Załącznik do Uchwały nr 2377 Senatu UwB z dnia 27 marca 2019 r.

#### LEARNING OUTCOMES

for the field of study

*first* **degree study** – *general academic* **profile** 

Setting the field of study in discipline/scientific disciplines, which the learning outcomes refer to: *computer science, mathematics, linguistics, law, philosophy, culture and religion science, economics and finance* 

Identification of the leading discipline: computer science

Description symbol of the second degree Polish Qualification Framework (PQF) in the scope of computer science	DESCRIPTION OF THE SECOND DEGREE PQF	Symbol of the field outcome	DESCRIPTION OF THE FIELD LEARNING OUTCOMES
	KNOWLEDGE, a graduate is famili	ar with and under	stands:
	Scope and depth - completeness of the cognitive perspective	KA6_WG1	basic knowledge about logic, discrete mathematics, algebra
	and dependence		and mathematical analysis
		KA6_WG2	basic knowledge about statistics and probabilistic methods
	to an advanced degree - selected facts, objects and phenomena	KA6_WG3	the idea of algorithm and the rules of designing and
	and their methods and theories explaining complex		analyzing algorithms
	relationships between them, constituting basic general	KA6_WG4	basic techniques and methods of programming,
	knowledge in the field of scientific or artistic disciplines		programming paradigms and languages
	forming theoretical foundations and selected issues related to	KA6_WG5	the rules of collecting and saving data
	detailed knowledge - appropriate for the study program	KA6_WG6	basic methods of approximate and exact calculations,
			understands the significance of error analysis in numerical
P6S WG			calculations
1002110		KA6_WG7	possibilities to use software for numerical calculations
		KA6_WG8	methodologies and tools allowing to create software in local,
			distributed and internet environment
		KA6_WG9	methods of network communication as well as rules of
			network safety
		KA6_WG10	basic rules of operating systems functioning
		KA6_WG11	basic concepts of artificial intelligence, representation and
		VAC WO12	processing knowledge, human-computer interaction
		KA6_WG12	foundations of software engineering
		KA6_WG13	basic methods of technology and elements of
			distributed systems architecture, fundamental assumptions

			of parallel and distributed programming, fundamental
		KA6 WG14	basic concepts of automata theory and mathematical
		_	linguistics
P6S_WK	Context - conditions, effects	KA6_WK1	basic knowledge referring to legal and ethical issues
			connected with computer science; fundamental rules of
	fundamental dilemmas of modern civilization		Occupational Safety and Health while using computer
	hasic economic legal and other conditions of various types of	KA6 WK2	naruware selected dilemmas of modern civilization
	activities related to the awarded qualification, including basic	KA0_WK2	selected unenimas of modern ervinzation
	concepts and principles in the field of protection of industrial		
	property and copyright		
	have a single of an ating and have being a series of		
	basic principles of creating and developing various forms of entrepreneurship		
	SKILLS, a graduate ca	n/is able to:	
	The use of knowledge - problems to be solved and tasks	KA6_UW1	use algebra methods: follow simple reasoning inside
	performed		theories of basic algebraic structures (groups, rings,
	use acquired knowledge formulate and solve complex and		fields); use matrices to solve problems
	unusual problems and perform tasks in conditions not fully	KAU_UWZ	notion and properties of functions sequences and series
	predictable by:		limits and continuity of functions of one and several
	- proper selection of sources and information from them,		variables, integral and differential calculus of functions of
	evaluation, critical analysis and synthesis of this information,		one and several variables
	- selection and application of appropriate methods and tools,	KA6_UW3	use statistical and probabilistic methods for data analysis
	including advanced information and communication techniques	KA6_UW4	use apparatus of mathematical logic to describe and verify
		KAG UW5	facts, using inductive and deductive reasoning
P6S_UW		KAU_UWS	mathematical constructions and computational methods
		KA6_UW6	independently design algorithms realizing selected
			tasks, analyze the complexity of an algorithm
		KA6_UW7	choose an appropriate paradigm and programming language
			to solve tasks of a certain type
		KA6_UW8	elements of a chosen programming language
		KA6 UW9	solve algebraic and analytical problems in a numerical way
		KA6 UW10	apply software for numerical calculations to solve problems.
			estimate an error of numerical calculations, implement
			known numerical algorithms in a chosen programming
			language

		KA6_UW11	design and optimize a database in accordance with a specification, efficiently search for required information in an existing database, implement a database in a selected system of databases
		KA6_UW12	design a local area network, ensure safety while managing a local area network
		KA6_UW13	take advantage of possibilities of different operating systems in computer systems realizing different functions
		KA6_UW14	describe problems expressed in a natural language using the terminology of artificial intelligence
		KA6_UW15	use design patterns, APIs and tools supporting the process of creating, testing and debugging software
		KA6_UW16	use knowledge of the automata theory as well as formal languages to solve simple problems regarding human- computer interaction, artificial intelligence, formulating algorithms and designing simple information systems
		KA6_UW17	create client-server type software
		KA6_UW18	use technologies of creating software working in the Internet
		KA6_UW19	use parallel calculations to increase the efficiency of algorithmic problem resolution, choose a suitable algorithm for a given model of parallel and distributed calculations
		KA6_UW20	implement the resolution of a problem requiring interaction between processes in distributed environment employing available software
		KA6_UW21	numerically model selected phenomena and simulate simple processes in a computational way, optimize numerical representations of phenomena and processes
		KA6_UW22	use selected computation models
P6S_UK	Communicating - receiving and creating statements,	KA6_UK1	use the computer terminology in a foreign language
	disseminating knowledge in the scientific community and using a foreign language	KA6_UK2	prepare a study of computer science concepts and present them
	communicate using specialized terminology	KA6_UK3	independently devise the resolution of an assigned information technology task which is a borderline case of theory and practice as well as present the resolution and
	take part in a debate - present and evaluate various opinions and positions and discuss them		conclusions
	use a foreign language at B2 level of the Common European Framework of Reference for Languages		
P6S_UO	Work organization - planning and teamwork	KA6_UO1	work in a programming team to solve assigned problem

			comprehensively
	plan and organize individual work and as part of the team	KA6_UO2	cooperate in a team completing collective tasks
	cooperate with other people as part of team work (also of an interdisciplinary nature)		
P6S_UU	Learning - planning one's own development and the development of others	KA6_UU1	understand the need to improve their skills and qualifications, and monitor the development of technologies and IT tools
	independently plan and implement own lifelong learning		
	SOCIAL COMPETENCE, a gra	duate is prepared	l for:
P6S_KK	Assessment - a critical approach	KA6_KK1	careful determining priorities and the order of actions
	critical assessment of own knowledge and received content		
	recognition of the importance of knowledge in solving cognitive and practical problems and consulting experts in case of difficulties in solving a problem		
P6S_KO	Responsibility - fulfilling social obligations and acting for the public interest	KA6_KO1	showing the right attitude necessary to take up practical activity in the information society
	fulfilling social obligations, co-organizing activities for the social environment		
	initiating activities for the public interest		
	thinking and acting in an entrepreneurial way		
P6S_KR	Professional role - independence and development of the ethos	KA6_KR1	understanding the need to obey ethical rules and legal regulations connected with the activity in the IT environment
	responsible performance of professional roles, including: - observing the rules of professional ethics and requirements from others, care for the achievements and traditions of the profession		
	- cure for the achievements and traditions of the profession		

#### Explanation of the symbols

<b>P6S_WG</b> – description symbol of the second degree PQF	<b>KA6_WG1</b> – symbol of the field outcome
$\mathbf{P}$ – practical profile	<b>K</b> – field learning outcomes
A – general academic profile	A – educational profile (A – general academic, P – practical)
<b>P6 or P7</b> – PQF level (6 – first degree study, 7 – second degree study and	<b>6</b> – educational level (6 - first degree study, 7 – second degree study and uniform
uniform master degree study)	master degree study)
$\mathbf{S}$ – specification typical of qualifications obtained in higher education	
W – knowledge (descriptive category)	W – knowledge (descriptive category)
$\mathbf{G}$ – depth and extent	$\mathbf{G}$ – depth and extent
$\mathbf{K}$ – context	$\mathbf{K}$ – context
<b>U</b> – <b>skills</b> (descriptive category)	<b>U</b> – <b>skills</b> (descriptive category)
W – use of knowledge	W – use of knowledge
<b>K</b> – communicating	<b>K</b> – communicating
<b>O</b> – work organization	$\mathbf{O}$ – work organization
U – learning	U – learning
<b>K</b> – social competence (descriptive category)	<b>K</b> – <b>social competence</b> (descriptive category)
<b>K</b> – critical evaluation	$\mathbf{K}$ – critical evaluation
$\mathbf{O}$ – responsibility	$\mathbf{O}$ – responsibility
$\mathbf{R}$ – professional role	$\mathbf{R}$ – professional role

#### STUDY PROGRAMME - Part A

#### I GENERAL INFORMATION

1. Setting the field of studies in discipline/scientific disciplines, which the learing outcomes refer to: computer science, mathematics, linguistics, law, philosophy, culture and religion science, economics and finance

2. Name of the field of study: **Computer Science** 

- 3. Level of education: first degree studies
- 4. Educational profile: general academic
- 5. Form of study: **full-time studies**
- 6. A number of semesters: 6
- 7. Total number of ECTS points required to achieve the equivalent level of relevant qualifications: 183
- 8. Total number of teaching hours: 2210
- 9. Programme is effective from the academic year: 2019/2020
- 10. Programme adopted at the meeting of Faculty Board on 13.02.2019

#### **II. EDUCATION MODULES**

	Image: Skills     Field learing outcomes       Wather String     Woodnes       Knowledge     Skills       Social competence (symbols)     Terano       KA6_UW2,     process       KA6_UW4,     exec       KA6_UU1,     KA6_UU1,       KA6_UU1,     KA6_UU1,       KA6_KO1     As			e	Q	UANTITATI	VE INDICATOI	RS - ECTS p	oints includ	ed in course	s:
Modules (module code: MK_1 and name)		Teaching methods and verification	ching methods and verification Courses/modules	a number of ECTS points per course/modul	that require direct participation of teachers or other people conducting the classes	in basic science specific for a given field of study, which learning outcomes for a given field, level and profile of education refer to	classes shaping practical skills/classes connected with scientific activity conducted at the university in discipline/disciplines, which the field of study is assigned to	in discipline of humanities or social sciences (min. 5 ECTS points) - for the fields from other discipline of science*	in a foreign language (language classes)	in apprenticeships	that are elective
is		Teaching methods: Lecture	1. Review of Mathematics	3,0	1,0		3,0				
, Analys	KA6_WG1, Ka6_UW2	and exercise classes, discussion, presentation, problem solving individual	2. Mathematical Analysis 1	4,0	2,0		2,0				
MK_1 matical	KA6_UW4, KA6_UU1,	exercises.	3. Mathematical Analysis 2	6,0	2,0		2,0				
Mathe	KA6_KO1	Assessment methods: exams (written and/or oral), tests,	4. Mathematical Analysis 3	3,0	2,0		2,0				
			5. Differential and Difference Methods	2,0	1,0		1,0				
			total	18,0	8,0	0,0	10,0	0,0	0,0	0,0	0,0

MK_2, Algebra	KA6_WG1, KA6_UW1, KA6_UW4, KA6_UU1, KA6_KK1	Teaching methods: lecture and exercise classes. Assesment methods: exams, tests, activity evaluation.	Linear Algebra with Analytical Geometry	6,0	2,0		1,0				
			total	6,0	2,0	0,0	1,0	0,0	0,0	0,0	0,0
MK_3, Logic and Set Theory	KA6_WG1, KA6_UW4, KA6_UW5, KA6_UU1, KA6_KK1	Teaching methods: lecture and exercise classes Assesment methods: exams, tests, activity evaluation	Elements of Logic and Set Theory	6,0	3,0		3,0				
			total	6,0	3,0	0,0	3,0	0,0	0,0	0,0	0,0
4, nalysis of ıms	KA6_WG1, KA6_WG3, KA6_UW2,	Teaching methods: lecture and exercise classes.	1. Discrete Mathematics	5,0	2,0	2,0	5,0				
MK_ <sup>-</sup> Design and A <sup>-</sup> Algorit	KA6_UW4, KA6_UW6, KA6_UW8, KA6_UU1	Assesment methods: exams, tests, activity evaluation.	2. Algorithms and Data Structures	5,0	3,0	5,0	5,0				
			total	10,0	5,0	7,0	10,0	0,0	0,0	0,0	0,0

	KA6_WG1,		1. Introduction to Structured Programming	7,0	4,0	7,0	7,0				
	$KA6_WG3, KA6_WG4, KA6_WG5$		2. Python Programming	4,0	2,0	4,0	4,0				
ස ස	KA6_WG6, KA6_WG7,	Teaching methods: lecture, exercise classes and	3. Introduction to Object-Oriented Programming	5,0	3,0	5,0	5,0				
MK_5, Programmi	KA6_W07, KA6_UW6, KA6_UW8, KA6_UW9, KA6_UW10, KA6_UW15, KA6_UK1, KA6_UK3, KA6_UU1, KA6_KK1	homeworks. Assesment methods: exams (written and/or oral), tests, activity evaluation.	4. Advanced Programming	5,0	3,0	5,0	5,0				
			total	21,0	12,0	21,0	21,0	0,0	0,0	0,0	0,0
ants	KA6_WG1, KA6_WG3, KA6_WG4,		1. Graphics and Human-Computer Communication	3,0	2,0	3,0	1,0				
MK_6, Programming Environme	KA6_WG10, KA6_WG11, KA6_UW6, KA6_UW7, KA6_UW8, KA6_UW15, KA6_UK3 KA6_UC2, KA6_UU1, KA6_KK1	Teaching methods: lecture and laboratory classes, discussion. Assesment methods: exams (written and/or oral) tests, activity evaluation.	2. Graphical User Interface Programming	5,0	2,0	5,0	2,0				

~	KA6_WG1, KA6_WG5,		1. Computer System Architecture	5,0	3,0	5,0	2,0				
Informatic	KA6_WG9, KA6_WG10, KA6_WG13,	Teaching methods: lecture	2. Operating Systems	5,0	3,0	5,0	2,0				
MK_7, Technical Aspects of	KA6_UW2, KA6_UW4, KA6_UW12, KA6_UW13, KA6_UK1, KA6_UW21, KA6_UO2, KA6_UO1, KA6_KO1	and laboratory classes, individual and group work. Assesment methods: exams, tests, activity evaluation.	3. Network Technologies	4,0	2,0	4,0	2,0				
			total	14,0	8,0	14,0	6,0	0,0	0,0	0,0	0,0
8, I Legal Issues in natics	KA6_WK1, KA6_UU1,	Teaching methods: lecture and discussion.	1. Health, Safety and Ergonomics	0,0	0,0						
MK Professional and Inforr	KA6_KR1, KA6_KO1	Assesment methods: tests, activity evaluation.	2. Intellectual Property Rights	1,0	1,0						
			total	1,0	1,0	0,0	0,0	0,0	0,0	0,0	0,0
MK_9, Numerical Methods	KA6_WG3, KA6_WG6, KA6_WG7 KA6_UW9, KA6_UW10 KA6_UU1, KA6_KO1	Teaching methods: lecture and laboratory classes, discussion. Assesment methods: exams, tests, activity evaluation.	Computational Methods	4,0	2,0		4,0				
1	•	•	total	4.0	2.0	0.0	4.0	0.0	0.0	0.0	0.0

ications	KA6_WG4, KA6_WG5, KA6_WG8, KA6_WG9,	Teaching methods: lecture, laboratory and project	1. Databases	5,0	3,0	5,0	5,0				
MK_10, Databases and Appl	KA6_UW8, KA6_UW11, KA6_UW17, KA6_UW18, KA6_UK1, KA6_UO2, KA6_UO1, KA6_KR1, KA6_KO1	classes, individual and group work. Assesment methods: exams (written and/or oral), tests, activity evaluation.	2. Internet Programming	4,0	3,0	4,0	4,0				
			total	9,0	6,0	9,0	9,0	0,0	0,0	0,0	0,0
	KA6_WG4, KA6_WG5, KA6_WG8, KA6_WG12,	Teaching methods: lecture	1. Software Engineering 1	2,0	1,0	2,0	2,0				
MK_11, are Engineering	KA6_UW6, KA6_UW7, KA6_UW8, KA6_UW11, KA6_UW15, KA6_UW17	and laboratory classes, group work on a project, problem solving method, discussion, presentation.	2. Software Engineering 2	4,0	2,0	4,0	4,0				
Softw	KA6_UK2, KA6_UO1, KA6_UK3, KA6_UO2, KA6_UU1, KA6_KO1	(written and/or oral), tests, activity evaluation, project documentation evaluation.	3. Team Project	5,0	1,0	5,0					
			total	11,0	4,0	11,0	6,0	0,0	0,0	0,0	0,0

MK_12, Probabilistic Methods and Statistic	KA6_WG2, KA6_UW3, KA6_UU1	Teaching methods: lecture and exercise classes, homeworks. Methods of verificationtests: exams, tests, activity evaluation.	Probability Methods and Statistics	5,0	3,0						
			total	5,0	3,0	0,0	0,0	0,0	0,0	0,0	0,0
ial Courses	KA6_WK2,	Teaching methods: lecture and discussion, individual	1.Humanities Course Students choose one humanities course from a list approved by the Council responsible for the course of study	2,0	1,0			2,0			2,0
MK_13, unities and Soc	KA6_UU1, KA6_KR1, KA6_KO1	projects. Assesment methods: exams (written and/or oral), tests, activity evaluation	2. Social Course Students choose one economy course from a list approved by the Council responsible for the course of study	2,0	1,0			2,0			2,0
Huma			3. Computer and Information Ethics	1,0	1,0			1,0			
			total	5,0	3,0	0,0	0,0	5,0	0,0	0,0	4,0
MK_14, Artificial Intelligence	KA6_WG11, KA6_UW14, KA6_UK3, KA6_UO2, KA6_UU1, KA6_KR1	Teaching methods: lecture, laboratory and project classes. Assesment methods: exams, tests, activity evaluation, project documentation evaluation.	Artificial Intelligence	4,0	2,0	4,0	4,0				
	•	-	total	4.0	2.0	4.0	4.0	0.0	0.0	0.0	0.0

MK_15, Parallel and Distributed Programming	KA6_WG13, KA6_UW19, KA6_UW20, KA6_UU1	Teaching methods: lecture and laboratory classes. Assesment methods: exams (written and/or oral) tests, activity evaluation.	Parallel and Distributed Programming	4,0	2,0	4,0	4,0				
			total	4,0	2,0	4,0	4,0	0,0	0,0	0,0	0,0
MK_16, Theoretical Foundations of Informatics	KA6_WG1, KA6_WG14, KA6_UW5, KA6_UW16, KA6_UK3, KA6_UW22, KA6_UU1, KA6_KK1	Teaching methods: lecture and laboratory classes. Assesment methods: exams, tests, activity evaluation.	Introduction to the Theory of Automata and Formal Languages	4,0	3,0	4,0	4,0				
-			total	4,0	3,0	4,0	4,0	0,0	0,0	0,0	0,0
17, ninar	KA6_UK2,	Teaching methods: discussion, presentations.	1. Seminar 1	2,0	1,0	2,0					2,0
MK Sen	KA6_KK1	Assesment methods: activity evaluation.	2. Seminar 2	2,0	1,0	2,0					2,0
			total	4,0	2,0	4,0	0,0	0,0	0,0	0,0	4,0
_18, Preparation	KA6_UK2, KA6_UK3 KA6_UU1	Teaching methods: presentations, individual work.	1. Diploma Preparation Class 1	2,0	2,0	2,0					2,0
MK Diploma F	KA6_KO1	Assesment methods: evaluation of diploma thesis preparation.	2. Diploma Preparation Class 2	7,0	3,0	7,0					7,0
			total	9,0	5,0	9,0	0,0	0,0	0,0	0,0	9,0

MK_19, Physical Education	KA6_UO2	Teaching methods: exercises. Assesment methods: activity evaluation.	Physical Education	0,0	0,0						
		-	total	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
MK_20, Foreign Languages	KA6_UK1 KA6_UO2, KA6_UU1, KA6_KK1, KA6_KO1	Teaching methods: exercises, discussions, literature study, homeworks. Assesment methods: exams (written and/or oral), tests, activity evaluation, self- assesment.	<ol> <li>English</li> <li>Russian</li> <li>German</li> <li>Polish (only for foreign students)</li> <li>A student chooses one of the above subjects</li> </ol>	12,0	4,0				12,0		12,0
			total	12,0	4,0	0,0	0,0	0,0	12,0	0,0	12,0
	KA6_WG4, KA6_WG8, KA6_UW7, KA6_UW8, KA6_UU1, KA6_KO1		<ul> <li>Advanced Programming Methods:</li> <li>1. Component Programming</li> <li>2NET Programming</li> <li>3. Design Patterns</li> <li>4. Matlab Programming</li> <li>5. Internet Frameworks</li> <li>A student chooses two of the above subjects or optional subjects with analogous learning outcomes and ECTS points from the offer approved by the Council responsible for the course of study</li> </ul>	8,0	4,0	8,0	8,0				8,0
	KA6_WG4, KA6_WG8, KA6_WG11, KA6_UW8, KA6_UO1, KA6_UK3, KA6_UO2, KA6_KK1		<ul> <li>Diagnostic and Control Systems:</li> <li>1. LabVIEW Programming</li> <li>2. Computer Measurement Systems</li> <li>3. Digital Signal Processing</li> <li>4. Medical Informatics</li> <li>A student chooses one of the above subjects or optional subjects with analogous learning outcomes and ECTS points from the offer approved by the Council responsible for the course of study</li> </ul>	4,0	2,0	4,0	4,0				4,0

MK_21, Elective Courses	KA6_WG11, KA6_UW4, KA6_KK1	Teaching methods: lecture and laboratory classes, group work. Assesment methods: exams, tests presentation and report evaluation.	<ul> <li>Knowledge Representation and Processing: <ol> <li>Constructive Methods in Computer</li> <li>Science</li> <li>Functional Programming</li> <li>Logic Programming</li> <li>LaTeX Typesetting System</li> <li>A student chooses one of the above subjects or optional subjects with analogous learning outcomes and ECTS points from the offer approved by the Council responsible for the course of study</li> </ol></li></ul>	4,0	2,0	4,0	4,0				4,0	
	KA6_WG1, KA6_UW2, KA6_KO1		Modelling and Simulation: 1. Computer Modelling and Simulation Methods 2. Optimization Methods 3. Computer Statistics A student chooses one of the above subjects or optional subjects with analogous learning outcomes and ECTS points from the offer approved by the Council responsible for the course of study	4,0	2,0	4,0	4,0				4,0	
	KA6_WG4, KA6_WG11, KA6_UO1, KA6_UK3, KA6_UO2, KA6_UU1, KA6_KO1		<ul> <li>Applied Computer Science:</li> <li>1. Bioinformatics</li> <li>2. Digital Image Processing</li> <li>3. Computer Methods in Technology</li> <li>4. Machine Translation in Grammatical Framework</li> <li>5. Graphics Cards Programming A student chooses one of the above subjects or optional subjects with analogous learning outcomes and ECTS points from the offer approved by the Council responsible for the course of study</li> </ul>	4,0	2,0	4,0	4,0				4,0	
				24,0	12,0	24,0	24,0	0,0	0,0	0,0	24,0	

MK_22, Apprenticeships	KA6_WG5, KA6_WG9, KA6_WG10, KA6_WK1, KA6_UW11, KA6_UW12, KA6_UW13, KA6_UW17, KA6_UK1, KA6_UK2, KA6_UC1, KA6_UO2, KA6_UU1, KA6_KR1, KA6_KO1	Teaching methods: presentations and demonstrations, practical exercises, group workshops. Assesment methods: employer and supervisor evaluation, practice register evaluation.	Apprenticeships	4,0	4,0	4,0				4,0	4,0
			total	4,0	4,0	4,0	0,0	0,0	0,0	4,0	4,0
		TOTAL NUMB	ER OF ECTS points for ALL MODULES	183,0	95,0	123,0	109,0	5,0	12,0	4,0	57,0
* refers to the fie	lds that are not assig	ned to the disciplines of hun	nanities or social sciences								
III PROPORTI	ONAL INDICATO	RS (percentage)									

1. Percentage share of ECTS points for the classes that require direct participation of teachers or other people conducting classes:	51,91%
2. Percentage share of ECTS points earned for elective modules (min. 30%):	31,15%
3. Percentage share of ECTS points earned for the classes conducted in a foreign language (in a total number of ECTS points envisaged by the study programme):	100,00%
4. Percentage share of ECTS points earned for the modules of classes shaping practical skills for practical educational profiles (above 50%):	not applicable
5. Percentage share of ECTS points earned for the modules of classes connected with scientific activity conducted at the university in discipline/disciplines, to which the field of study is assigned for general academic profile (above 50%):	59,56%

	computer science	69,67%
	mathematics	20,49%
	linguistics	6,56%
6. Percentage shares of individual (all) discipline of science, which the study programme refers to:	law	0,55%
	philosophy	0,55%
	culture and religion science	1,09%
	economics and finance	1,09%

#### IV. CONDITIONS OF GRADUATION AND CONFERRED PROFESSIONAL TITLE

Graduating with the Bachelor's Degree professional title requires completing all obligatory courses in the study programme, preparing a dissertation and passing a diploma examination.

#### **STUDY PROGRAMME – Part B**

- 1. Name of the field of study: Computer Science
- 2. Level of education: first degree studies
- 3. Educational profile: general academic

#### **MODULES' PROGRAMME CONTENT**

#### MK\_1 Mathematical Analysis:

MK\_1/1 Review of Mathematics: Systematize math knowledge acquired in secondary school. Bridge the gap between the "school math knowledge" and math knowledge required for academic level mathematics.

MK\_1/2 Mathematical Analysis 1: Mathematical logic - elements, elements of set theory. Relations, functions and their properties. Numerical sequences, properties, limits. Numerical series, their properties and convergence.

MK\_1/3 Mathematical Analysis 2: Limit of one variable function. Actions on functions and their boundaries. Asymptote functions. Continuity of function. Derivative of the function of one variable and its properties. Derivative of the inverse and composite function. Differential of a function. Extrema of functions of one variable. L'Hospital's rule. Derivatives of higher orders. Taylor series. Power series. Sequences and series functions. Antiderivative indefinite integral. Integration of rational, irrational and trigonometric functions. The Riemann integral. Improper integral.

MK\_1/4 Mathematical Analysis 3: Topological properties, metric space. Function of several variables, domain, limits, graphs of two variable functions. Partial derivatives. Symmetry of second derivatives. Directional derivative, gradient. Implicit differentiation. Second partial derivative test. Jacobian. Polar coordinate system. Double, triple integral over a normal domain and its applications.

MK\_1/5 Differential and Difference Methods: Types of ordinary differential equations, methods of solving differential equations, certain applications of first-order differential equations, difference equations.

#### MK\_2 Algebra:

Linear Algebra with Analytical Geometry: Fundamental algebraic structures: groups, rings and fields; the complex number field; the polynomial ring over an arbitrary ring; formulation of problems in matrix-vector terms and operations on matrices (the inverse of matrices, the rank of matrices); solving systems of linear equations using different methods; checking linear independence and determination a base of vector space; using notions of analytic geometry.

### MK\_3 Logic and Set Theory:

Elements of Logic and Set Theory: Expressing thoughts formally and correctly, reasoning using logical tools. Fundamental notions and methods necessary to understand more advanced mathematical theories. Formally constructing and modelling mathematical objects on set-theoretical grounds.

# MK\_4 Design and Analysis of Algorithms:

MK\_4/1 Discrete Mathematics: Induction and recursion, the basics of combinatorics, basic techniques of counting, the basics of graph theory, the basics of number theory.

MK\_4/2 Algorithms and Data Structures: Basic data structures (lists, stacks, queues, hash tables, trees, graphs), algorithms (graph algorithms, pattern matching in strings) and different methods of their design ("divide and conquer", dynamic programming, greedy methods) and also estimation of their complexity.

# MK\_5 Programming:

MK\_5/1 Introduction to Structured Programming: Information processing in computer (representation of information, information processing on machine-level and high-level languages). Programming in C.

MK\_5/2 Python Programming: Python Environment. Programming paradigms (structural, object-oriented, functional) in the context of Python. Elements of network programming. The designing and implementation of programs using selected packages and modules. The course includes elements of processing and analysis of big data sets.

MK\_5/3 Introduction to Object-Oriented Programming: Familiarize the students with the basic concepts and techniques of object-oriented programming on the example of C++. Practice the most important object-oriented techniques. Teach design, implementation and analysis of programs in the object-oriented paradigm.

MK\_5/4 Advanced Programming: Introduction to the Java language. Object oriented programming: inheritance, polymorphism. Exceptions – defining and using. Generic programming: parametrized types, collections, comparators, iterators, algorithms. Graphical user interfaces. Event programming.

# MK\_6 Programming Environments:

MK\_6/1 Graphics and Human-Computer Communication: Programming in a graphical environment. Analysis of the human-computer interaction on the example of 2D games programming. Digital image representation and processing: intensity transformations, blending, filtering, enhancement by histogram modification, geometric transformations. The basics of 3D modelling.

MK\_6/2 Graphical User Interface Programming: Basic mechanisms of programming in the Windows operating system. Functionality of the Windows API, Windows Forms library

contained in the. NET Framework and WPF engine to create user interfaces. General principles of designing a graphical user interface with regard to ergonomics and analysis of the needs of potential users.

# MK\_7 Technical Aspects of Informatics:

MK\_7/1 Computer System Architecture: Digital technology and digital systems, Machine representation of data and execution of arithmetic operations, Computer organization on the level of assembler, Organization and storage systems architecture, Interfaces and communication, organization of the CPU, Multiprocessing and alternative architectures

MK\_7/2 Operating Systems: Basic use, configuration and administration of various operating systems. Solving basic problems concerning a multitasking operating system environment and using all its resources, i.e. CPU, memory, disks.

MK\_7/3 Network Technologies: Construction and operation of computer networks. OSI and TCP / IP - the protocols and features, IP addressing, routing, switching, Wide Area Networks (WAN), Virtual Private Networks (VPN).

# MK\_8 Professional and legal issues in informatics:

MK\_8/1 Health, Safety and Ergonomics: General principles of safety and ergonomics with a special focus on health and safety regulations for computer workstation and ergonomic principles in the design of the computer workstation.

MK\_8/2 Intellectual Property Rights: Copyrights and related rights; observance of intellectual property including the computer programs.

# MK\_9 Numerical Methods:

Computational Methods: Calculation of errors of arithmetic operations. Interpolation and approximation methods. Numerical integration (quadratures with fixed nodes, Gauss quadratures). Approximated solving of systems of linear equations. Solving of nonlinear equations with one unknown.

# MK\_10 Databases and Applications:

MK\_10/1 Databases: Introduction. Relational model. Relational algebra. SQL language. Designing relational databases. Normalization. Normal forms. Conceptual design. Entity relationship diagram. Logical design. Physical design. Basic file structures. Indexes. Transactions. Concurrency. Optimization.

 $MK\_10/2$  Internet Programming: Basic Internet programming techniques, languages, tools and standards.

# MK\_11 Software engineering:

MK\_11/1 Software Engineering 1: The typical software lifecycle phases, principles of systems design by the object method, software development tools, software requirements

specification, testing rules of software and software configuration management, project planning and software development process management.

MK\_11/2 Software Engineering 2: The rules of development of complex systems with particular consideration of implementation as phase. The four main programming paradigms (imperative, functional, object-oriented and logic) as a fundamental style of computer programming, as well the basic software design patterns will be discussed.

MK\_11/3 Team Project: Creating simple applications in a small team. Choosing a suitable model of creating an application. Dividing tasks for each person in a group. Creating a work plan. Documenting and testing applications.

# MK\_12 Probabilistic Methods and Statistics:

Probability methods and statistics: Random variable, The probability of discrete and continuous, Probability distributions, Expected values, Variance, Standard deviation, Stochastic processes, Sampling, The problem of estimation, Testing statistical hypotheses, Correlation and regression, Computer methods of statistics.

#### MK\_13 Humanities and Social Courses:

MK\_13/1 Humanities Course: Students choose one humanities course from a list approved by the Faculty Board

MK\_13/2 Economy Course: Students choose one economy course from a list approved by the Faculty Board

MK\_13/3 Computer and Information Ethics: The genesis of computer and information ethics. Intellectual property. Privacy and anonymity. Professional responsibility of computer scientists, codes of conduct for computer professionals, and computer crimes.

#### MK\_14 Artificial intelligence:

Artificial Intelligence: Rough sets. Fuzzy sets. Artificial neural networks. Classification and clustering algorithms. Search methods. Evolutionary algorithms. Practical part: Application selected classification/clustering algorithms to data sets and reporting on the results.

#### MK\_15 Parallel and Distributed Programming:

Parallel and Distributed Programming: Characteristics of parallel and distributed programming. Architectures of computers. Models and algorithms of calculations. Programming with shared memory, OpenMP interface. Programming with message-passing, MPI library. GPGPU graphics cards programming elements.

#### MK\_16 Theoretical Foundations of Informatics:

Introduction to the Theory of Automata and Formal Languages: Basic issues: the language and grammar, regular grammars, context-free grammars, context-sensitive grammars, finite

automata, pushdown automata, Turing machines, non-determinism, Chomsky hierarchy, characterization of the problems due to the undecidability and complexity.

# MK\_17 Seminar:

MK\_17/1 Seminar 1: Presentation of students' research results achieved during preparation of their diploma theses, improvement of skills of communicative transfer of knowledge, presentation of issues from the list of exam topics. The range of presentation topics corresponds to the topics of prepared theses.

MK\_17/1 Seminar 2: Presentation of students' research results achieved during preparation of their diploma theses, improvement of skills of communicative transfer of knowledge, presentation of issues from the list of exam topics. The range of presentation topics corresponds to the topics of prepared theses.

# MK\_18 Diploma preparation:

MK\_18/1 Diploma Preparation Class 1: Directing the student to develop and write a thesis. Description justifying the purpose of the thesis, the description of the current state of knowledge related to the topic of work, searching for information in the literature, also in foreign languages, planning, conducting and critical assessment of experiments, presentation of research results of independent own work. Contents are selected subject to ongoing theses.

MK\_18/2 Diploma Preparation Class 2: Directing the student to develop and write a thesis. Description justifying the purpose of the thesis, the description of the current state of knowledge related to the topic of work, searching for information in the literature, also in foreign languages, planning, conducting and critical assessment of experiments, presentation of research results of independent own work. Contents are selected subject to ongoing theses.

# MK\_19 Physical Education:

Physical Education: Safety precautions for physical education classes, the rules of use of the sports facility. Learning the basic technical and tactical elements. Educating students to care for their physical condition and supporting the development of social competence in group cooperation.

# MK\_20 Foreign Languages:

MK\_20/1 English: Everyday use of foreign language (travel, mass media and other means of communication, global issues, education), understanding and applying IT terminology (electronic devices, IT data security, communication systems, computer engineering, development of information techniques).

MK\_20/2 Russian: Everyday use of foreign language (travel, mass media and other means of communication, global issues, education), understanding and applying IT terminology (electronic devices, IT data security, communication systems, computer engineering, development of information techniques).

MK\_20/3 German: Everyday use of foreign language (travel, mass media and other means of communication, global issues, education), understanding and applying IT terminology (electronic devices, IT data security, communication systems, computer engineering, development of information techniques).

MK\_20/4 Polish: Everyday use of foreign language (travel, mass media and other means of communication, global issues, education), understanding and applying IT terminology (electronic devices, IT data security, communication systems, computer engineering, development of information techniques).

# MK\_21 Elective Courses:

MK\_21A Advanced Programming Methods; to choose among:

MK\_21A/1 Component Programming: Design multilayer component-based applications implemented on J2EE platform. Architecture of J2EE application. Model-View-Controller (MVC) design pattern. Enterprise JavaBeans (EJB). Types of EJB components. Java database connectivity interface (JDBC). Servlets in J2EE application. Session management. Security issues.

MK\_21A/2 .NET Programming: To provide foundations and characteristics of .NET platform and its derivatives. Implementation of programs for .NET using WPF engine.

MK\_21A/3 Design Patterns: Genesis of design patterns. Uses of design patterns and examples of their use in practice. Recognize the applicability of design patterns in the projects. Correct design and implementation of projects using design patterns on the example of Java.

MK\_21A/4 Matlab Programming: Matlab Environment. The designing and implementation of programs using embedded Matlab function and selected Matlab toolboxes, in particularly to solve 'Big Data' problems. Parallel computing.

MK\_21A/5 Internet Frameworks: The essence and purpose of web frameworks. Overview of the most popular frameworks and online libraries.

MK\_21B Diagnostic and Control Systems; to choose among:

MK\_21B/1 LabVIEW Programming: The basics of graphical programming in LabVIEW. Creating simple programs in G language. Operating and modifying selected applications in the LabVIEW environment. Creating applications which can control selected electronic devices. Creating data acquisition applications and data visualization applications.

MK\_21B/2 Computer Measurement Systems: Configuration and structure of measurement system. Measurement interfaces. Digital-to-analogue and analogue-to-digital converters. Signal processing. ELVIS II + educational platform. Programming elements in LabVIEW. Virtual and wireless measurement systems.

MK\_21B/3 Digital Signal Processing: Different methods of signal analysis and practical signal analysis in MATLAB (application of digital signal processing methods for artificially generated signals and biomedical signals ECG and EEG).

MK\_21B/4 Medical Informatics: Various methods of signal and image analysis, computer systems and software at different levels of health care, telemedicine and medicine on the Internet and the possibility of practical applications.

MK\_21C Knowledge Representation and Processing; to choose among:

MK\_21C/1 Constructive Methods in Computer Science: The basics of the Mizar proof verification system to enable verification of various reasoning examples.

MK\_21C/2 Functional Programming: Introduction to lambda calculus, acquaintance with functional programming paradigm, acquaintance with selected functional language.

MK\_21C/3 Logic Programming: Introduction to logic programming paradigm, acquaintance with Prolog.

MK\_21C/4 LaTeX Typesetting System: Various document classes. Fonts. Environments. Tables. Graphics. Definitions and redefinitions. Mathematical mode. Various indexes. Creating of classes and packages. Dynamic presentations.

MK\_21D Modelling and Simulation; to choose among:

MK\_21D/1 Computer modelling and simulation methods: The modelling phases and the methods of creating models of selected systems and their analysis using computer simulation. Creating mathematical models of systems, creating computer models using selected programming environments and conducting computer simulation of the systems' performance.

MK\_21D/2 Optimization Methods: The formulation of the goal function with constraints and without constraints. The necessary and sufficient conditions of extremum. Searching extremum of goal function by numerical methods. Gradient methods. Nonlinear optimization with constraints. Square programming. Simplex method for linear optimization.

MK\_21D/3 Computer Statistics: The purpose of the course is to give the student a good overview of statistical techniques that have been developed during the last years due to increasing computer capacity. Using the statistical software R.

MK\_21E Applied Computer Science; to choose among:

MK\_21E/1 Bioinformatics: Introduction to molecular biology. Bimolecular sequence analysis. Biological databases. Introduction to structural bioinformatics. Introduction to R and Python and their applications in bioinformatics. Biopython and Bioconductor libraries. Implementation of bioinformatics workflows in R and Python.

MK\_21E/2 Digital Image Processing: Acquisition of digital images – equipment, sampling, quantization, colour representation. Methods of digital image processing: arithmetic

operations, image enhancement, noise removal, edge detection, tresholding and morphological methods. Analysis of digital images: segmentation, background generation, foreground object detection, labelling and shape coefficients. Image processing in the frequency domain, the 2D Fourier Transform. Vision systems: standards, equipment and acceleration methods.

MK\_21E/3 Computer Methods in Technology: Basic concepts of computer modelling and simulation. Analysis of mathematical models. Boundary problems. Finite Difference Method (FDM). Boundary element method (BEM). Finite element method (FEM). Parametric integral equation system (PIES) as a computer method for 2D and 3D problems.

MK\_21E/4 Machine Translation in Grammatical Framework: The possibilities of machine translation based on grammatical analysis with examples of its applications.

MK\_21E/5 Graphics Cards Programming: Practical applications of massively parallel graphic cards for scientific computations. Programming model for massively parallel processors. Applications in machine learning algorithms.

# MK\_22 Apprenticeships:

Apprenticeships: Configuration of computer equipment, work on different operating systems (eg. Windows, Linux). Understanding the infrastructure of computer networks of the enterprise as well as its data protection, processing and archiving programs. Knowledge of the basic principles of teamwork, working together on projects in the enterprise software development teams.

#### UNIVERSITY OF BIALYSTOK

#### STUDY PLAN

**Computer Science** 

level of education:

COURSE

First degree studies

**Computer Science** scientific discipline:

effective from the academic year

2019/2020

general academic eduactional profile: (intramural)

form of study:	full-time (
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						Number of classes							l year 1 sem 2 sem					ll year								III ye:	l year			
			Number of classes         1 sem.         2 sem.						3 sem	I.	4	sem.			5 sem.		6 :	sem.												
Item	MODULE NAME/COURSE NAME	USOS course code	ECTS	exam after the semester	credit after the semester	IN TOTAL	LECTURES	CLASSES	TUTORIALS	LABORATORIES	FOREIGN LANGUAGE COURSES	SEMINARS/PROSEMINARS	FIELD CLASSES	LECTURES	CL/T/L/F/SaP/FC	ECTS	LECTURES	CLT1/LF/SaP/FC ECTS												
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31 32
MODULE 1 (M	athematical Analysis)	r		r									-	-14																
1	Review of Mathematics	0600-CS1-1REM	3		1	30		30							30	3												ļļ		
2	Mathematical Analysis 1	0600-CS1-1AM1	4	1		30	15	15						15	15	4												ļļ		
3	Mathematical Analysis 2	0600-CS1-1AM2	6	2		60	30	30									30	30	6									ļļ		
4	Mathematical Analysis 3	0600-CS1-2AM3	3	3		45	15	30												15	30	3							$\rightarrow$	
5	Differential and Difference Methods	0600-CS1-2RRR	2		3	30	15	15												15	15	2								
	TOTAL		18			195	75	120						15	45	7	30	30	6	30	45	5								
MODULE 2 (A	lgebra)	F		r		-11							-	-11																
1	Linear Algebra with Analytical Geometry	0600-CS1-1ALG	6	1		60	30	30						30	30	6													$\rightarrow$	
	TOTAL		6			60	30	30						30	30	6														<u></u>
MODULE 3 (Lo	ogic and Set Theory)			r	1r	-11-	11						-				1													
1	Elements of Logic and Set Theory	0600-CS1-1PLTM	6	1		60	30	30						30	30	6														
	TOTAL		6			60	30	30						30	30	6														
MODULE 4 (D	esign and Analysis of Algorithms)					-11																	<u></u>							
1	Discrete Mathematics	0600-CS1-1MDY	5	2		60	30	30									30	30	5									ļļ		
2	Algorithms and Data Structures	0600-CS1-2ASD	5	3		60	30	30												30	30	5								
	TOTAL		10			120	60	60									30	30	5	30	30	5								
MODULE 5 (P	rogramming)														-								<u></u>							
1	Introduction to Structured Programming	0600-CS1-1PPS	7	1		75	30	30		15				30	45	7														
2	Python Programming	0600-CS1-1PJP	4		2	45	15			30							15	30	4											
3	Introduction to Object-Oriented Programming	0600-CS1-1WPO	5	2		75	30			45							30	45	5											
4	Advanced Programming	0600-CS1-2PZ	5	3		75	30			45										30	45	5								
	TOTAL		21			270	105	30		135				30	45	7	45	75	9	30	45	5								
MODULE 6 (P	rogramming Environments)	F		r		-11	0							4			d.			0										
1	Graphics and Human-Computer Communication	0600-CS1-2GRA	3		4	45	15			30													15	30	3			I		
2	Graphical User Interface Programming	0600-CS1-2PWSG	5		4	60	30			30													30	30	5					
	TOTAL		8			105	45			60													45	60	8					
MODULE 7 (To	echnical Aspects of Informatics)																						<u></u>							
1	Computer Systems Architecture	0600-CS1-1ASK	5		2	60	30			30							30	30	5											
2	Operating Systems	0600-CS1-2SOP	5	3		60	30			30										30	30	5						I		
3	Network Technologies	0600-CS1-2TSI	4		4	60	30			30								<u> </u>					30	30	4					
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MODULE 8 (P	rofessional and Legal Issues in Informatics)					-11	0										1													
1	Health, Safety and Ergonomics	0600-CS1-1BHPE			1	10	10							10							ļ							I	$\perp$	
2	Intellectual Property Rights	0600-CS1-1OWI	1		1	10	10							10		1		<u> </u>												
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Item	MODULE NAME/COURSE NAME	USOS course code	ECTS	exam after the semester	credit after the semester	IN TOTAL	LECTURES	CLASSES	TUTORIALS	LABORATORIES	FOREIGN LANGUAGE COURSES	SEMINARS/PROSEMINARS	FIELD CLASSES	LECTURES	CL/T/LF/SaP/FC	ECTS	LECTURES	CL/T/LF/SaP/FC	ECTS	LECTURES	CL/T/UF/SaP/FC	ECTS	LECTURES	CL/T/L/F/SaP/FC	ECTS	LECTURES	CL/T/L/F/SaP/FC	ECTS	LECTURES	CL/T/UF/SaP/FC ECTS
MODULE 9 (N	umerical Methods)							•	• •						•	:														
1	Computational Methods	0600-CS1-2MOB	4	4		60	30			30													30	30	4		, <u> </u>	i		
	TOTAL		4			60	30			30													30	30	4					
MODULE 10 (	Databases and Applications)																													
1	Databases	0600-CS1-2BD	5	3		60	30			30										30	30	5						i T		
2	Internet Programming	0600-CS1-2PIN	4		4	60	30			30													30	30	4					
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MODULE 11 (S	Software Engineering)																													
1	Software Engineering 1	0600-CS1-2IO1	2		4	30	30																30		2					
2	Software Engineering 2	0600-CS1-3IO2	4	5		60	15			45																15	45	4		
3	Team Project	0600-CS1-3PZE	5		6	30				30																				30 5
	TOTAL		11			120	45			75													30		2	15	45	4		30 5
MODULE 12 (F	Probabilistic Methods and Statistics)																													
1	Probabilistic Methods and Statistics	0600-CS1-2PST	5	4		75	30	30		15													30	45	5					
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MODULE 13 (I	Humanities and Social Courses)																													
1	Humanities Course		2		2	30	30										30		2											
2	Social Course		2		3	30	15	15												15	15	2						لــــــــــــــــــــــــــــــــــــــ		
3	Computer and Information Ethics	0600-CS1-3EI	1		5	15	15																			15	L	1		
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MODULE 14 (A	Artificial Intelligence)																													
1	Artificial Intelligence	0600-CS1-3SZI	4	6		60	30			30																			30	30 4
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MODULE 15 (F	Parallel and Distributed Programming)																													
1	Parallel and Distributed Programming	0600-CS1-3PRR	4		5	60	30			30																30	30	4		
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MODULE 16 (1	Theoretical Foundations of Informatics)															0														
1	Introduction to the Theory of Automata and	0600-CS1-3TAJE	4	5		60	30			30																30	30	4	1	
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2	Seminar 2	0600-CS1-3SD2	2		6	30						30		_										╞━━┩	╘━━┩			_	┢━━╈	30 2
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MODULE 18 (L	Diploma Preparation)	0000 001 0001		1		45	1	1	1 1	45				-	1	<b></b>	11	1	11	1	1	11	11				45		—	
1	Diploma Preparation Class 1	0600-CS1-3PD1	2		5	15				15														_┦			15		<b></b>	45 7
2	Diploma Preparation Class 2	0600-CS1-3PD2	/		6	45		-		45			-											ļ	╞━━┩		45		┢──╁	45 7
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MODULE 19 (F	Physical Education)	0000 001 11/1/54		11		20	1	00	1	<u> </u>			-		00		11	1	1	1	1	1	11				<u> </u>			
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2	Foreign Language 1		2		2	20		-			30				30	3		20	2					$\vdash$	⊢−−┦	-			r+	
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3	Foreign Language 3	1	2	1	- 3	30		+			30			-	+			+	-		30	3		30	3		<del> </del>		<del> </del>	
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ltem	MODULE NAME/COURSE NAME	USOS course code	ECTS	exam after the semester	credit after the semester	IN TOTAL	LECTURES	CLASSES	TUTORIALS	LABORATORIES	FOREIGN LANGUAGE COURSES	SEMINARS/PROSEMINARS	FIELD CLASSES	LECTURES	CL/T/L/F/SaP/FC	ECTS	LECTURES	CL/T/I/F/SaP/FC	ECTS	LECTURES	CL/T/L/F/SaP/FC	ECTS	LECTURES	CL/T/L/F/SaP/FC	ECTS	LECTURES	CL/T/U/F/SaP/FC	ECTS	LECTURES	CL/T/UF/SaP/FC	ECTS
MODULE 21 (E	Elective Courses)																														
1	Elective Course 1		4		5	45	15			30																15	30	4			1
2	Elective Course 2		4		5	45	15			30																15	30	4			1
3	Elective Course 3		4		5	45	15			30																15	30	4			1
4	Elective Course 4		4		6	45	15			30																		1	15	30	4
5	Elective Course 5		4		6	45	15			30																		ł	15	30	4
6	Elective Course 6		4		6	45	15			30																			15	30	4
	TOTAL		24			270	90			180																45	90	12	45	90	12
MODULE 22 (A	Apprenticeships)																														
1	Apprenticeships	0600-CS1-3PZA	4		5	3 weeks																						4			
	TOTAL		4																									4			
			-																											_	
	IN TOTAL		183			2210	860	375		795	120	60		125	210	30	165	225	30	165	225	30	195	225	30	135	240	33	75	225	30

no. of exams/cred. 4 5 3 5 5 3 5 3 2 8 1 6