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

#### **LEARNING OUTCOMES**

for the field of study

second 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, 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 and dependence	KA7_WG1	broadened and deepened knowledge about analyzing advanced algorithms and data structures
	to an extended degree - selected facts, objects and phenomena as well as their methods and theories explaining the complex relationships between them, providing advanced general knowledge in the field of scientific or artistic disciplines that	KA7_WG2	basic knowledge of analytical and algebraic methods in IT applications	
		as well as their methods and theories explaining the complex relationships between them, providing advanced general knowledge in the field of scientific or artistic disciplines that	KA7_WG3	basic knowledge about modeling and analysis of information systems architecture, as well as creating models and analyzing their quality
form theoretical foundations, structured and theoretically founded knowledge covering key issues and selected issues in the advanced field detailed knowledge - appropriate for the	KA7_WG4	basic knowledge of modeling and simulation using models of imprecision or uncertainty and the practical application of these models		
	P7S_WG	study program	KA7_WG5	ordered and in-depth theoretical knowledge in the field of designing and programming relational databases
		main development tendencies of scientific or artistic disciplines to which the field of study is assigned - in the case of general	KA7_WG6	basic knowledge in the field of contemporary expert systems and their applications
		academic studies	KA7_WG7	deepened and structured knowledge in the field of security of digital data and information systems, including in the context of the functioning of computer networks
				basic knowledge about algorithms for massive parallel computations with the use of modern numerical methods and their implementation on multiprocessor, multi-core machines and graphics cards
			KA7_WG9	structured theoretical knowledge of information techniques

			and technologies used in various fields
		KA7_WG10	structured theoretical knowledge about methods of
			designing and programming applications used in various fields
P7S_WK	Context - conditions, effects	KA7_WK1	knowledge about development trends and new achievements in the field of computer science
	fundamental dilemmas of modern civilization	KA7_WK2	basic knowledge in the field of managing and managing teams implementing IT projects
	economic, legal, ethical and other conditions of various types of activities related to the awarded qualification, including basic concepts and principles in the field of protection of industrial property and copyright	KA7_WK3	fundamental dilemmas of modern civilization
	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 performed	KA7_UW1	construct models in a selected area of computer science and use their realization in the implementation environment,
			analyzing the characteristics of information systems
	use acquired knowledge - formulate and solve complex and unusual problems and perform innovatively tasks in	KA7_UW2	apply basic models of imprecision or uncertainty and model practical issues using these models
	unpredictable by: - proper selection of sources and information from them, evaluation, critical analysis, synthesis, creative interpretationKA7_UW3implement advanced algorithmsKA7_UW4implement known all their appropriate mode	implement advanced dynamic data structures and advanced algorithms	
		KA7_UW4	implement known algebra and analysis methods and make their appropriate modification depending on the applications
	- selection and application of appropriate methods and tools,	KA7_UW5	program databases using SQL extensions
	<i>including advanced information and communication techniques</i> <i>- adapting existing or developing new methods and tools</i>	KA7_UW6	plan an expert system which solves specific problems and implement it
P7S_UW	- formulating and testing hypotheses related to simple research problems	KA7_UW7	apply models and classes of information systems security as well as methods of user identification and authentication
		KA7_UW8	implement massive parallel processing algorithms, including in a graphic card environment
		KA7_UW9	use the methods and mathematical models learned, modify them if necessary, for analyzing and designing applications
		KA7_UW10	assess and compare design solutions and the process of programming applications using various information
		KA7_UW11	design and implement software for selected computer science applications
		KA7_UW12	use the software appropriate for selected computer science applications

		KA7_UW13	configure devices appropriate for selected computer science applications
		KA7_UW14	propose improvements to existing algorithms and applications used in various fields
		KA7_UW15	assess the suitability and the possibility of using new developments in the field of computer science
P7S UK	Communicating - receiving and creating statements,	KA7 UK1	use a foreign language at the B2 + level with specialist
	disseminating knowledge in the scientific community and		terminology appropriate for computer science, allowing to
	using a foreign language		express ideas, in written and oral form, on general subjects
			and those related to computer science
	communicate on specialist topics with diverse groups of	KA7_UK2	prepare and present a presentation about a project task,
	recipients		research project or a selected computer science subject,
			leading a discussion about this presentation
	lead a debate	KA7_UK3	use a foreign language well enough to read and understand
			professional literature and communicate, including
	use a foreign language at B2+ level of the Common European		professional topics
	Framework of Reference for Languages and specialist	KA7_UK4	develop the detailed documentation of a project or research
	terminology		task, results of an experiment, prepare a study discussing
			these results
P7S_UO	Work organization - planning and teamwork	KA7_UO1	manage teams implementing computer science projects
		KA7_UO2	collaborate in a team implementing joint projects
	manage the team's work	KA7_UO3	develop an IT project, its documentation, and manage the
			team
	leading role in teams	KA7_UO4	act and think in a creative and innovative way
P7S_UU	Learning - planning one's own development and the	KA7_UU1	acquire information from various sources (literature,
	development of others		websites, databases, etc.), integrate it and make its
			interpretation and critical assessment, draw conclusions,
	plan and implement own lifelong learning and guide others in		formulate and fully justify opinions
	this area	KA7_UU2	understand the need for continuous training and self- education
		KA7_UU3	carefully identify the priorities and order of activities
	SOCIAL COMPETENCE, a gra	duate is prepare	ed for:
P7S_KK	Assessment - a critical approach	KA7_KK1	understanding the limitations of own knowledge and the
			need for further education, including the acquisition of non-
	critical assessment of own knowledge and received content		domain knowledge
	recognition of the importance of knowledge in solving cognitive		
	and practical problems and consulting experts in case of		
	difficulties in solving a problem		
P7S_KO	Responsibility - fulfilling social obligations and acting for	KA7_KO1	initiating activities necessary to take up practical activity for
	the public interest		the development of the information society

	fulfilling social obligations, inspiring and organizing activities for the social environment initiating activities for the public interest thinking and acting in an entrepreneurial way		
P7S_KR	Professional role - independence and development of the	KA7_KR1	systematic familiarization with the latest trends in the
	ethos		development of information technologies through scientific
			and popular science magazines and websites
	responsible performance of professional roles, taking into	KA7_KR2	appreciating the importance of intellectual honesty in own
	account changing social needs, including:		and other people's activities and the need of adherence to the
	- developing the profession,		principles of professional ethics
	- maintaining the ethos of the profession,		
	- adherence to and development of professional ethics and		
	actions to comply with these principles		

#### Explanation of the symbols

<b>P6S_WG</b> – description symbol of the second degree PQF	<b>KA6_WG1</b> – symbol of the field outcome
<b>P</b> – 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	6 – 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)
<b>G</b> – <i>depth and extent</i>	<b>G</b> – <i>depth and extent</i>
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	K – communicating
<b>O</b> – work organization	<b>O</b> – work organization
U – learning	U – learning
<b>K</b> – <b>social competence</b> (descriptive category)	<b>K</b> – <b>social competence</b> ( <i>descriptive category</i> )
<b>K</b> – critical evaluation	<b>K</b> – critical evaluation
<b>O</b> – 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, culture and religion science, economics and finance

2. Name of the field of study: Computer Science

- 3. Specializations offered: Internet and Mobile Technologies
- 4. Level of education: second degree studies
- 5. Educational profile: general academic
- 6. Form of study: **full-time studies**
- 7. A number of semesters: 4
- 8. Total number of ECTS points required to achieve the equivalent level of relevant qualifications: 122
- 9. Total number of teaching hours: 1080

10. Programme accepted at the meeting of Faculty Council on 13.02.2019, effective from the academic year: 2019/2020

#### II. Education modules

					QUANTI	TATIVE IND	ICATORS -	ECTS POINT	S INCLUDED	IN COURS	SES:
Modules (module code: MK_1 and module name)	Field learing outcomes Knowledge Skills Social competence (symbols)	Teaching methods and verification	Courses/modules	a number of ECTS points per course/module	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
MK_1, Modelling and Analysis of IT Systems	KA7_WG3, KA7_WG5, KA7_UU1, KA7_UK4, KA7_UW1, KA7_UO3, KA7_UO4, KA7_UO2, KA7_UU2	Teaching methods: lecture, laboratory and project classes. Verification: exams (written and/or oral), projects evaluation, activity evaluation.	Modelling and Analysis of IT Systems	4,0	3,0	4,0					
			total	4,0	3,0	4,0	0,0	0,0	0,0	0,0	0,0

MK_2. Advanced Databases	KA7_WG5, KA7_WG10, KA7_UU1, KA7_UW5, KA7_UO4, KA7_UO2, KA7_UU2	Teaching methods: lecture and laboratory classes, multimedia presentations, individual work, consultations. Verification: exams, tests, projects evaluation, activity evaluation.	Advanced Databases	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_3, Analytic methods in Computer Science	KA7_WG2, KA7_UW4, KA7_KR1	Teaching methods: lecture and laboratory classes, exercises, consultations. Verification: exams (written and/or oral), tests, activity evaluation.	1. Analytical Methods in Computer Science 2. Analytical Geometry in Computer Graphics The student chooses one of the above courses or another course from the list of elective courses with the same learning effects and ECTS scores, each proposed subject is approved by the Council responsible for the course of study on the basis of its full description according to the pattern existing on the UwB. The course can be run in a foreign language.	4,0	2,0	2,0	2,0				4,0
		•	total	4,0	2,0	2,0	2,0	0,0	0,0	0,0	4,0
MK_4, Global Optimization	KA7_WG9, KA7_WK1, KA7_UW1, KA7_UW9, KA7_UW11, KA7_UW12, KA7_UO4, KA7_UO2	Teaching methods: lecture and laboratory classes, multimedia presentations. Verification: exams (written and/or oral), projects evaluation, problems solving, activity evaluation.	Global Optimization	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

Solution         total         4,0         2,0         4,0         4,0         0,0         0,0         0,0         4,0           Wing         KA7_WG9, KA7_WG10, KA7_UV1, KA7_UV1, KA7_UV1, KA7_UV12, KA7_UV12, KA7_UV13, KA7_UV13, KA7_UV13, KA7_UV14, KA7_UV14, KA7_UV15, KA7_UV15, KA7_WG10, KA7_WG10, KA7_WG10, KA7_WG10, KA7_WG10, KA7_WG10, KA7_WG10, KA7_WG10, KA7_WG10, KA7_KR1         Teaching methods: lecture, presentation, project classes that require creation of prototype and testing its functionality verification: exams (written and/or oral), paper, report, problems solving, activity evaluation.         4,0         2,0         4,0         4,0         0,0         <	MK_5, Advanced Object-Oriented Programming	KA7_WG9, KA7_WG10, KA7_UW3, KA7_UW11, KA7_UO2	Teaching methods: lecture and project classes, consultations. Verification: exams (written and/or oral), projects evaluation, problems solving, activity evaluation.	<ol> <li>Advanced Object-Oriented Programming in C++</li> <li>Advanced Object-Oriented Programming in Java Student chooses one of the above courses or another course from the list of elective courses with the same learning effects and ECTS scores, each proposed subject is approved by the Council responsible for the course of study on the basis of its full description according to the pattern existing on the UwB. The course can be run in a foreign language.</li> </ol>	4,0	2,0	4,0	4,0				4,0
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$				total	4,0	2,0	4,0	4,0	0,0	0,0	0,0	4,0
total 4,02,04,00,00,00,00,00,0internet Applications DesignKA7_WG10, KA7_WK1, Project classes that require creation of prototype and testing its functionality KA7_UW12, KA7_UW15, KA7_UW15, KA7_UW15, KA7_LW15,Teaching methods: lecture, presentation, project classes that require creation of prototype and testing its functionality projects evaluation, activity evaluation.Internet Applications Design4,02,04,04,04,0Internet Applications Design	MK_6, Multimedia Techniques	KA7_WG9, KA7_WG10, KA7_WK1, KA7_UU1, KA7_UW11, KA7_UW12, KA7_UW13, KA7_UO4, KA7_UU2, KA7_KR1	Teaching methods: traditional methods: lecture, presentation, demonstration, activating methods: classical exercises, simulation exercises, discussion, case study. Verification: exams (written and/or oral), paper, report, problems solving, activity evaluation.	Multimedia Techniques	4,0	2,0	4,0	4,0				
Under StateKA7_WG10, KA7_WK1,Teaching methods: lecture, presentation, project classes that require creation of KA7_UW11,Teaching methods: lecture, presentation, project classes that require creation of Internet Applications Design4,02,04,04,04,0WStateKA7_UW12, Project ClassesProject classes that require creation of project classes that require creation of KA7_UW12, Project sevaluation, activity evaluation.Internet Applications Design4,02,04,04,04,0				total	4,0	2,0	4,0	4,0	0,0	0,0	0,0	0,0
	MK_7, Projects of Web Application	KA7_WG10, KA7_WK1, KA7_UW11, KA7_UW12, KA7_UW14, KA7_UW15, KA7_KR1	Teaching methods: lecture, presentation, project classes that require creation of prototype and testing its functionality Verification: exams (written and/or oral), projects evaluation, activity evaluation.	Internet Applications Design	4,0	2,0	4,0	4,0				

MK_8, Algebraic Methods in Computer Science	KA7_WG2, KA7_WG9, KA7_WG10, KA7_WK1, KA7_UU1, KA7_UW4, KA7_UW15, KA7_UO4, KA7_UO2, KA7_UU2, KA7_KR1	Teaching methods: lecture, exercises, project as homework. Verification: exams (written and/or oral), projects evaluation, tests, activity evaluation.	Algebraic Methods in Computer Science	4,0	2,0	2,0	2,0				
			total	4,0	2,0	2,0	2,0	0,0	0,0	0,0	0,0
MK_9, Introduction to Fuzzy Modelling and Analysis	KA7_WG4, KA7_UW2, KA7_UO4, KA7_UU2, KA7_KR1	Teaching methods: lecture, laboratory classes, consultations. Verification: exams (written and/or oral), tests, activity evaluation.	Introduction to Fuzzy Modelling and Analysis	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_10, Expert Systems	KA7_WG6, KA7_WK1, KA7_UW6, KA7_UW15, KA7_UO4	Teaching methods: lecture, laboratory classes, presentation, discussion. Verification: exams (written and/or oral), project evaluation, problems solving, activity evaluation.	Expert Systems	3,0	2,0	3,0	3,0				
		•	total	3,0	2,0	3,0	3,0	0,0	0,0	0,0	0,0
MK_11, Massive Parallel Computing	KA7_WG8, KA7_WG9, KA7_WK1, KA7_UW8, KA7_UW11, KA7_UW12, KA7_UW13, KA7_UW14, KA7_UW15, KA7_UO4, KA7_UU2, KA7_KR1	Teaching methods: lecture, laboratory classes, consultations. Verification: exams (written and/or oral), problems solving, activity evaluation.	Massive Parallel Computing	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_12, XML Technologies in Programming	KA7_WG10, KA7_WK1, KA7_UW11, KA7_UW15, KA7_UU2	Teaching methods: lecture, laboratory classes, discussion, presentation, case study. Verification: exams (written and/or oral), tests, evaluation of laboratory work, activity evaluation.	XML Technologies in Programming	4,0	2,0	4,0	4,0				
1			total	4,0	2,0	4,0	4,0	0,0	0,0	0,0	0,0
MK_13, Multimedia Systems	KA7_WG10, KA7_WK1, KA7_UW11, KA7_UW12, KA7_UW15, KA7_UO4, KA7_UU2	Teaching methods: lecture, laboratory classes, presentation, discussion. Verification: exams (written and/or oral), evaluation of created system, problems solving, activity evaluation.	1. Adaptive Internet Multimedia Systems 2. Intelligent Multimedia Teaching systems Student chooses one of the above courses or another course from the list of elective courses with the same learning effects and ECTS scores, each proposed subject is approved by the Council responsible for the course of study on the basis of its full description according to the pattern existing on the UwB. The course can be run in a foreign language.	4,0	2,0	4,0	4,0				4,0
		-		4,0	2,0	4,0	4,0	0,0	0,0	0,0	4,0
MK_14, E-learning Systems	KA7_WG9, KA7_WG10, KA7_WK1, KA7_UW11, KA7_UW15, KA7_UO4, KA7_UU2	Teaching methods: lecture, presentation, discussion, project classes, case study. Verification: exams, evaluation of created e-learning course, problems solving, activity evaluation.	E-learning Systems	3,0	2,0	3,0	3,0				
			total	3,0	2,0	3,0	3,0	0,0	0,0	0,0	0,0

MK_15, Mobile Technologies	KA7_WG9, KA7_WK1, KA7_UW12, KA7_UW13, KA7_UO4, KA7_UU2, KA7_KR1	Teaching methods: lecture, laboratory classes. Verification: exams (written and/or oral), report, activity evaluation.	Mobile Technologies	3,0	2,0	3,0	3,0				
	•		total	3,0	2,0	3,0	3,0	0,0	0,0	0,0	0,0
MK_16, Security of Data and IT Systems	KA7_WG7, KA7_UW7, KA7_UW10, KA7_UW12, KA7_KR1	Teaching methods: lecture, laboratory classes, consultation. Verification: exams, tests, activity evaluation.	Security of Data and IT Systems	4,0	2,0	4,0	2,0				
			total	4,0	2,0	4,0	2,0	0,0	0,0	0,0	0,0
MK_17, Advanced Algorithms and Data Structures	KA7_WG1, KA7_UU1, KA7_UK4, KA7_UW3, KA7_UO4, KA7_UU2	Teaching methods: lecture, laboratory classes, case study. Verification: exams, paper, problems solving, activity evaluation.	Advanced Algorithms and Data Structers	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_18, Internet Data Analysis	KA7_WK1, KA7_UW11, KA7_UW12, KA7_UW15, KA7_UO4, KA7_UU2, KA7_UU3, KA7_KR1, KA7_KR2	Teaching methods: lecture, laboratory classes, presentation, discussion, case study. Verification: exams, tests, problems solving, activity evaluation.	Internet Data Analysis	3,0	2,0	3,0	3,0				
			total	3,0	2,0	3,0	3,0	0,0	0,0	0,0	0,0
MK_19, Internet Frameworks	KA7_WG10, KA7_WK1, KA7_UW11, KA7_UW15, KA7_UO4	Teaching methods: lecture, individual laboratory classes, presentation, discussion, project classes, consultations. Verification: exams (written and/or oral), project evaluation, evaluation of laboratory work, activity evaluation.	Internet Frameworks	4,0	2,0	4,0	4,0				
	8		total	4.0	2.0	4.0	4.0	0.0	0.0	0,0	0,0

MK_20, Mobile Applications Programming	KA7_WG9, KA7_WK1, KA7_UW1, KA7_UW11, KA7_UW15, KA7_UO4, KA7_UU2, KA7_KR1	Teaching methods: lecture, laboratory classes, explanation, discussion. Verification: exams (written and/or oral), project evaluation, activity evaluation.	Mobile Applications 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_21, Network Programming	KA7_WG7, KA7_WK1, KA7_UW7, KA7_UW11, KA7_UW12, KA7_UO2, KA7_KR1	Teaching methods: lecture, laboratory classes, consultation. Verification: exams, report, activity evaluation.	Network Programming	4,0	2,0	4,0	2,0				
			total	4,0	2,0	4,0	2,0	0,0	0,0	0,0	0,0
MK_22, Management of IT Projects	KA7_WK2, KA7_UO3, KA7_UO4, KA7_UU2, KA7_KR1, KA7_KR2, KA7_UO1, KA7_UO2	Teaching methods: lecture, project classes, consultation. Verification: exams, project evaluation, activity evaluation.	Management of IT Projects	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
-23, ial Sciences Courses		Teaching methods: traditional lecture using multimedia presentations with elements of discussion, case study on exercises, discussion papers	Course to choose from humanities Student chooses a course from the list of humanities approved by the Council responsible for the course of study on the basis of its full description according to the pattern existing on the University of Bialystok.	2,0	1,0			2,0			2,0
MK Humanities and Soc	KA7_WK3, KA7_KO1, KA7_KK1	Verification: exams (written and/or oral), project evaluation, papers, activity evaluation.	Course to choose from social sciences Student chooses a course from the list of social sciences approved by the Council responsible for the course of study on the basis of its full description according to the pattern existing on the University of Bialystok.	3,0	2,0	0.5	0.5	3,0			3,0
			total	5.0	3.0	0.0	0.0	5.0	0.0	0.0	5.0

MK_24, Intellectual Property Rights	KA7_KR2	Teaching methods: lecture, discussion. Verification: exams (written and/or oral).	Intellectual Property Rights	1,0	1,0						
			total	1,0	1,0	0,0	0,0	0,0	0,0	0,0	0,0
IK_25, m language	KA7_UK1, KA7_UK2, KA7_UK3, KA7_UK4, KA7_UU1.	Teaching methods: exercises, consultations, work on literature, solving homework tasks, discussion in problem groups. Practical exercises for all language skills: speaking, writing, reading, listening.	<ol> <li>English</li> <li>Russian</li> <li>German</li> <li>Polish (only for foreign students)</li> <li>Student choose one of the above courses</li> </ol>	2,0	1,0				2,0		2,0
M Foreig	KA7_UU2, KA7_KR1	Verification: exams (written and/or oral), tests, project evaluation, papers, activity evaluation, self-evaluation of learning outcomes.	English for IT Professionals	2,0	1,0				2,0		
			total	4,0	2,0	0,0	0,0	0,0	4,0	0,0	2,0
MK_26, M.Sc. Diploma Seminar	KA7_UK1, KA7_UU1, KA7_UK2, KA7_UK3, KA7_UU2, KA7_UU3, KA7_KR1, KA7_KK1	Teaching methods: seminar classes, presentations, papers. Verification: presentation of assumptions and achieved results of thesis, evaluation of degree of thesis preparation, activity evaluation.	1. M. Sc. Diploma Seminar 1 2. M. Sc. Diploma Seminar 2 Student attends both seminars. Thematic seminars - student chooses the subject from the list proposed by the labs / departments.	6,0	4,0	6,0			3,0		6,0
			total	6,0	4,0	6,0	0,0	0,0	3,0	0,0	6,0
MK_27, M. Sc. Diploma Preparation Class	Store In the second seco		22,0	7,0	22,0					22,0	
		total	22,0	7,0	22,0	0,0	0,0	0,0	0,0	22,0	
		TOTAL NUMBE	122,0	62,0	108,0	72,0	5,0	7,0	0,0	47,0	

\* refers to the fields that are not assigned to the disciplines of humanities or social sciences

#### III PROPORTIONAL INDICATORS (percentage)

1. Percentage share of ECTS points for the classes that require direct participation of teachers or other people conducting classes:	50,82%								
2. Percentage share of ECTS points earned for elective modules (min. 30%):	38,52%								
3. Percentage share of ECTS points earned for the classes conducted in a foreign language (in a total number of ECTS points envisa	100,00%								
4. Percentage share of ECTS points earned for the modules of classes shaping practical skills for practical educational profiles (abov	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%):									
	computer science	88,52%							
	mathematics	3,28%							
6 Percentage shares of individual (all) discipline of science, which the study programme refers to:	linguistics	3,28%							
b. recentage shares of individual (an) discipline of science, which the study programme refers to.	law	0,82%							
	culture and religion science	1,64%							
	economics and finance	2,46%							

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

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

#### **STUDY PROGRAMME - Part B**

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

## 4. Specialization: Internet and Mobile Technologies

Programme accepted at the meeting of Faculty Council on 13.02.2019, effective from the academic year: 2019/2020

## **MODULES' PROGRAMME CONTENT**

## MK\_1 Modelling and Analysis of IT Systems:

Modelling and Analysis of IT Systems: Business and object-oriented modelling methods of IT systems. UML modelling of IT system requirements, statics and dynamics. Principles of choice UML diagrams and recording of connections between theirs elements. Realisation of selected UML constructions in object-oriented programming languages.

#### MK\_2 Advanced Databases:

Advanced Databases: Introduction to PL/SQL. Language rules. Data types. Blocks. Variables and their scope. Conditional instructions. Loops. SQL in PL/SQL. Records. Cursors. Collections. Exceptions. Creating and using procedures, functions and packages. Triggers. Dynamic SQL: NDS and DBMS\_SQL. Introduction to PL/SQL objects.

## MK\_3 Analytic Methods in Computer Science:

MK\_3/1 Analytical methods in computer science: Analytical methods in computer science: Linear space, projective space. Distance, non-Euclidean geometry. Length, volume. Pseudorandom number generators. Monte-Carlo simulations convergence. Probabilistic measures, generating functions, Fourier transform. Classes supported by CAS.

MK\_3/2 Analytical geometry in computer graphics: Finite dimensional linear spaces, linear transformations. Spherical geometry - complex numbers - quaternions. Projective space, cross-ratio, distances. Bernstein polynomials approximation. Examples in: PostScript (Ghostscript), gnuplot (supported by CAS).

## MK\_4 Global Optimization:

Global Optimization: Genetic algorithm. Travelling salesman problem. Evolution strategies. Randomized algorithm of "lonely seeker"; simulated annealing; tabu-search; ant colony optimization algorithm; particle swarm optimization; artificial immune systems; clonal selection; applications of evolutionary algorithms.

## MK\_5 Advanced Object-Oriented Programming:

MK\_5/1 Advanced Object-Oriented Programming in C++: Advanced methods of object-oriented programming, STL.

MK\_5/2: Advanced Object-Oriented Programming in Java: a Reminder to the Object-Oriented paradigm. Reflection. Annotations - using existing and creating new ones. Creating client / server applications using RMI technology. Using code written in other languages - JNI.

## MK\_6 Multimedia Techniques:

Multimedia Techniques: Multimedia as the form of communicating – applications of multimedia. Multimedia devices. Internet transmission of the image and sound in the real time – videoconferences. Compression of multimedia data. Entropy. Redundancy. Lossy compression – JPEG standard, MPEG Video, MPEG Audio. Lossless compression – Huffman method, structure of Huffman tree. Dictionary methods (LZ). Coding systems of the graphics, audio, video – formats. Digital recording and processing of sound and sequence of video. Computer animations, "video capturing". Multimedia applications, tutorials.

# MK\_7 Projects of Web Application:

Internet Applications Design: Website design based on Internet standards. Web usability. User-oriented design. Recommendations for the design of individual parts of the website: homepage, forms, links, etc. Web page navigation design. Advertising and web usability, typography, formatting and web usability, color and web usability. Web usability testing tools. Designing useful error handling. Designing forms. Methods and objectives of prototyping. Examples of mock-ups, prototypes and personae. Prototyping tools. Testing the usability and functionality of web pages. Design for different target groups (including disabled people). Designing multi-lingual pages. Designing applications for mobile devices.

## MK\_8 Algebraic Methods in Computer Science:

Algebraic methods in computer science: Selected algebraic methods needed in the field of computer science, especially in coding theory and cryptography. Basic algebraic structures and theorems in algebra used in cryptographic algorithms

# MK\_9 Introduction to Fuzzy Modelling and Analysis:

Introduction to Fuzzy Modelling and Analysis: Fuzzy sets. Fuzziness and randomness. Types of membership functions of fuzzy sets. Arithmetic operations on fuzzy numbers. Extension principle. Basic fuzzy models. Fuzzy neural models. Fuzzy control using fuzzy models.

## MK\_10 Expert Systems:

Expert Systems: Architecture of an expert system (ES). Applications of ES. Methods of knowledge representation in ES. Methods of acquisition of knowledge to ES. Methods of the inference. Influence of the uncertainty on functioning system based on the knowledge. Hybrid systems. Characteristics of programming languages for creating ES.

#### MK\_11 Massive Parallel Computing:

Massive parallel computing: Programming algorithms methods in massive parallel computing. Parallel computing using graphic cards in CUDA environment. Architecture of parallel computer systems. Numerical libraries. Parallel algorithms for solving systems of linear equations. Monte-Carlo calculations and simulations. Multidimensional numerical integrations.

#### MK\_12 XML Technologies in Programming:

XML Technologies in Programming: Description of XML language. Syntactical and structural correctness of XML document. DTD. XML Schema. Supplementing languages XML. Presentation of content in XML - cascading stylesheets. Examples of XML applications. Transformations of XML documents and paths in transformations - XSLT and XPath. Object model of XML document. Syntactic analysis.

#### MK\_13 Multimedia Systems:

MK\_13/1 Adaptive Internet Multimedia Systems: The idea and structure of the system adapting itself to the needs of user. Individualization of the needs of a learner. Styles of learning and their classifications. Strategies of teaching and their computer representations. Selection of the strategy of teaching to the learning style. Tools for creating adaptive systems.

MK\_13/2 Intelligent Multimedia Teaching systems: The idea and structure of the intelligent systems. Individualization of the needs of a learner. Styles of learning and their classifications. Strategies of teaching and their computer representations. Selection of the strategy of teaching to the learning style. Tools for creating intelligent systems.

MK\_14 E-learning Systems: E-learning Systems: Architecture and models of e-learning systems. Stages of constructing the course. Principles of preparation of teaching materials. Communication and information flow in e-learning. E-learning platforms. Testing knowledge in e-learning. Tools that allow remote experiments.

#### MK\_15 Mobile Technologies:

Mobile Technologies: Positioning and navigation of mobile users. Global positioning systems. Cellular systems. Wireless communication systems. Complex mobile processing problems. Wireless Local Area Networks. Mobile SDKs in various operating systems. Configuration and securing of wireless networks.

#### MK\_16 Security of Data and IT Systems:

Security of Data and IT Systems: Data security digital systems and threats to information systems in the context of confidentiality, integrity and availability of information. Basics of cryptography. Theoretical and practical issues regarding data security in the context of the functioning of computer networks.

#### MK\_17 Advanced Algorithms and Data Structures:

Advanced Algorithms and Data Structures. Advanced graph algorithms: all-pairs shortest paths, flow networks. String matching algorithms. Advanced data structures. Approximation algorithms. Parallel algorithms.

#### MK\_18 Internet Data Analysis:

Internet Data Analysis: Types of data. Review of qualitative analyses. Analysis of quantitative data. Tests. Analysis of competitiveness. Analyses of flow of users. New forms of analyses: social portals, mobile services and video contents. Software supporting internet data analysis.

#### MK\_19 Internet Frameworks:

Internet Frameworks: Introduction to internet frameworks. Network templates - Smarty and PHPTAL. Architectural design pattern MVC. Object-Relational Mapping ORM. Review of the most popular internet frameworks.

#### MK\_20 Mobile Applications Programming:

Mobile Applications Programming: Mobile operating systems, responsive web design in mobile applications, native mobile applications, and hybrid mobile applications. Features of mobile operating systems. Mobile networks, wireless LAN, NFC, Bluetooth, accelerometer, touch screen. Responsive mobile web applications address the mobile aspects of HTML5, CSS3, JavaScript, libraries, and front-end frameworks such as jQuery, jQuery Mobile, AngularJS, Bootstrap, Semantic UI. Native mobile applications include APIs for operating systems such as Android, iOS, and Windows Phone. Hybrid mobile applications complement the above content with the PhoneGap and Apache Cordova frameworks.

## MK\_21 Network Programming:

Network Programming: Implementing client-server types of applications in popular programming languages. Methods of implementing web services using selected tools and technologies. The working and configuration of a J2EE application server, e.g. Apache Tomcat. Programming Java servlets and Java Server Pages. Communication in heterogeneous networks using the SOAP standard. Definition and description of network services in the WSDL format. Practical application of main network programming technologies.

#### MK\_22 Management of IT Projects:

Management of IT Projects: life cycle, success rate and project plan. Task assignments and selection of team members. Management of: user requirements, risk and budget. Project schedule development. Tracking progress, Earned Value method. Documentation. Testing. Implementation of project. End user training. Warranty and Maintenance.

## MK\_23 Humanities and Social Sciences Courses:

MK\_23/1 Course to choose from humanities: Student chooses one of the courses from the list of humanities approved by the Faculty Council on the basis of its full description according to the pattern existing on the University of Bialystok.

MK\_23/2 Course to choose from social sciences: The student chooses one of the courses from the list of social sciences courses approved by the Faculty Council on the basis of its full description according to the pattern existing on the University of Bialystok.

MK\_24 Intellectual Property Rights: Protection intellectual property: those - basic concepts and problems. Protection of the secret. Protection of the artistic work. Protection of inventions. Protection from a creative and legal point of view of works of students. Copyright in digital technologies. Administering the intellectual property in the college and the enterprise. Comprehending the technology transfer.

# MK\_25 Foreign language:

MK\_25/1 English: Every day 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\_25/2 Russian: Every day 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\_25/3 German: Every day 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\_25/4 Polish: Every day 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\_25/5 English for IT Professionals: The use of a foreign language in work by IT professionals, the ability to understand and use advanced IT terminology (computer networks, operating systems, electronic devices, data and computer systems security, communication systems, computer engineering, development of information technology).

## MK\_26 M.Sc. Diploma Seminar:

MK\_26/1 M.Sc. Diploma Seminar 1: Students give talks related to the seminar topics and their master theses. They present their research results and elaborated possible examination questions. The seminar topics are adequate to the topics of students' master theses.

MK\_26/2 M.Sc. Diploma Seminar 2: Students give talks related to the seminar topics and their master theses. They present their research results and elaborated possible examination questions. The seminar topics are adequate to the topics of students' master theses.

#### MK\_27 M. Sc. Diploma Preparation Class:

MK\_27/1 M. Sc. 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\_27/2 M. Sc. 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.

#### UNIVERSITY OF BIALYSTOK

#### STUDY PLAN

		C	OURSE	Computer Scie	ence
		level of educa	Second degree s	tudies	
scientific discipline:	Computer science	effective from the	e academic year	201	9/2020
specialization:	Internet and Mobile	Technologies			
eduactional profile:	general academic				
form of study:	full-time studies				
Study plan approved by the Faculty Council on		13.02.2019			

														l year								ll ye	/ear			
		ir	1	r		Number of classes									1 sem. 2 sem.					3	sem.		4			
ltem	MODULE NAME/COURSE NAME	USOS course code	ECTS	exam after the semester	credit after the semester	IN TOTAL	LECTURES	CLASSES	TUTORIALS	LABORATORIES	LABORATORIES - PROJECT	FOREIGN LANGUAGE COURSES SEMINARS / PROSEMINARS	FIELD CLASSES	LECTURES	CL/T/L/F/SaP/FC	ECTS	LECTURES	CL/T/LF/SaP/FC	ECTS	LECTURES	CL/T/L/F/SaP/FC	ECTS	LECTURES	CL/T/L/F/SaP/FC	ECTS	
1	2	3	4	5	6	7	8	9	10	11	12	13	4 15	16	17	18	19	20	21	22	23	24	25	26	27	
MODU	JLE 1. Modelling and Analysis of IT Systems																									
1	Modelling and Analysis of IT Systems	0600-IS2-1MASI#a	4		1	45	15			15	15			15	30	4										
	TOTAL		4			45	15			15	15			15	30	4										
MODU	JLE 2 Advanced Databases																									
1	Advanced Databases	0600-IS2-1ZBD#a	4	1		45	15			30				15	30	4										
	TOTAL		4			45	15			30				15	30	4										
MODU	JLE 3 Analytic Methods in Computer Science																									
1	Elective Course 1 <sup>1)</sup>		4		1	45	15	30						15	30	4										
	TOTAL		4			45	15	30						15	30	4										
MODU	JLE 4 Global Optimization																									
1	Global Optimization	0600-IS2-1OG#a	4		1	45	15			15	15			15	30	4										
	TOTAL		4			45	15			15	15			15	30	4										
MODU	JLE 5 Advanced Object-Oriented Programming																									
1	Elective Course 1 <sup>1)</sup>		4		1	30	15				15			15	15	4										
	TOTAL		4			30	15				15			15	15	4										
MODU	JLE 6 Multimedia Techniques																									
1	Multimedia Techniques	0600-IS2-1TMUL#a	4		1	30	15			15				15	15	4										
	TOTAL		4			30	15			15				15	15	4							1		i	
MODU	JLE 7 Projects of Web Application																									
1	Internet Applications Design	0600-IS2-1PAI#a	4		1	30	15			15				15	15	4										
·	TOTAL		4		·	30	15			15				15	15	4										
MODU	JLE 8 Algebraic Methods in Computer Science																									
1	Algebraic Methods in Computer Science	0600-IS2-1MAL#a	4		2	45	15	30									15	30	4							
	TOTAL		4			45	15	30									15	30	4							
MODU	JLE 9 Introduction to Fuzzy Modelling and Analysis		·														·									
1	Introduction to Fuzzy Modelling and Analysis	0600-IS2-1PMSR#a	4	2		45	30			15							30	15	4				1			
	TOTAL		4			45	30			15							30	15	4				1			
MODU	JLE 10 Expert Systems																									
1	Expert Systems	0600-IS2-1SE#a	3		2	30	15			15							15	15	3							
	TOTAL		3			30	15			15							15	15	3							
MODU	JLE 11 Massive Parallel Computing																									
1	Massive Parallel Computing	0600-IS2-1MOR#a	4		2	45	15			30							15	30	4							
	TOTAL		4			45	15			30							15	30	4							

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( <b></b>			-	r			II	Nu	umber	of clas	sses		-		1 sem.	1		2 sem.		3	3 sem.	┉		I sem.	<u> </u>
ltem	MODULE NAME/COURSE NAME	USOS course code	ECTS	exam atter the semester	credit after the semester	IN TOTAL	LECTURES	CLASSES	TUTORIALS	LABORATORIES	LABORATORIES - PROJECT	FOREIGN LANGUAGE COURSES	FIELD CLASSES	LECTURES	CL/T/L/F/SaP/FC	ECTS	LECTURES	CL/T/L/F/SaP/FC	ECTS	LECTURES	CL/T/L/F/SaP/FC	ECTS	LECTURES	CL/T/L/F/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
MODU	JLE 12 XML Technologies in Programming																								
1	XML Technologies in Programming	0600-IS2-1TXWP#a	4		2	45	15			30							15	30	4						
	TOTAL		4			45	15			30							15	30	4						
MODU	JLE 13 Multimedia System																								
1	Elective Course 1 <sup>1)</sup>		4		2	30	15			15							15	15	4						
	TOTAL		4			30	15			15							15	15	4						
MODU	JLE 14 E-learning Systems																								
1	E-learning Systems	0600-IS2-1SZE#a	3	2		30	15				15						15	15	3						
	TOTAL		3			30	15				15						15	15	3						
MODU	JLE 15 Mobile Technologies																								
1	Mobile Technologies	0600-IS2-1TMO#a	3		2	30	15			15							15	15	3						
	TOTAL		3			30	15			15							15	15	3						
MODU	JLE 16 Security of Data and IT Systems																								
1	Security of Data and IT Systems	0600-IS2-2BDSI#a	4	3		45	15			30										15	30	4			
	TOTAL		4			45	15			30										15	30	4			
MODU	JLE 17 Advanced Algorithms and Data Structures																								
1	Advanced Algorithms and Data Structures	0600-IS2-2ZASD#a	4	3		45	30			15										30	15	4			
	TOTAL		4			45	30			15										30	15	4			
MODU	JLE 18 Internet Data Analysis																								
1	Internet Data Analysis	0600-IS2-2ADI#a	3	3		30	15			15										15	15	3			
	TOTAL		3			30	15			15										15	15	3			
MODU	JLE 19 Internet Frameworks:																								
1	Internet Frameworks	0600-IS2-2PFI#a	4		3	45	15			30										15	30	4			
	TOTAL		4			45	15			30										15	30	4			
MODU	JLE 20 Mobile Applications Programming																								
1	Mobile Applications Programming	0600-IS2-2PAM#a	4		3	45	15			15	15									15	30	4			
	TOTAL		4			45	15			15	15									15	30	4			
MODU	JLE 21 Network Programming																								
1	Network Programming	0600-IS2-2PSS#a	4	3		45	15			30										15	30	4			
	TOTAL		4			45	15			30										15	30	4			
MODU	JLE 22 Management of IT Projects													_											
1	Management of IT Projects	0600-IS2-2ZPI#a	4	4		30	15			15													15	15	4
	TOTAL		4			30	15			15													15	15	4
MODU	JLE 23 Humanities and Social Sciences Courses*																								
1	Course to choose from humanities		2		3	10	10											$\square$		10		2		]	
2	Course to choose from social sciences		3		4	25	10			15							<u> </u>	ĻЦ				∟∟	10	15	3
	TOTAL		5			35	20			15										10		2	10	15	3
MODU	JLE 24 Intellectual Property Rights																								
1	Intellectual Property Rights	0600-IS2-1OWI#a	1		1	10	10							10		1		$\square$				للسا	$\square$	]	ļ
	TOTAL		1			10	10							10		1									

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								Nu	mber	of clas	sses					1 sem.		1	2 sem.			3 sem.		4	sem.	
ltem	MODULE NAME/COURSE NAME	USOS course code	ECTS	exam after the semester	credit after the semester	IN TOTAL	LECTURES	CLASSES	TUTORIALS	LABORATORIES	LABORATORIES - PROJECT	FOREIGN LANGUAGE COURSES	SEMINARS / PROSEMINARS	FIELD CLASSES	LECTURES	CL/T/LF/SaP/FC	ECTS	LECTURES	CL/T/L/F/SaP/FC	ECTS	LECTURES	CL/T/L/F/SaP/FC	ECTS	LECTURES	CL/T/L/F/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
MODU	LE 25 Foreign language																									
1	Foreign language		2		1	30						30				30	2									1
2	English for IT Professionals	0600-IS2-1JAIT	2		2	30						30							30	2						1
	TOTAL		4			60						60				30	2		30	2						
MODU	LE 26 M.Sc. Diploma Seminar																									
1	M.Sc. Diploma Seminar 1	0600-IS2-2SM1#a	3		3	30							30									30	3			1
2	M.Sc. Diploma Seminar 2	0600-IS2-2SM2#a	3		4	30							30												30	3
	TOTAL		6			60							60									30	3		30	3
MODU	LE 27 M. Sc. Diploma Preparation Class																									
1	M. Sc. Diploma Preparation Class 1	0600-IS2-2PM1#a	2		3	15				15												15	2			1
2	M. Sc. Diploma Preparation Class 2	0600-IS2-2PM2#a	20		4	45				45															45	20
	TOTAL		22			60				60												15	2		45	20
	IN TOTAL		122			1080	390	60		435	75	60	60		115	195	31	135	195	31	115	195	30	25	105	30

no. of exams/cred. 1 8 2 7 4 5 1 3

\* course realized within the faculty's offer

<sup>1)</sup> List of courses at the study programme - Part A