

DESCRIPTION OF THE PROGRAM OF STUDIES**Main field of study** Computer Engineering**Profile** general academic**Specializations:** *Advanced Computer Science (ACS)**Internet Engineering (INE)***Level of studies** second-level**Form of studies** full-time**1. General description**

1.1 Number of semesters: 3	1.2 Total number of ECTS points necessary to complete studies at a given level: 90
1.3 Total number of hours: 972	1.4 Prerequisites (particularly for second-level studies): Candidates for second-level studies in Computer Engineering may be recruited after obtaining at least an engineer's degree in the approved fields of study referred to in the document "Conditions and mode of recruitment for higher studies at Wrocław University of Science and Technology" for a given academic year.
1.5 Upon completion of studies graduate obtains professional degree of: MAGISTER INŻYNIER 2nd level qualifications	1.6 Graduate profile, employability: The study program covers the issues of designing information systems for various applications in the economy and industry. Second level studies in English also develop towards research competences. Students acquire knowledge and skills necessary for the analysts and systems architects. Emphasis is placed on teaching the content which is current, modern and

sought-after on the labor market. The study program gives a solid foundation for comprehensive competence development and the possibility of a wide choice of further education and career paths, including the research and development departments.

The *Advanced Computer Science* studies' programme is focused on delivering multidisciplinary knowledge and developing theoretical and practical skills in modern areas of computer science (Machine Learning, Neural Networks, Optimisation, etc.), information technology and computer systems. We believe that students gain the most when they are involved in research (working on projects) individually and as a team while the lecturer is ready to advise and guide. Therefore, more than 65% of the course's programme is focused on active forms of learning like group projects, seminars, classes (tutorials) and laboratory training. The students will learn how to solve real-life IT and computer science problems, conduct research and gain information from the literature and other available sources. The graduates will be prepared for a role of a team leader and have extensive teamwork skills (critical thinking, collaboration, communication etc.). They will acquire the experience necessary for a professional career at research units, universities, colleges, and industry.

The *Internet Engineering* programme covers the issues of creating websites and Internet applications. It includes knowledge of managing, reconfiguring and ensuring the security of Internet services, creating concurrent and

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distributed applications. Provides UNIX / LINUX programming and administration skills, creating advanced embedded systems, designing and implementing Internet of Things solutions. Students are prepared to solve IT problems (including complexity, specification and implementation of solutions) and to manage an IT team. They have the ability to prepare, implement and verify projects, the ability to use IT tools in practice and programming skills and the knowledge to quickly adapt to the IT challenges. Students gain experience and skills in a project team working, as well as in managing, ensuring the availability and security of Internet services. Graduates can find employment in the creation and operation of software systems, Internet applications (e-business, e-commerce, e-banking), management systems in administration and military services. He or she works as a system administrator, team leader, designer or programmer of web, mobile and embedded applications, indicating threats resulting from cyber security and counteracting them both at the hardware and software level. Good theoretical preparation, experience, specific practical knowledge acquired thanks to access to modern computer and network equipment and design tools, good knowledge of foreign languages, allow graduates to easily adapt to the needs of the labour market and find interesting and well-paid jobs both in domestic companies, as well as and foreign, both in small and large research, design and implementation. Graduates have the experience necessary for a professional career and to undertake level III (Ph.D.) education.

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<p>1.7 Possibility of continuing studies: eligibility to apply for admission to a doctoral school, non-degree postgraduate programs</p>	<p>1.8 Indicate connection with University's mission and its development strategy: The program of studies is coherent with the mission and development strategy of Wroclaw University of Science and Technology</p>
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2. Detailed description

2.1 Total number of learning outcomes in the program of study: W (knowledge) = 9, U (skills) = 10, K (competences) = 4, W + U + K = 23

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

not applicable

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:

not applicable

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) 71

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) not applicable

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

The expected learning outcomes are consistent with the needs of the labor market. This position is justified by the results of analyzes of labor market needs, among others in the following studies:

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- Raport z II edycji badań Branża IT w dobie pandemii „Analiza sytuacji pracodawców, kluczowych trendów rozwojowych i zapotrzebowania na kompetencje”, podsumowujący II edycję badań realizowanych w latach 2020-2021. <https://www.parp.gov.pl/component/publications/publication/branzowy-bilans-kapitalu-ludzkiego-ii-sektor-it>
- I edycja raportu „Potrzeby kompetencyjne w kontekście skutków pandemii koronawirusa „Raport zbiorczy z badania dotyczącego działań anty COVIDowych w sektorach: Informatyka oraz Telekomunikacja i Cyberbezpieczeństwo.”, Warszawa 2021. Badanie przeprowadzone w ramach działania Sektorowej Rady ds. Kompetencji – Informatyka oraz Sektorowej Rady ds. Kompetencji Telekomunikacja i Cyberbezpieczeństwo. https://www.piit.org.pl/_data/assets/pdf_file/0023/19184/raport_zbiorczy.pdf
- Raport „Wrocławski sektor IT”, 2019, https://www.wroclaw.pl/biznes/files/dokumenty/24951/Raport_ARAW_10-10-2019_Wroclawski_sektro_IT_web.pdf
- "Przygotuj się na rekrutację IT w 2022 roku - Rynek pracy IT w Polsce", <https://nexttechnology.io/pl/raport-rynek-pracy-it-w-polsce/>

The compliance of educational outcomes is in line with expectations both in the local labor market (graduates easily find employment in companies operating on the local market, such as VOLVO, NSN, Teta, InsERT, Sente, Techland) and in the national or even global market (many graduates find employment in international corporations abroad, such as Microsoft or IBM).

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 subjects / groups of classes marked with the BU¹ code) **46,9 (ACS), 46,26 (INE) ECTS**

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

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

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

Number of ECTS points for obligatory subjects	17
Number of ECTS points for optional subjects	42 (ACS), (INE)
Total number of ECTS points	59 (ACS), (INE)

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 subjects/group of classes denoted with code O)

9 ECTS points

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

55 ECTS points

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

Implementing the curriculum, students attend organized classes, according to the regulations of higher education at the Wrocław University of Science and Technology (available at the web page of the University). Classes are conducted in the forms specified in the study regulations, while both traditional methods and teaching tools as well as opportunities offered by the university e-learning platform are used. Besides the classes, the lecturers are available to students at the hours of consultation designated and announced on the website or teaching service system (USOS). An important element of learning is student's own work, consisting in preparing for classes (based on materials made available by the teachers and the recommended literature), studying literature, preparing reports, preparing for tests and exams.

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For each PRK learning outcome, the codes of courses present in the study program are assigned. Completing these courses (this course) means getting the effect. The courses are passed on the basis of forms of control of the acquired knowledge, skills and social competences, defined in the course cards. The student's failure to achieve the learning outcomes attributed to the course results in the failure to complete the course and the need to repeat it.

Passing each semester of study is conditioned by obtaining a number of ECTS points given by a study program, which is synonymous with achieving the majority of learning outcomes provided for a given semester. Student is obligated to repeat all the not completed courses during the following semesters, thus achieving the remaining learning outcomes.

Positive completion of studies is possible after the student has achieved all the learning outcomes determined by the study program.

The quality of classes and learning outcomes are controlled by the Faculty Quality Assurance System, including, among others, the procedures for creating and modifying education programs, individualizing study programs, implementing the teaching process and diploma. Quality control of the educational process includes evaluation of learning outcomes achieved by students. Quality control of the conducted classes is supported by class inspections and surveys, carried out according to well-defined faculty procedures.

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4. List of education blocks:

4.1. List of obligatory blocks:

4.1.1 List of general education blocks

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

No.	Subject group of classes code	Name of Subjectgroup of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of Subjectgroup of courses	Way ³ of crediting	Subjectgroup of classes			
			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	W08W04-SM4002	Social Communication						K2ITE_U02K_2ITE_K01	15	50	2		0,68	T/Z	Z	O		P(1)	KO
2	W08W04-SM4006	Entrepreneurship (GK)	1					K2ITE_W02_K2ITE_K02	30	75	3		1,36	T/Z	Z (w)	O		P (1,5)	KO
Total			1					-	45	125	5	0	1,8	-	-	-	-	P(2,5)	-

Altogether for general education blocks

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
1	0	0	0	2	45	125	5	0	2,04

4.1.2 List of basic sciences blocks

4.1.2.1 Mathematics block

No.	Subject	Weekly number of hours	Learning effect symbol	Number of hours	Number of ECTS points	Form ² of Subjectgr	Way ³ of crediting	Subjectgroup of classes
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	group of classes code	Name of Subjectgroup of classes (denote group of courses with symbol GK)	lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes	oup of courses		University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W04ITE-SM4013	Discrete Mathematics (GK)	2			2		K2ITE W01 K2ITE U04	60	125	5		3,04	T/Z*	E (w)			P (2,5)	K
Total			2	0	0	2	0	–	60	125	5	0	2,48	–	–	–	–	P (2,5)	–

4.1.2.2 Physics block

No.	Subject group of classes code	Name of Subjectgroup of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of Subjectgroup of courses	Way ³ of crediting	Subjectgroup of classes			
			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	W11ITE-SM4001	Physics	1					K2ITE W01	15	25	1		0,68	T/Z	Z	O			PD
Total			1	0	0	0	0	–	15	25	1	0	0,68	–	–	–	–	P (0)	–

Altogether for basic sciences blocks:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
3	0	0	2	0	75	150	6	0	5,2

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4.1.3 List of the main field of study blocks

4.1.3.1 *Obligatory main field of study blocks*

No.	Subject group of classes code	Name of Subjectgroup of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of Subjectgroup of courses	Way ³ of crediting	Subjectgroup of classes			
			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	W04ITE-SM4010	Computer Project Management (GK)	2		1		1	K2ITE_W06 K2ITE_U03 K2ITE_K02 K2ITE_K03	60	125	5		2,88	T/Z*	E (w)			P(2,5)	K
2	W04ITE-SM4017G	Optimization Methods: Theory and Applications (GK)	2				2	K2ITE_W05 K2ITE_W07 K2ITE_U08	60	125	5	5	2,72	T/Z*	Z(w)			P(2,5)	K
3	W04ITE-SM4018G	IT Applications in Business and Commerce (GK)	2				2	K2ITE_W05 K2ITE_K03 K2ITE_U03	60	125	5	5	2,88	T/Z*	Z(w)		DN	P (2,5)	K
4	W04ITE-SM4019G	Information Systems Modeling (GK)	2		1			K2ITE_W06 K2ITE_U04	45	75	3	3	2,04	T/Z*	Z (w)		DN	P(1,5)	K
5	W04ITE-SM4020G	Research Skills and Methodologies (GK)	1				2	K2ITE_W03 K2ITE_K04	45	75	3	3	2,04	T/Z	Z		DN	P (2)	K
6	W04ITE-SM4021G	Secure systems and networks (GK)	2		1			K2ITE_W04 K2ITE_U04	45	75	3	3	2,04	T/Z*	Z (w)		DN	P(1)	K
Total			11	0	3	4	3	-	315	600	24	19	14,6	-	-	-	-	P(12)	-

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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					
11	0	3	4	3	315	600	24	19	14,6

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4.2 List of optional blocks

4.2.1 List of general education blocks

4.2.1.1 Foreign languages block (min. 3 ECTS points):

No.	Subject group of classes code	Name of Subjectgroup of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of Subjectgroup of courses	Way ³ of crediting	Subjectgroup of classes			
			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	SJO-SM0001	Foreing Language I		1				K2ITE U01	15	30	1		0,63	T	Z	O		P (1)	KO
2	SJO-SM0002	Foreign Language II		3				K2ITE U01	45	60	2		1,63	T	Z	O		P (2)	KO
Total			0	4	0	0	0	–	60	90	3	0	2,26	–	–	–	–	P (3)	–

Altogether for general education blocks:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
0	4	0	0	0	60	90	3	0	2,26

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4.2.2 List of specialization blocks

4.2.4.1 Specialization subjects (Advanced Computer Science - ACS) blocks (min. 41 ECTS points):

No.	Subject group of classes code	Name of Subjectgroup 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 Subjectgroup of courses	Way ³ of crediting	Subjectgroup of classes				
			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	W04ITE-SM4246P	Research Project				3		K2ITE_U08 K2ITE_K02	45	75	3	3	2,28	T	Z		DN	P (3)	S	
2	W04ITE-SM4226	ACS Seminar 1					2	K2ITE_W07 K2ITE_U05	30	50	2	2	1,36	T/Z	Z		DN	P (2)	S	
3	W04ITE-SM4247G	Modeling and Optimization of Computer Networks (GK)	1				2	1	K2ITE_W07 K2ITE_U08 K2ITE_U10 K2ITE_K04	60	150	6	6	3,04	T/Z*	E (w)		DN	P (4)	S
4	W04ITE-SM4248G	Information and Storage Management (GK)	1		1				K2ITE_W07 K2ITE_U09	30	50	2	2	1,36	T/Z*	Z (w)		DN	P (1)	S
5	W04ITE-SM4249G	Neural Networks (GK)	2				2		K2ITE_W07 K2ITE_W08 K2ITE_U08	60	150	6	6	2,88	T/Z*	Z (w)		DN	P (3)	S
6	W04ITE-SM4250G	Machine Learning (GK)	2		1	1			K2ITE_W08 K2ITE_U08 K2ITE_K01 K2ITE_K02	60	150	6	6	2,96	T/Z*	E (w)		DN	P (3)	S
7	W04ITE-SM4245	ACS Seminar 2					2		K2ITE_U06	30	75	3	3	1,36	T/Z	Z		DN	P (3)	S
8	W04ITE-SM4251G	Introduction to Computer Vision in Quality Control (GK)	2				2		K2ITE_W07 K2ITE_W09 K2ITE_U08	60	125	5	5	2,88	T/Z*	Z (w)		DN	P (2,5)	S
9	W04ITE-SM4252G	Natural Language Processing (GK)	1				2		K2ITE_W07 K2ITE_W08 K2ITE_U10	45	100	4	4	2,2	T/Z*	Z (w)		DN	P (2,5)	S
10	W04ITE-SM4253G	Research Project 2 (GK)					1	2	K2ITE_U08 K2ITE_K04 K2ITE_U05 K2ITE_K03	45	100	4	4	2,12	T/Z*	Z (p)		DN	P (4)	S
Total			9	0	2	13	7		465	1025	41	41	22,44					P(28)		

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

Altogether for specialization blocks - ACS:

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	0	2	13	7	465	1025	41	41	22,44

4.2.4.1 Specialization subjects (Internet Engineering - INE) blocks (min. 41 ECTS points):

No.	Subject group of classes code	Name of Subjectgroup 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 Subjectgroup of courses	Way ³ of crediting	Subjectgroup of classes			
			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	W04ITE-SM4116	Application Programming – Java and XML Technologies (GK)	2	1	1			K2ITE_W09 K2ITE_U10	60	125	5	5	2,72	T/Z*	Z (w)		DN	P (2,5)	S
2	W04ITE-SM4117	Information Systems Analysis (GK)	2		2			K2ITE_W07 K2ITE_U08	60	125	5	5	2,88	T/Z*	E (w)		DN	P (3)	S
3	W04ITE-SM4120G	Advanced Databases (GK)	2		2			K2ITE_W07 K2ITE_U09	60	125	5	5	2,72	T/Z*	Z(w)		DN	P (2,5)	S
4	W04ITE-SM4119	Softcomputing (GK)	2			2		K2ITE_W08 K2ITE_U08	60	125	5	5	2,88	T/Z*	Z (w)		DN	P (2)	S
5	W04ITE-SM4115	Multimedia and Computer Visualization (GK)	1			2		K2ITE_W07 K2ITE_U08	45	125	5	5	2,36	T/Z*	E (w)		DN	P (3)	S
6	W04-SM4114	Internet Engineering Seminar					2	K2ITE_U05 K2ITE_U06	30	75	3	3	1,36	T/Z	Z		DN	P (3)	S
7	W04ITE-SM4121G	Application Programming – Data Mining and Data Warehousing (GK)	2		2	1		K2ITE_W07 K2ITE_U09	75	150	6	6	3,48	T/Z*	Z (w)		DN	P (4)	S

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

⁴University-wide subject /group of classes – enter O

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

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8	W04ITE-SM4122 G	Application Programming – Mobile Computing (GK)	2		2		1	K2ITE_W09 K2ITE_U10	75	175	7	7	3,4	T/Z*	Z (w)		DN	P (4)	S
Total			13	1	9	5	3		465	1025	41	41	21,8					P(24)	

Altogether for specialization blocks - INE:

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					
13	1	9	5	3	465	1025	41	41	21,8

4.3 Training block - concerning principles of training crediting

Not applicable

4.4 „Diploma dissertation” block

Type of diploma dissertation	magister inżynier	
Number of diploma dissertation semesters	Number of ECTS points	Code
1	11 P(11)	W04ITE-SM4218 (ACS) W04ITE-SM4113 (INE)
Character of diploma dissertation		
Scientific-research		
Number of BU ¹ ECTS points	1,84	

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5. Ways of verifying assumed learning outcomes

Form of classes	Ways of verifying assumed learning outcomes
lecture	written or oral crediting, colloquium (test), written exam, colloquium, oral exam
class	control reports average grade, homework assignments average grade, classwork grades, final test
laboratory	monitoring the preparation for and realization of laboratory exercises, evaluation of laboratory tasks, presentation of results with conclusions and discussion, pretest, report from laboratory
project	realization analysis of project assignment, written project documentation, presentation of project assumptions and final solution, presentation of project results with conclusions and discussion, evaluation of report, evaluation of project realization, project defense, participation in problem discussions, evaluations of project elements and final project, evaluation of simulation software, oral answers, discussions, presentation of initial results for diploma dissertation.
seminar	topic presentation, participation in discussion, report on seminar realization, evaluation of technical aspects and merits of the presentation
diploma dissertation	prepared diploma dissertation

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

6. Range of diploma examination

Specialization Advanced Computer Science (ACS)

1. The requirements and tasks of the main design patterns of each layer of the multilayer information systems.
2. Graphs: definition, classification, algorithms, applications.
3. Enterprise and corporate applications - characteristics and technical aspects.
4. Payment card transactions: types of transactions, technological solutions, security.
5. Investigations using computer simulation: rules of experiment design, simulation tools, analysis of results, examples.
6. Project management – main groups of the processes.
7. Requirements description methods – the most popular ones, their pros and cons.
8. Users authentication in computer systems – methods, advantages, drawbacks.
9. Optimization using nature inspired algorithms
10. Inductive learning task and problem of overfitting.
11. The idea of multilayer perceptron learning.
12. Algorithms of pattern recognition.
13. Convolutional neural network.
14. Methods of image processing.
15. Computer vision applications in quality monitoring.
16. Modeling and optimization of survivable computer networks.
17. Modeling of computer networks using multi-commodity flows.
18. Stages of natural language processing.
19. Planning and conducting of scientific research.
20. Storage technology solutions (e.g. DAS, NAS, SAN).
21. Replication methods in storage systems.

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

⁴University-wide subject /group of classes – enter O

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

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

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

Specialization Internet Engineering (INE)

1. The requirements and tasks of the main design patterns of each layer of the multilayer information systems.
2. Graphs: definition, classification, algorithms, applications.
3. Enterprise and corporate applications - characteristics and technical aspects.
4. Payment card transactions: types of transactions, technological solutions, security.
5. Investigations using computer simulation: rules of experiment design, simulation tools, analysis of results, examples.
6. Project management – main groups of the processes.
7. Requirements description methods – the most popular ones, their pros and cons.
8. Users authentication in computer systems – methods, advantages, drawbacks.
9. Optimization using nature inspired algorithms
10. XSLT concept, area of applications. Describe language directives.
11. XML documents processing in Java: describe and compare available techniques.
12. Information systems analysis using Petri nets.
13. Privacy, access control and security management in relational database management systems.
14. XML extensions to relational database management systems and non-relational databases.
15. Purpose and short characteristics of main methods of data mining.
16. Security problems related to network communication.
17. Artificial neural networks: learning algorithms
18. Describe the color model "luminancechrominance" and its application
19. Discuss the JPEG compression algorithm
20. Data warehouse – purpose, characteristics and architectures.
21. Characteristic limitations of mobile systems related to hardware, software, user interface and networking

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

No requirements

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8. Plan of studies (attachment no. 4)

Approved by faculty student government legislative body:

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

.....
Date Dean's signature

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²Traditional – enter T, remote – enter Z, remote for lecture and seminar – Z*

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

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