~~ / 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			90	
Form of crediting	Examination			crediting with grade	
For group of courses mark final course with (X)					
Number of ECTS points	3			3	
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,8			1,8	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basics of Software Engineering
2. Familiarity with object-oriented programming principles

SUBJECT OBJECTIVES

C1 Familiarity with basic concepts of software engineering
C2 Familiarity with requirements engineering priciples and techiques
C3 Familiarity with main aspects of modelling, design and testing of information systems

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
K1INF_W14

relating to skills:
K1INF_U03
K1INF_U04

K1INF_U21

PROGRAM CONTENT

Lectures		Number of hours
Lec 1	Introduction, Basic Terms and Definitions	2
Lec 2	Requirements Engineering (Stakeholder Requirements Definition Process, Techniques of Requirements Elicitation, Semantics of Business Vocabulary and Business Rules, System Requirements Analysis Process, Requirements Classification, Requirements Diagrams, Use Case Diagram)	10
Lec 3	Modelling and Design (Software Architecture, Behavioural Modelling, Structural Modelling, Database Design)	16
Lec 4	Testing	2
	Total hours	30

Project		Number of hours
Proj 1	Elaboration of application concept (Aim of the Project, General Assumptions, Stakeholders Description, Gantt Chart, Use Case Diagram)	4
Proj 2	Requirements specification (Functional Requirements Specification, Non-Functional Requirements, Requirement Matrix, Requirements Diagram, Dictionary and Business Rules)	6
Proj 3	Design (Structural Model, Behavioral Model, Database Model, Software Architecture, User Interface Design)	12
Proj 4	Construction and tests (Implementation, Tests)	8
	Total hours	30

TEACHING TOOLS USED

N1. Informative lecture supported by multimedia presentations
N2. Software modelling and design tools
N3. IDE used for programming and testing

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1 – elaboration of application concept		Checking of completeness, intra and inter consistency. Up to 15% of maximal number of points for the whole project
F2 – requirements specification		Checking of intra-consistency, completeness, correctness, GUI guidelines. Up to 25% of the maximal number of points for the whole project
F3 - design		Checking for inter-consistency (with preceding phases, and between different diagrams), completeness. Up to 40% of the maximal number of points for the whole project

F4 – construction and tests		As above. Up to 20% of the maximal number of points.
P1 – final grade from project		The grade calculated basing on the formula: <0%, 50%) → 2.0 <50%, 60%) → 3.0 <60%, 70%) → 3.5 <70%, 80%) → 4.0 <80%, 90%) → 4.5 <90%, 95%) → 5.0 <95%, 100%) → 5.5
P2 – final grade from lecture		Exam – test. The grade calculated basing on the formula: <0%, 50%) → 2.0 <50%, 60%) → 3.0 <60%, 70%) → 3.5 <70%, 80%) → 4.0 <80%, 90%) → 4.5 <90%, 95%) → 5.0 <95%, 100%) → 5.5

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Bruegge Bernd. Object-oriented software engineering: using UML, Patterns, and Java. Pearson/Prentice Hall, cop. 2004.
[2] Pfleeger Shari Lawrence. Software engineering: theory and practice. Pearson/Prentice Hall, 2006.

SECONDARY LITERATURE:

[1] Sommerville Ian, Software engineering, Addison-Wesley, 2007.
[2] Materials prepared by the lecturer

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Zał. nr 5 do ZW 16/2020

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Programowanie Strukturalne i Obiektowe
Name of subject in English: Structural and Object oriented Programming
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic
Level and form of studies: 1st , full-time
Kind of subject: obligatory
Subject code INZ004399
Group of courses YES

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	30	30		
Number of hours of total student workload (CNPS)	120		60		
Form of crediting	crediting with grade	crediting with grade*	crediting with grade*		
For group of courses mark final course with (X)	X				
Number of ECTS points	4		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	2,4		1,2		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. None

SUBJECT OBJECTIVES

C1 Knows the basics of Structured and Object Oriented Programming
C2 Knows the methodology of problem solving and decomposition

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 Knows the basics of structured and Object Oriented Programming
PEU_W02 Knows the methodology of problem solving and decomposition

relating to skills:
PEU_U01 Is able to implement algorithms in JAVA
PEU_U02 Masters the tools and methods needed for program testing and debugging

PROGRAM CONTENT

	Lectures	**Number of hours**
Lec 1	Introduction to computers, the concept of an algorithm, instruction, variables, heap, stack, one dimension arrays, compiler, simple program	2
Lec 2	Principles of structured programming, basic data types, operators, rules for coding and naming	2

Lec 3	Problem decomposition, functions, iteration, recursion and their comparison.	2
Lec 4	OOP paradigm, types of methods, scope of visibility, functions and parameter passing	2
Lec 5	Inheritance and aggregation	2
Lec 6	Exceptions, assertions, program testing with JUnit	2
Lec 7	Useful classes, stream processing, object serialization, properties, advanced enumerations	2
Lec 8	Interfaces, Abstract classes	2
Lec 9	Principles of GUI, event driven programming, layout managers, basic GUI components	2
Lec 10	More on GUI components, implementation of MVG pattern	2
Lec 11	Basic collections	2
Lec 12	More on collection, pro and cons of generic collections	2
Lec 13	Threads, sockets simple client-server application	2
Lec 14	Good programming practices, Clear Code methodology	2
Lec 15	Final test	2
	Total hours	30

Classes		**Number of hours**
Cl 1	Ways of conduct, first algorithms	2
Cl 2	One dimension arrays, simple numeric argorithms	2
Cl 3	Problem decomposition	2
Cl 4	Recursive data structures: list and queues	2
Cl 5	Recursive data structures: trees and sets	2
Cl 6	Test1: Algorithms	2
Cl 7	OOP paradigm	2
Cl 8	Defining Hierarchy of classes	2
Cl 9	Polymorphism	2
Cl 10	GUI components, layout managers	2
Cl 11	MVC programming pattern	2
Cl 12	Basic Collections	2
Cl 13	Advanced Collections	2
Cl 14	Test #2	2
Cl 15	Case study	2
	Total hours	

Laboratory		**Number of hours**
Lab 1	Ways of conduct, first algorithms, the Eclipse IDE	2
Lab 2	Modifications of a simple program, debugging	2
Lab 3	Standard input/output, simple numeric algorithms	2
Lab 4	Dynamic data stuctures implementation	2
Lab 5	Simple classes	2
Lab 6	Inheritance and aggragation	2

Lab 7	Program testing with JUnit	2
Lab 8	File and folders processing	2
Lab 9	Interfaces, Abstract Classes	2
Lab 10	Basic GUI	2
Lab 11	Advanced GUI	2
Lab 12	Collections	2
Lab 13	GUI for the implemented database	2
Lab 14	Practical Test 1	2
Lab 15	Practical Test 2	2
	Total hours	30

TEACHING TOOLS USED

N1. Lecture notes in PDF format available on-line
N2. Source files for case study programs available on - line
N3. Laboratory equipped with necessary software and hardware

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes numer	Way of evaluating learning outcomes achievement
F1	PEU_W01 PEU_W02 PEU_U01	During Classes, the students have to present solutions to tasks given to them on a weekly basis. Activity measured on a weekly base makes 30% of the final grade. 70% comes from two tests.
F2	PEU_W01 PEU_W02 PEU_U01 PEU_U02	During laboratories, the students have to present solutions to tasks given to them on a weekly basis. An overdue for solution delivery of one week is allowed but affects the grade. In order to pass, they have to pass the practical test at the end of the semester. During the test, they are given modified versions of tasks solved during the semester. 40% of the grade comes from work during the semester and 60% from the final test.
P1	PEU_W01 PEU_W02 PEU_U01	The final test during the lecture is required for all students that have not gathered at least over 75% of all points from the classes. To pass the final test at least 50% of points are obligatory.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Eckel B.: Thinking in Java, available at www.bruceeckel.com (http://mindviewllc.com/quicklinks/)
[2] Burd B.: Java For Dummies, Wiley Publishing Inc.
[3] Cadenhead R.:Sams Teach Yourself Java in 21 Days (Covering Java 7 and Android) Prentice Hall Publishing

SECONDARY LITERATURE:

[1] Schildt H.: Java The Complete Reference, The McGraw Inc.
[2] Flanagan D.: Java Examples in a Nutshell, O'Reilly
[3] Darwin I.F.:Java Cookbook, O'Reilly

On-Line Documantation

[1] https://docs.oracle.com/javase/8/docs/api/
[2] http://www.java2s.com/Tutorial/Java/

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Zał. nr 5 do ZW 16/2020

FACULTY Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Wspomaganie zarządzania projektami informatycznymi
Name of subject in English:Support for IT Project Management
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic
Level and form of studies: 1st level, full-time
Kind of subject: optional
Subject code INZ002033Wls
Group of courses NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30		15
Number of hours of total student workload (CNPS)	30		60		30
Form of crediting	crediting with grade		crediting with grade		crediting with grade
For group of courses mark (X) final course	X				
Number of ECTS points	1		2		1
including number of ECTS points for practical classes (P)			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0,8		1,6		0,8

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the basics of programming
2. Basic knowledge of database technology

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SUBJECT OBJECTIVES

C1 Familiarize students with basic methods for IT project management.
C2 Familiarize students with categories of software tools aiding IT project management.
C3 Gaining skills in work breakdown, planning, scheduling, cost estimation, and monitoring in IT projects.
C4 Gaining skills in utilizing software tools aiding IT project management.
C5 Gaining skills in working and cooperating with a team utilizing software tools aiding IT project management.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEK_W01 student has a basic knowledge of methods for IT project management.
PEK_W02 student knows categories of software tools aiding IT project management.

relating to skills:
PEK_U01 student can select and utilize aiding software tools appropriate for different phases of IT project management.
PEK_U02 student is able to carry out work breakdown, allocate resources, schedule and monitor accomplishment of a small IT project.

relating to social competences:

PEK_K01 student can retrieve and utilize information from recommended sources and acquire knowledge on his own.
PEK_K02 student understands the necessity of working systematically and creatively to accomplish the course.
PEK_K03 student is capable of cooperating in a team utilizing software tools aiding IT project management.

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Introduction. Basic concepts. Life cycle of an IT project.	1
Lec 2	Total cost of acquiring and maintaining an IT system.	2
Lec 3	Systematics of supporting software.	2
Lec 4	Software size measurements - review of supporting tools	2
Lec 5	Support for planning and scheduling an IT project.	2
Lec 6	Supporting the management of project teams	2
Lec 7	Supporting communication in an IT project	2
Lec 8	Final test	2
	Total hours	**15**

Laboratory		Number of hours
Lab 1	Introduction to the class. Division into teams. Task allocation.	2
Lab 2	Utilizing software for business process modeling.	2
Lab 3	Utilizing software for requirements management.	2
Lab 4	Utilizing software for system modeling.	2
Lab 5	Utilizing software for interface modeling.	2
Lab 6	Utilizing software to create and maintain a RACI matrix.	2
Lab 7	Utilizing software to schedule an IT project.	2
Lab 8	Utilizing software to assign and account for tasks.	2
Lab 9	Utilizing software to monitor project performance.	2
Lab 10	Utilizing software to communicate within a group.	2
Lab 11	Utilizing software to estimate the total cost of software acquisition and maintenance.	2
Lab 12	Utilizing software for risk management.	2
Lab 13	Utilizing software for configuration management.	2
Lab 14	Utilizing software integrated in cloud computing.	2
Lab 15	Final report presentation	2
	Total hours	30

Seminar		Number of hours
Semin 1	Introduction. Allocation of seminar topics.	1
Semin 2	Comparative analysis of business process modeling software.	1
Semin 3	Comparative analysis of requirements management software.	1
Semin 4	Comparative analysis of system modeling software.	1
Semin 5	Comparative analysis of interface modeling software.	1

Semin 6	Comparative analysis of software for scheduling an IT project.	1
Semin 7	Comparative analysis of task allocation and accounting software.	1
Semin 8	Comparative analysis of project implementation monitoring software.	1
Semin 9	Comparative analysis of group communication software.	1
Semin 10	Comparative analysis of risk management software.	1
Semin 11	Comparative analysis of data archiving software.	1
Semin 12	Comparative analysis of software integrated in a computing cloud.	1
Semin 13	Meyers-Briggs Personality Tests.	1
Semin 14	The Big Five Personality Tests.	1
Semin 15	DISC Personality Tests.	1
	Total hours	15

TEACHING TOOLS USED

N1. Lecture (delivered with slides)
N2. Laboratory (utilizing supporting software tools)
N3. Seminar (comparative analysis of various supporting software tools)
N4. Consultations
N5. Student's own work

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F1	PEK_U01 ÷ PEK_U02	Assessment for reports on exercises performed on particular topics during the laboratories
F2	PEK_U01 ÷ PEK_U02, PEK_K03	Grade for preparing and conducting classes on the leading topic in a given laboratory.
F3	PEK_K01 ÷ PEK_K02	Assessment of the presentation of the assigned topic delivered during the seminar
F4	PEK_K01 ÷ PEK_K02	Assessment of activity in discussing the topics presented during the seminar
F5	PEK_W01 ÷ PEK_W02	Final test
P (lect) = F5		
P (lab) = W1 × F1 + W2 × F2, weights W1, W2 will be given at the beginning of the semester		
P (sem) = W3 × F3 + W4 × F4, weights W3, W4 will be given at the beginning of the semester		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Project Management Institute. A Guide to the Project Management Body of Knowledge (PMBOK Guide) – 6th Edition 2017
[2] SWEBOK - Guide to the Software Engineering Body of Knowledge v.3.0 IEEE 2014.
[3] Kathy Schwalbe: Information Technology Project Management, 9th Edition. Cengage Learning 2018

SECONDARY LITERATURE:

[1] Capterra: https://www.capterra.com/
[2] Software Advice: https://www.softwareadvice.com/
[3] GetApp: https://www.getapp.com/
[4] G2: https://www.g2.com/

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

Bogdan Trawiński, bogdan.trawinski@pwr.edu.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Metody systemowe i decyzyjne
Name of subject in English: Systems analysis and decision support methods.
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic / ~~practical*~~
Level and form of studies: 1st/ ~~2nd level, uniform magister studies~~*, full-time ~~/ part-time studies*~~
Kind of subject: obligatory / ~~optional / university-wide*~~
Subject code INZ002024
Group of courses YES / ~~NO~~*

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15	15		
Number of hours of total student workload (CNPS)	140		50		
Form of crediting	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark (X) final course	X				
Number of ECTS points	5		2		
including number of ECTS points for practical (P) classes	2		2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	3		1,2		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows basics of mathematical analysis and linear algebra.
2. Basic programming skills (variables, functions, loops, conditional statements).

SUBJECT OBJECTIVES

C1 Knowledge about methods of modelling static and dynamic systems.
C2 Acquisition of skills necessary to develop computer models of technical and non-technical processes.
C3 Learning how to formulate typical decision making problems and how to solve them.
C4 Learning how to use computer engineering software to develop decision making support systems and solve optimization tasks.

SUBJECT EDUCATIONAL EFFECTS

related to knowledge:
PEK_W01 Knows basic ideas, problems and methods of systems modelling and identification.
PEK_W02 Knows typical decision making tasks and knows methods of solving optimization problems.

related to skills:

PEK_U01 Knows how to formulate decision making problems.
PEK_U02 Knows how to use MATLAB and SIMULINK for engineering computations, in particular for systems modelling and identification.
PEK_U03 Knows how to use computer engineering software to solve optimization tasks and to develop decision making support systems.

related to social competences:
PEK_K01 Knows how to make documentation of their own work, that is readable for other people.

PROGRAM CONTENT

	Lectures	**Number of hours**
Lec 1	Model in systems research. Introduction – basic concept.	1
Lec 2	Typical plant models – relations between descriptions.	1
Lec 3	Elementary linear elements.	1
Lec 4	Model building task based on experiment – identification problem.	1
Lec 5	Identification of static plant. Deterministic problem – determination of the plant parameters.	2
Lec 6	Noised measurements of the physical variables.	1
Lec 7	Estimation of plant parameters with noisy measurements.	1
Lec 8	Choice of the best model – probabilistic case. Regression functions.	1
Lec 9	Determination of the regression functions based on the experimental data.	1
Lec 10	Machine learning algorithm in decision support.	2
Lec 11	Model based decision making (acceptable, satisfactory and optimal decisions).	1
Lec 12	Analytical methods of unconstrained optimization for multivariable functions.	1
Lec 13	Analytical methods of constrained optimization for multivariable functions.	2
Lec 14	Numerical optimization methods – basic concepts. Numerical optimization methods for single variable function.	1
Lec 15	Non gradient optimization methods for multivariable function wit out constraints.	2
Lec 16	Gradient based optimization methods for multivariable function wit out constraints.	1
Lec 17	Numerical optimization method for multivariable function with constraints. Random search.	2
Lec 18	Linear programming.	2
Lec 19	Discrete optimization – the branch and bound algorithm.	1
Lec 20	Decision making in uncertain conditions.	1
Lec 21	Game theory in decision making.	2
Lec 22	Multi-criteria optimization.	1
Lec 23	Multi-stage decision making, dynamical programming.	1
	Total hours	**30**

Classes		Number of hours
Cl 1	Examples of dynamical processes and their models.	1
Cl 2	Discrete processes examples and their models.	1
Cl 3	Identification algorithm for static plant – deterministic case.	1
Cl 4	Identification algorithm for static plant – probabilistic case.	1
Cl 5	Machine learning algorithms	2
Cl 6	Optimization problems formulations. Decision variables, performance index, constraints.	2
Cl 7	Foundations of optimization. Convex sets and functions, quadratic form, gradient, the Hess matrix.	1
Cl 8	Analytical methods for unconstrained and constrained optimization. Equality constraints and the Lagrange function.	2
Cl 9	Analytical methods for unconstrained and constrained optimization. Inequality constraints and Kuhn-Tucker conditions.	2
Cl 10	Linear programming.	1
Cl 11	Integer programming.	1
	Total hours	15

Laboratory		Number of hours
Lab 1	Instructions for OSH. Introduction for MATLAB. Basic commands, working with command window.	1
Lab 2	Advanced functions in MATLAB for data processing.	1
Lab 3	Dynamical processes modeling in Simulink. Simulation studies.	2
Lab 4	Identification algorithm for selected plant. Test.	2
Lab 5	Optimization method for one variable function. Implementation and graphical presentation of selected methods.	2
Lab 6	Optimization method for multi variable function. Implementation and graphical presentation of selected methods. Report.	3
Lab 7	Application of Matlab's toolbox for advanced problems of modeling and optimization.	2
Lab 8	Elaboration of student's own project in Matlab environment. Report.	2
	Total hours	15

TEACHING TOOLS USED

N1. Traditional lecture. Multimedia presentations.
N2. Student's own works – solving calculation tasks.
N3. Collective works – consultations with teacher.
N4. Student's own works – literature studies.
N5. Student's own works – computer programming.
N5. Student's own works – simulation studies.
N7. Student's own works – results presentation.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), C –	Learning outcomes number	Way of evaluating learning outcomes achievement

concluding (at semester end)		
F1	PEK_U02	Observation of student's activity. Conversation with student about current laboratory exercises. Programming test.
F2	PEKU03 PEK_K01	Observation of student's activity. Conversation with student about current laboratory exercises. Report evaluation.
F3	PEK_W01 PEK_W02 PEK_U01	Observation of student's activity. Solving exercises. Test.
C1 (Lec)	PEK_W01 PEK_W02 PEK_U01	On the basis of F3 and exam.
C2 (La)	PEK_U02 PEK_U03	On the basis of F1, F2.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Bubnicki Z., *Identification of control plants*, PWN, Warszawa, 1980.
[2] Bubnicki Z. *Modern Control Theory*, Springer, Berlin-Heidelberg-New York, 2005
[3] Ikonen E., Najim K., *Advanced identification and control*, CRC Press LLC, 2002

SECONDARY LITERATURE:

[1] Bazaraa M. S., Sherali H.D., Shett C. M., *Nonlinear Programming Theory and Algorithms*, John Wiley and Sons, Inc., 2006
[2] Bishop C.M., *Pattern Recognition and Machine Learning*, Springer Science +Business Media, LLC
[3] Duda R.O., Hart P.E., Storok D.G., Pattern Classification, John Wiley and Sons, Inc., 2006.
[4] Chong E.K.P., Żak S.H., *An Introduction to Optimization*, Wiley-Interscience, 2008.
[5] Ogata K., *Modern Control Engineering*, Prentice Hall, 2009.

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

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FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Zespołowe Przedsięwzięcie Inżynierskie
Name of subject in English: Team Project
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic*
Level and form of studies: 1st level, full-time
Kind of subject: obligatory
Subject code INZ002017
Group of courses YES*

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				120	15
Number of hours of total student workload (CNPS)					
Form of crediting	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark final course with (X)				X	
Number of ECTS points				19	2
including number of ECTS points for practical (P) classes				19	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				11,4	1,2

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the basic stages of implementation of an IT project, techniques used to prioritize and task assessment.
2. Ability to program, test, create technical documentation.

SUBJECT OBJECTIVES

C1 To enable students to gain professional experience in "near-natural" conditions.
C2. Implementation of a small or medium scale engineering project in a team, using modern approaches, practices and tools.

SUBJECT EDUCATIONAL EFFECTS

relating to skills:

PEU_U01 Student plans iteration tasks, estimates their execution time, presents the way they are implemented.
PEU_U02 Student works individually and in a team; communicates with team members using modern means and tools.
PEU_U03 Student solves the encountered (complex) engineering problems using various sources of information.

PEU_U04 Student presents a solution from various perspectives (business, technical). He takes part in the discussion.

relating to social competences:
PEU_K01 Student improves technical skills and shares his knowledge with colleagues.
PEU_K02 Student cooperates in the group taking on different roles.

Project		**Number of hours**
Proj 1	Vision. Definition of requirements. Task planning as part of the first iteration.	8
Proj 2	Implementation of tasks according to the plan. Preparation of technical documentation. Summary of iteration and planning of the next one.[1]	112
	Total hours	120

Seminar		**Number of hours**
Sem 1	Organizational classes. Preparation of speeches schedule.	1
Sem 2	Presentation of the product vision, expected business benefits, addressed problems, competitive products - according to the schedule.	7
Sem 3	Presentation of the program product (in its current form), its basic functionalities, used technologies and approaches to solve problems - according to the schedule.	7
	Total hours	**15**

TEACHING TOOLS USED

N1. Software for modeling, implementation, software testing, code sharing (possibly others), preparation of multimedia presentations.
N2. A system supporting team, work among others in the area of planning tasks and reporting work progress.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F_i – phase grade (option)	PEK_U01, …, PEK_U03 PEK_K01,PEK_K02	The lecturer may decide on the phase evaluation after each (selected) phases of the project implementation. The grade should reflect the scope of implementation, its quality, and being in time.
FP - final evaluation of the project	PEK_U01, … PEK_U03 PEK_K01, PEK_K02	The grade is determined on the basis of the scope, completeness (relative to plans) of implementation, quality of the solution and documentation (at least user / administrator documentation required), timeliness of tasks implementation, if phase evaluations were not used or based on phase estimates (average of phase ratings)

[1] The number of iterations depends on the type of project and is determined by the course provider. Activities: summary of iterations and subsequent planning take place at the end and the beginning of each iteration. Some iterations may end with the release of the product. The number of releases and their scope is determined by the teacher together with the team.

FS - final grade from the seminar	PEK_U04, PEK_K01	The grade is based on: a) Preparations of the presentation: preservation of time limits, readability, substantive value of the presentation, purity of the language used, attempt to involve the participants b) Participation in the discussion of the presented solutions
P – final grade	PEK_U01… PEK_U04, PEK_K01, PEK_K02	Grade calculated on the formula: P = 0.8 * FP + 0.2 * FS

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] K. Schwaber, Agile Project Management with Scrum, Microsoft Press, 2004
[2] A. Cocburn, Agile Software Development: The Cooperative Game, Addison Wesley, 2006

SECONDARY LITERATURE:

[1] Literature about the technology used by a team.

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

Bogumiła Hnatkowska, Bogumila.Hnatkowska@pwr.wroc.pl

Zał. nr 5 do ZW 16/2020

FACULTY of Information and Communication Technology

SUBJECT CARD

Name of subject in Polish: Rachunek prawdopodobieństwa i statystyka
Name of subject in English: Theory of probabilistic and statistics
Main field of study (if applicable): Applied Computer Science
Specialization (if applicable):
Profile: academic / practical*
Level and form of studies: 1st/ ~~2nd~~ level, ~~uniform magister studies~~*, full-time / ~~part-time~~ studies*
Kind of subject: obligatory / ~~optional~~ / ~~university-wide~~*
Subject code: INZ004410
Group of courses YES / ~~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)	200				
Form of crediting	Examination / ~~crediting with grade~~*	~~Examination~~ / crediting with grade*			
For group of courses mark final course with (X)	X				
Number of ECTS points	7				
including number of ECTS points for practical (P) classes					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	4,2				

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Passed the subject: Algebra and Analytic Geometry. Knowledge of the subject.
2. Passed the subject: Mathematical analysis. Knowledge of the subject.
3. Passed the subject: Discrete Mathematics. Knowledge of the subject.

SUBJECT OBJECTIVES

C1 Acquisition of basic knowledge of probability and increased knowledge of selected aspects of the theory of probability.
C2 Acquisition of basic knowledge of the reliability of systems.
C3 Acquisition of basic knowledge of mathematical statistics.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 - has knowledge of the nature and properties of probability and probability space, and has knowledge of calculating probability and conditional probability events.
PEU_W02 - know the total probability theorem events and Bayesian model and also has knowledge of the reliability of circuits.

PEU_W03 - has knowledge of random variables, the distribution of the probability distribution function of a random variable, has a knowledge of the basic parameters of random variable and their interpretations.
PEU_W04 - knows limit theorems and their interpretation, and knows the probability inequalities, and knows how to pre-analyze the data for the analysis of probabilistic.

PEU_W05 - knows the point estimate and the maximum likelihood estimators.
PEU_W06 - has knowledge of confidence intervals for the mean and variance of the normal distribution and the ratio, it also has the knowledge of statistical hypothesis testing, tests for the mean and variance for a normal distribution and proportion.
PEU_W07 - known compatibility tests and independence tests, chi-square test, gained knowledgeof analysis of variance and one-dimensional linear regression.

relating to skills:
PEU_U01 - can calculate the overlap of events, conditional probability and the probability of overlap completely overlapping events.
PEU_U02 - can calculate the reliability of connections.
PEU_U03 - is able to calculate the distribution and the cumulative distribution of a random variable, and the basic parameters of random variables.
PEU_U04 - can use estimation and processes greatest reliability estimates, test hypotheses about the mean and variance of the normal distribution, as well as be a one-dimensional linear regression.

relating to social competences:
PEU_K01 - understands the importance of the theory of probability and statistics in the processes of social and economics.
PEU_K02 - understands the importance of the theory of probability and statistics in the technology.

PROGRAMME CONTENT		
Lectures		**Number of hours**
Lec 1	The essence of a random experience. The definition and the properties of probability. Calculation of the probability of the event. The definition of the probability space.	2
Lec 2	Conditional probability. Definition and examples.	2
Lec 3	Bayesian formula. Total probability theorem events.	2
Lec 4	Independence of events. Reliability of connections.	2
Lec 5	Random variable. Probability distribution. The distribution of the random variable. Formal definitions and examples.	2
Lec 6	Basic parameters of random variable. Interpretation of parameters.	2
Lec 7	Limit theorems and their interpretation. Important inequalities of probability.	2
Lec 8	Preliminary analysis of the data.	2
Lec 9	The point estimate.	2
Lec 10	Maximum likelihood estimators.	2

Lec 11	Confidence intervals for the mean and variance of the normal distribution and the aspect ratio.	2
Lec 12	Testing statistical hypotheses. Tests for the mean and variance for a normal distribution and proportion.	2
Lec 13	Compliance tests and independence tests. Chi-square test.	2
Lec 14	Analysis of variance. Simple linear regression.	2
Lec 15	Repertory.	2
	Total hours	**30**

Classes		**Number of hours**
Cl 1	Determination and calculation of the probability of events - accounting exercises.	2
Cl 2	Conditional probability - examples and tutorials.	2
Cl 3	Independence of events - examples, tutorials. Reliability of connections - accounting exercises.	2
Cl 4	Random variable. Probability distribution. The distribution of the random variable. Analysis of the properties of the distributions of random variables. Examples of phenomena of the distribution.	2
Cl 5	Basic parameters of the random variable and their interpretation - tutorials.	2
Cl 6	Important inequalities in probability theory, limit theorems and their interpretation - tutorials.	2
Cl 7	Preliminary analysis of the data. Examples of data analysis problems. Types of analytical variables. Examples and tutorials.	2
Cl 8	Point estimation - tutorials.	2
Cl 9	Maximum likelihood estimators - tutorials.	2
Cl 10	Confidence intervals for the mean and variance of the normal distribution and the aspect ratio. Classes.	2
Cl 11	Statistical hypothesis testing - examples. Tests for the mean and variance of the normal distribution and the ratio - examples and tutorials.	2
Cl 12	Compliance tests and chi-square independence - tutorials.	2
Cl 13	Analysis of variance. Simple linear regression. Examples and tutorials.	2
Cl 14	Simple linear regression.	2
Cl 15	Final test.	2
	Total hours	**30**

TEACHING TOOLS USED

N1. Traditional lecture. Slideshows.
N2. Tutorials and discussion of solutions of the foundations of probability theory and the reliability of systems. Discussing and presenting solutions lists. Final test of the exercise.
N3. Counseling for students.
N4. Self-study students - solving task lists.
N5. Own work - self-study problems of lecture and exam preparation.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEU_U01-PEU_U04	Examples and tutorials. Solving lists. Analysis of system reliability problems.
F2		
F3		
C	PEU_W01-PEU_W_07, PEU_K01-PEU_K02	Examination.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] J. Bartos, W. Dyczka, W. Krysicki, *Rachunek prawdopodobieństwa i statystyka matematyczna w zadaniach*, PWN, Warszawa 2008.
[2] J. Jakubowski, R. Sztencel, *Rachunek prawdopodobieństwa dla prawie każdego,* Script, Warszawa, 2009.
[3] A. Plucińska, E. Pluciński, *Rachunek prawdopodobieństwa*, WNT, Warszawa 1999.
[4] R. Zieliński, *Tablice statystyczne,* WNT, Warszawa 2006.
[5] J. Koronacki, J. Mielniczuk, *Statystyka dla studentów kierunków technicznych i przyrodniczych*, WNT, Warszawa 2001.
[6] L. Gajek, M. Kaluszka, *Wnioskowanie statystyczne. Modele i metody*, Wydawnictwa Naukowo-Techniczne, Warszawa 1984.
[7] D. Bobrowski, *Probabilistyka w zastosowaniach technicznych*, WNT, Warszawa 1986.
[8] D. Bobrowski, *Modele i metody matematyczne teorii niezawodności w przykładach i zadaniach*, WNT, Warszawa 1985.
[9] M. Fisz, *Probability theory and mathematical statistics, 3 edition*, Krieger Pub Co, June 1980.
[10] A. Stanisz, *Przystępny kurs satystyki z zastosowaniem STATISTICA PL na przykładach z medycyny*. Tom 1, 2, 3. Wydawnictwo StatSoft Polska, Kraków 2007.
[11] A. Luszkiewicz, T. Słaby, *Statystyka z pakietem komputerowym STATISTICA PL. Teoria i zastosowania.* Wydawnictwo C.H. Beck, Warszawa 2001.
[12] H. Kobayashi, B.L. Mark, W. Turin, *Probability, Random Processes and Statistical Analysis.* Cambridge University Press, Cambridge (UK) 2012.

SECONDARY LITERATURE:

[1] W. Feller, *Wstęp do rachunku prawdopodobieństwa*, tom I.II, PWN, Warszawa 2009.
[2] G. Grimmet, D. Stirzaker, *One thousand exercises In probability*, Oxford University Press, 2004.
[3] H. Jasiulewicz, W. Kordecki, *Rachunek prawdopodobieństwa i statystyka matematyczna. Definicje, twierdzenia, wzory*, GiS, Wrocław 2001.
[4] H. Jasiulewicz, W. Kordecki, *Rachunek prawdopodobieństwa i statystyka matematyczna. Przykłady i zadania*, GiS, Wrocław 2001.
[5] M. Maliński, *Weryfikacja hipotez statystycznych wspomagana komputerowo*, Wyd. Politechniki Śląskiej, Gliwice 2004.

[6] O. Hryniewicz, *Wykłady ze statystyki.* Skrypt Wyższej Szk. Informatyki Stosow. i Zarz. Warszawa 2001.
[7] A. Zelaś, B. Pawełek, S. Wanat, *Metody statystyczne. Zadania i sprawdziany.* PWE Warszawa 2002.
[8] J. Jakubowski, R. Sztencel, *Wstęp do teorii prawdopodobieństwa.* Wydawnictwo SCRIPT, Warszawa 2010.

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

Ireneusz Jóźwiak, ireneusz.jozwiak@pwr.edu.pl

FACULTY of Information and Communication Technology

SUBJECT CARD

Name in Polish: **Programowanie systemów webowych**
Name in English: **Web Systems Programming**
Main field of study (if applicable): **Applied Computer Science**
Specialization (if applicable):
Profile: practical
Level and form of studies: **1st, full-time**
Kind of subject: **optional**
Subject code **INZ004420**
Group of courses: **YES**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30		
Number of hours of total student workload (CNPS)	120				
Form of crediting	Crediting with grade		Crediting with points		
For group of courses mark (X) final course	X				
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,2		1,2		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of structured and object-oriented programming
2. Basic database skills

SUBJECT OBJECTIVES

C1 Acquisition of knowledge and skills in developing systems that are based on client-server communication and use of HTTP.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 Understands HTTP communication
PEU_W02 Selects the appropriate technology for programming Web-based systems' components

relating to skills:
PEU_U01 Adapts, arranges and rearranges working systems or their components in accordance with the submitted requirements
PEU_U02 Constructs simple web-based systems in accordance with the submitted requirements

relating to social competences:
PEU_K01 Presents the results of his or her work

PROGRAMME CONTENT

Form of classes – lecture		Number of hours
Lec1	Internet and Web - Introduction	2
Lec2	Introduction to HTML5	2
Lec3	Introduction to CSS3	2
Lec4	Selected elements of JavaScript, Document Object Model and event handling	2
Lec5	Working with WWW and database server	2
Lec6	Overview of backend programming languages, frontend frameworks and usage of AJAX	2
Lec7	Session mechanisms, usage of database	2
Lec8	Final test	1
	Total hours	**15**
Form of classes - laboratory		**Number of hours**
Lab 1	Introductory classes: presentation of health and safety regulations, fire protection rules as well as grading and class policies.	2
Lab 2	HTML5 programming basics - part 1	2
Lab 3	HTML5 programming basics - part 2	2
Lab 4	CSS3 programming basics - part 1	2
Lab 5	CSS3 programming basics - part 2	2
Lab 6	JavaScript programming	2
Lab 7	DOM and event handling	2
Lab 8	Web Server and SQL	2
Lab 9	Basics of backend programming	2
Lab 10	Usage of javascript libraries	2
Lab 11	Usage of session mechanisms	2
Lab 12	Usage of database	2
Lab 13	Programming service with login ability	2
Lab 14	Usage of AJAX	2

Lab 15	Credit	2
	Total number of hours	**30**

TEACHING TOOLS USED

N1. Lectures illustrated with the multimedia boards
N2. Laboratory exercises with use of appropriate programming environments
N3. The e-learning system for publishing course materials and receiving students' work
N4. **Student's i**ndividual work based on the lists of tasks
N5. **Student's** individual work – final test preparation
N6. **Final test conducted by the e-learning system**

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1 – F8	PEU_W02 PEU_U01 PEU_K01	Scoring on a scale (0-10).
F9 – F14	PEU_W01 PEU_W02 PEU_U01 PEU_U02 PEU_K01	Scoring on a scale (0-10).
P Lec	PEU_W01 PEU_W02	Crediting: over 50% points for correct answers in the final test. Points from the laboratory and points from the lecture are weighed so that their impact on the final grade is equal and then they are added together. Positive grade determined by proportional ranges from 50% to 100% of total points.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Paul Deitel, Harvey Deitel, Abbey Deitel: Internet & World Wide Web: How to Program, Fifth Edition, Prentice Hall, 2011

SECONDARY LITERATURE:

[1] HTML & CSS Design and Build Websites by Jon Duckett, Wiley 2011
[2] David Flanagan, JavaScript: The Definitive Guide. Activate Your Web Pages. 6th Edition, 1996
[3] Introduction to Client/Server Systems: A Practical Guide for Systems Professionals, Paul E. Renaud, 1993

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