SZKOŁA GŁÓWNA GOSPODARSTWA WIEJSKIEGO

Study programme

Informatics

Faculty:	Faculty of Applied Informatics and Mathematics
Level of study:	first cycle (engineering degree)
Education profile:	General academic
Form of study:	full-time studies
Academic year:	2025/26

Table of contents

Basic information

Faculty name:	Faculty of Applied Informatics and Mathematics
Major name:	Informatics
Level of study:	first cycle (engineering degree)
Profile of study:	General academic
Form of study:	full-time studies
Duration of studies (number of semesters):	7
Number of ECTS required to complete the studies:	210
The number of ECTS points a student obtains during classes conducted with the direct participation of academic teachers or other persons conducting classes:	107
Professional title awarded to graduates:	inżynier
ISCED code:	0619
Language of study:	english

Assigning the major to the fields and disciplines to which the learning outcomes relate

Technical computing and telecommunications	100%

Major characteristics

Major characteristics

The course educates engineers in the broadly understood field of computer techniques. The education covers all basic fields of theoretical and practical computer science, including computer systems, databases, computer networks, computer graphics, software engineering and cryptology. Students can design and run computer systems, program in high-level languages, design and administer databases. They also have theoretical and practical knowledge in the field of artificial intelligence, computer graphics and teleinformatics. Graduates of this course are sought by the best computer companies involved in creating software, websites or administering computer networks on the domestic and foreign market. This is a profession valued in many branches of the economy, including companies dealing with e-business, banks, European institutions, state and local government administration, non-governmental institutions, as well as scientific and research institutions.

Learning objectives

The aim of education is to achieve learning outcomes. Learning outcomes are achieved through various forms of classes (lectures, laboratory and auditorium exercises, and seminars). Independently performed projects by students enable the acquisition of skills that are sought after on the market, e.g.: formulating research problems, selecting methods and algorithms to solve them, implementing, developing research results, reporting. The offered education methods activate students by realizing the assumed learning outcomes in terms of in-depth knowledge, skills, and social competences, and prepare graduates for professional and scientific work.

Education concept

The concept of education in the field of computer science is consistent with the mission and development strategy of the University and the Faculty. The mission of the University, recorded in the Development Strategy of SGGW for the years 2022-2030, is to serve the economic and intellectual development of Polish society, with particular emphasis on rural areas, the food economy and the broadly understood natural environment. SGGW aims to conduct scientific research, education and implementation activities at the highest level. The mission of the Faculty, recorded in the implemented and monitored Faculty Strategy, includes educating students (in order to prepare them for professional work, acquiring and supplementing knowledge), promoting scientific staff, conducting scientific research and development work and providing research services, popularizing scientific achievements, especially in the field of computer science and econometrics. The concept of education refers to the strategic goals of the Faculty. One of them is to strengthen the position on the education market by improving and expanding the educational offer (in line with the development of knowledge and the needs of the labor market), monitoring, evaluating, analyzing and improving the education process, conducting scientific research and including internal and external stakeholders in the process of improving the quality of education. It is important to expand cooperation with leading domestic and foreign centers in the field of education and research, including by increasing the internationalization of education and developing the mobility of students and academic staff. The Faculty also cooperates with the economy and public administration.

Description of work placement (if provided for in the study programme)

The development of practical skills in using knowledge and social competences is realized through student internships, which include 4 weeks of work in a private enterprise or a state institution. The objectives, principles and method of organizing internships are specified in the Regulations for completing and crediting professional internships available on the Faculty's website (http://www.wzim.sggw.pl/studia/praktyki-studenckie/). The learning outcomes of internships and their program content are included in the syllabus. The internships are supervised by the Internship Coordinator. The legal basis for the implementation of the internship is an agreement or contract between WZIiM and the unit accepting the student for the internship.

Graduate profile

Graduates of computer science acquire knowledge, skills and social competences necessary to solve problems related to the application of information technology in the industry. A significant share of practical classes ensures a high level of qualifications necessary in professional work. Typical places of employment for graduates include: specialist positions in IT companies, managerial positions in enterprises related to modern technologies, local government units and government agencies.

Learning outcomes

Knowledge

Code	Content	PRK
INj_K3_W01_inz	The graduate knows and understands issues in mathematics - including mathematical analysis, algebra, discrete mathematics, probabilistic methods, statistics and numerical methods - useful for formulating and solving simple tasks related to computer science.	P6S_WG
INj_K3_W02_inz	The graduate knows and understands the basic issues in physics, including electromagnetism, lasers, semiconductor physics and the physical foundations of building quantum computers.	P6S_WG
INj_K3_W03_inz	The graduate knows and understands the basics of electrical engineering, allowing him to understand electronics and measure electrical quantities.	P6S_WG
INj_K3_W04_inz	The graduate knows and understands the elementary issues in electronics needed to understand analog and digital technology, logical systems and the principles of operation of modern computers.	P6S_WG
INj_K3_W05_inz	The graduate knows and understands the basics of telecommunications, necessary to understand the principles of operation of modern computer networks, including wireless networks.	P6S_WG
INj_K3_W06_inz	The graduate knows and understands issues in the field of data structures, computational complexity of computational problems and algorithms used to solve them, computer system architecture, operating systems, network technologies, programming languages and paradigms, graphics and human-computer communication, artificial intelligence, databases, software engineering and embedded systems.	P6S_WG
INj_K3_W07_inz	The graduate knows and understands detailed issues in the field of algorithms and object-oriented design and programming.	P6S_WG
INj_K3_W08_inz	The graduate knows and understands the basics of the IT systems life cycle.	P6S_WG
INj_K3_W09_inz	The graduate knows and understands the basic methods, techniques and tools used to solve simple IT tasks in the field of analysis of the computational complexity of algorithms, construction of computer systems, operating systems, computer networks, implementation of programming languages, computer graphics, artificial intelligence, databases, software engineering and embedded systems.	P6S_WG
INj_K3_W10_inz	The graduate knows and understands the basics of technical standards and norms in IT.	P6S_WG
INj_K3_W11_inz	The graduate knows and understands the basics of IT codes of ethics, knows the rules of netiquette, understands the threats related to electronic crime and the specificity of mission-critical systems.	P6S_WK
INj_K3_W12_inz	The graduate knows and understands the basic concepts of economics relating to IT investments and IT projects, such as return on investment, fixed and variable costs, financial risk, revenue and profit, profit and cash flow.	P6S_WK
INj_K3_W13_inz	The graduate knows and understands the basics of patents, the Copyright and Related Rights Act and the Personal Data Protection Act.	P6S_WK
INj_K3_W14_inz	The graduate knows and understands the basics of running and managing a business.	P6S_WK
INj_K3_W15_inz	The graduate knows and understands the basics of technology transfer in relation to IT solutions, including issues such as software installation, user training and help systems.	P6S_WG
INj_K3_W16_inz	The graduate knows and understands the relationships between computer techniques and natural sciences, and is able to recognize typical problems at the interface of computer science and other fields.	P6S_WG
INj_K3_W17_inz	The graduate knows and understands issues in the field of theoretical algorithms, formal languages and their connections with practical aspects of algorithms and programming paradigms.	P6S_WG
INj_K3_W18_inz	The graduate knows and understands the basics of methods for collecting, processing and analysing data (regardless of their origin) and drawing conclusions on this basis.	P6S_WG

Skills

Code	Content	PRK
INj_K3_U01_inz	The graduate is able to use the acquired mathematical knowledge to describe processes, create models, record algorithms and other activities in the field of computer science.	P6S_UW
INj_K3_U02_inz	The graduate is able to use mathematical knowledge to optimize hardware and software solutions; is able to use knowledge to formulate and solve IT tasks using analytical and experimental methods.	P6S_UW
INj_K3_U03_inz	The graduate is able to obtain information from literature, databases and other sources, integrate it, interpret it, draw conclusions and formulate opinions on IT problems and proposed solutions.	P6S_UW
INj_K3_U04	The graduate is able to work individually and in a team of IT specialists, is able to manage his/her time, make commitments and meet deadlines.	P6S_UO
INj_K3_U05	The graduate is able to communicate using various techniques in the professional environment and in other environments, also using IT tools.	P6S_UK
INj_K3_U06	The graduate is able to use English to a degree that allows him/her to communicate, read and understand texts and software documentation.	P6S_UK
INj_K3_U07_inz	The graduate is able to plan and conduct simulation and practical experiments, interpret the obtained results and draw conclusions.	P6S_UW
INj_K3_U08_inz	The graduate is able to use knowledge to formulate and solve computer science tasks, basic analytical and experimental methods, including simple computational experiments.	P6S_UW
INj_K3_U09_inz	The graduate is able to recognize their social, economic and legal aspects when formulating and solving IT tasks.	P6S_UW
INj_K3_U10_inz	The graduate is able to formulate algorithms and implement them using at least one of the popular tools and design environments.	P6S_UW
INj_K3_U11	The graduate is able to use information and communication techniques appropriate for the implementation of tasks typical of engineering activities and is able to prepare a well-documented study of problems in the field of computer science, is able to effectively process text files.	P6S_UK
INj_K3_U12_inz	The graduate is able to create an object model of a simple system (e.g. in UML).	P6S_UW
INj_K3_U13_inz	The graduate is able to assess the computational complexity of algorithms and problems.	P6S_UW
INj_K3_U14_inz	The graduate is able to use operating systems at the API level and from the position of a system administrator.	P6S_UW
INj_K3_U15_inz	The graduate is able to design simple computer networks; is able to act as a computer network administrator and maintain it.	P6S_UW
INj_K3_U16_inz	The graduate is able to protect transmitted data against unauthorized reading.	P6S_UW
INj_K3_U17_inz	The graduate is able to create simple internet applications.	P6S_UW
INj_K3_U18_inz	The graduate is able to design an ergonomic user interface for web applications.	P6S_UW
INj_K3_U19_inz	The graduate is able to build simple database systems using at least one of the most popular database management systems and has the ability to maintain database systems.	P6S_UW
INj_K3_U20_inz	The graduate is able to systematically conduct functional tests and is prepared to effectively participate in software inspection.	P6S_UW
INj_K3_U21_inz	The graduate is able to effectively participate in software inspection.	P6S_UW
INj_K3_U22	The graduate is able to demonstrate the ability to think logically and organize information in the form of general knowledge.	P6S_UU
INj_K3_U23_inz	The graduate is able to build simple embedded systems.	P6S_UW
INj_K3_U24_inz	The graduate is able to use safety principles, norms and standards related to work in an industrial environment.	P6S_UW

Code	Content	PRK
INj_K3_U25_inz	The graduate is able to correctly use at least one method of estimating software development effort.	P6S_UW
INj_K3_U26_inz	The graduate is able to perform a simple analysis of the functioning of an IT system and evaluate existing IT solutions, at least in relation to their functional features and IT norms and standards.	P6S_UW
INj_K3_U27_inz	The graduate is able to assess, at a basic level, the usefulness of routine IT methods and tools and select and apply the appropriate method and tools for typical IT tasks.	P6S_UW
INj_K3_U28_inz	The graduate is able to implement computer techniques in areas requiring their support, using appropriate methods and tools.	P6S_UW
INj_K3_U29_inz	The graduate is able to use specialist application or design software to solve practical tasks and IT problems.	P6S_UW
INj_K3_U30	The graduate is able to use a foreign language in the field of technical sciences, relevant to their field of study, in accordance with the requirements set out for level B2 of the Common European Framework of Reference for Languages.	P6S_UK

Social competence

Code	Content	PRK
INj_K3_K01	The graduate is ready to understand the speed of the process of changes in computer techniques; is prepared to constantly expand his knowledge and skills as part of his professional work.	P6S_KK
INj_K3_K02	The graduate is ready to understand the need and learn about the possibilities of further education (second and third cycle studies, postgraduate studies, courses and examinations conducted by universities, companies and professional organizations).	P6S_KK
INj_K3_K03	The graduate is ready to indicate examples and understands the causes of malfunctioning IT systems that have led to serious financial or social losses or to serious loss of health or even life.	P6S_KR
INj_K3_K04	The graduate is ready to behave professionally and adhere to ethical principles, including honesty.	P6S_KR
INj_K3_K05	The graduate is ready for teamwork.	P6S_KO
INj_K3_K06	The graduate is ready to demonstrate effectiveness in implementing projects of a social, scientific and research or programming and implementation nature, included in the study program or implemented outside of the studies.	P6S_KO
INj_K3_K07	The graduate is ready to convey information about the achievements of computer science and various aspects of the computer science profession in a generally understandable manner.	P6S_KR

Study plan

Semester 1

Students complete library training and a health and safety course on a platform available at https://szkolenia.sggw.pl.

Subject	Number of hours	ECTS points	Form of verification	Mandatory
Health and Safety Course	OHS training: 4	0	Pass	Obligatory subjects
Introduction to Programming	Lecture: 30 Laboratory exercises: 30	6	Exam	Obligatory subjects
Higher Mathematics Fundamentals	Lecture: 30 Auditorium exercises: 30	5	Exam	Obligatory subjects
Mathematical Analysis Fundamentals	Lecture: 30 Auditorium exercises: 30	6	Exam	Obligatory subjects
Discrete Mathematics 1	Lecture: 30 Auditorium exercises: 30	5	Exam	Obligatory subjects
Basics of Physics	Lecture: 30 Auditorium exercises: 30	5	Exam	Obligatory subjects
Algorithmic Reasoning	Lecture: 30	2	Pass with grade	Obligatory subjects
Ergonomics and Health and Safety	Lecture: 15	1	Pass with grade	Obligatory subjects
Sum	**349**	**30**		

Semester 2

Subject	Number of hours	ECTS points	Form of verification	Mandatory
Object-Oriented Programming	Lecture: 30 Laboratory exercises: 30	6	Exam	Obligatory subjects

Subject	Number of hours	ECTS points	Form of verification	Mandatory
Mathematical Analysis	Lecture: 30 Auditorium exercises: 30	5	Exam	Obligatory subjects
Linear Algebra	Lecture: 30 Auditorium exercises: 30	5	Exam	Obligatory subjects
Electronics Basics	Lecture: 30 Auditorium exercises: 30	5	Exam	Obligatory subjects
Discrete Mathematics 2	Lecture: 30 Auditorium exercises: 30	5	Pass with grade	Obligatory subjects
Physics Laboratory	Laboratory exercises: 30	2	Pass with grade	Obligatory subjects
HS elective	Lecture: 30	2	Pass with grade	Mandatory group
Student chooses one subject				
Psychology	Lecture: 30	2	Pass with grade	Elective subjects
Philosophy	Lecture: 30	2	Pass with grade	Elective subjects
Sociology	Lecture: 30	2	Pass with grade	Elective subjects
Sum	**360**	**30**		

Semester 3

Subject	Number of hours	ECTS points	Form of verification	Mandatory
Algorithms and Data Structures	Lecture: 30 Laboratory exercises: 30	6	Exam	Obligatory subjects
Software Engineering	Lecture: 30 Laboratory exercises: 30	5	Exam	Obligatory subjects
Computer Architecture	Lecture: 30 Laboratory exercises: 30	5	Exam	Obligatory subjects
Probability and Statistics	Lecture: 30 Auditorium exercises: 30	5	Exam	Obligatory subjects

Subject	Number of hours	ECTS points	Form of verification	Mandatory
Electronics Laboratory	Laboratory exercises: 30	2	Exam	Obligatory subjects
Forms of Economic Activity	Lecture: 15 Auditorium exercises: 15	2	Pass with grade	Obligatory subjects
Building Internet Services	Lecture: 15 Laboratory exercises: 15	2	Pass with grade	Obligatory subjects
Physical education	Physical education: 30	0	Pass	Mandatory group
The student chooses physical education classes				
Physical education	Physical education: 30	0	Pass	Elective subjects
Foreign language	Language course: 60	3	Pass with grade	Mandatory group
Student chooses classes from foreign language				
English	Language course: 60	3	Pass with grade	Elective subjects
German	Language course: 60	3	Pass with grade	Elective subjects
Russian	Language course: 60	3	Pass with grade	Elective subjects
Spanish	Language course: 60	3	Pass with grade	Elective subjects
Sum	**420**	**30**		

Semester 4

Subject	Number of hours	ECTS points	Form of verification	Mandatory
Database Technologies	Lecture: 30 Laboratory exercises: 30	6	Exam	Obligatory subjects
Operating Systems	Lecture: 30 Laboratory exercises: 30	5	Exam	Obligatory subjects
Numerical Methods	Lecture: 30 Auditorium exercises: 15 Laboratory exercises: 15	5	Pass with grade	Obligatory subjects

Subject	Number of hours	ECTS points	Form of verification	Mandatory
Graphs and Networks	Lecture: 30 Auditorium exercises: 15	3	Exam	Obligatory subjects
Intellectual property protection	Lecture: 15	1	Pass with grade	Obligatory subjects
Data Analysis Methods	Lecture: 15 Laboratory exercises: 15	2	Pass with grade	Obligatory subjects
Module 1	Lecture: 30 Laboratory exercises: 30	4	Pass with grade	Mandatory group
Student chooses two subjects from open list				
Module 1	Lecture: 30 Laboratory exercises: 30	4	Pass with grade	Elective subjects
Physical education	Physical education: 30	0	Pass	Mandatory group
The student conducts physical education classes selected in semester 3				
Physical education	Physical education: 30	0	Pass	Elective subjects
Foreign language	Language course: 60	3	Pass with grade	Mandatory group
The student conducts foreign language classes from semester 3				
English	Language course: 60	3	Pass with grade	Elective subjects
German	Language course: 60	3	Pass with grade	Elective subjects
Russian	Language course: 60	3	Pass with grade	Elective subjects
Spanish	Language course: 60	3	Pass with grade	Elective subjects
Confirmation of B2 Foreign Language	Contact hours: 2	1	Exam	Obligatory subjects
Sum	**422**	**30**		

Semester 5

In this semester, the student chooses a specialization, which is realized until the end of engineering studies. The student chooses two subjects from an open list.

Subject	Number of hours	ECTS points	Form of verification	Mandatory
Computer Networks	Lecture: 30 Laboratory exercises: 30	6	Exam	Obligatory subjects
Digital Techniques and Embedded Systems Fundamental	Lecture: 30 Laboratory exercises: 30	5	Pass with grade	Obligatory subjects
Programming Paradigms	Lecture: 30 Laboratory exercises: 30	4	Pass with grade	Obligatory subjects
Module 2	Lecture: 60	4	Pass with grade	Mandatory group
Student chooses two subjects from open list				
Module 2	Lecture: 60	4	Pass with grade	Elective subjects
Internships	Apprenticeships: 120	4	Pass	Mandatory group
Internships	Apprenticeships: 120	4	Pass	Elective subjects
Sum	**360**	**23**		

Speciality: Information systems engineering

Subject	Number of hours	ECTS points	Form of verification	Mandatory
Information Systems Engineering	Lecture: 30 Laboratory exercises: 60	7	Exam/pass with grade	Mandatory group
Software Architecture	Lecture: 15 Laboratory exercises: 30	4	Exam	Obligatory subjects
Component Programming	Lecture: 15 Laboratory exercises: 30	3	Pass with grade	Obligatory subjects
Sum	**90**	**7**		

Speciality: Computer Systems Engineering

Subject	Number of hours	ECTS points	Form of verification	Mandatory
Computer Systems Engineering	Lecture: 30 Laboratory exercises: 60	7	Exam/pass with grade	Mandatory group
Algorithms theory	Lecture: 15 Laboratory exercises: 30	4	Exam	Obligatory subjects
Fundamentals of teleinformatics	Lecture: 15 Laboratory exercises: 30	3	Pass with grade	Obligatory subjects
Sum	**90**	**7**		

Semester 6

Subject	Number of hours	ECTS points	Form of verification	Mandatory
Computer Graphics and Computer Communication	Lecture: 30 Laboratory exercises: 30	5	Exam	Obligatory subjects
Team Project	Laboratory exercises: 15	2	Pass with grade	Obligatory subjects
Social and Professional Problems of Computer Science	Lecture: 15	1	Pass with grade	Obligatory subjects
Module 3	Lecture: 60	4	Pass with grade	Mandatory group
Student chooses two subjects from open list				
Module 3	Lecture: 60	4	Pass with grade	Elective subjects
Diploma seminar	Auditorium exercises: 30	2	Pass	Mandatory group
Diploma seminar	Auditorium exercises: 30	2	Pass	Elective subjects
Sum	**180**	**14**		

Speciality: Information systems engineering

Subject	Number of hours	ECTS points	Form of verification	Mandatory
Information Systems Engineering	Lecture: 90 Laboratory exercises: 120	16	Exam/pass with grade	Mandatory group
Information Protection and Computer System Security	Lecture: 30 Laboratory exercises: 30	5	Exam	Obligatory subjects
Internet Programming	Lecture: 15 Laboratory exercises: 30	4	Exam	Obligatory subjects
Data Processing Systems	Lecture: 30 Laboratory exercises: 30	4	Pass with grade	Obligatory subjects
Data Warehouses	Lecture: 15 Laboratory exercises: 30	3	Pass with grade	Obligatory subjects
Sum	**210**	**16**		

Speciality: Computer Systems Engineering

Subject	Number of hours	ECTS points	Form of verification	Mandatory
Computer Systems Engineering	Lecture: 120 Laboratory exercises: 90	16	Exam/pass with grade	Mandatory group
Embedded Systems	Lecture: 30 Laboratory exercises: 30	5	Exam	Obligatory subjects
Distributed systems	Lecture: 30 Laboratory exercises: 30	5	Exam	Obligatory subjects
Network Services	Lecture: 30 Laboratory exercises: 15	3	Pass with grade	Obligatory subjects
Hardware security	Lecture: 30 Laboratory exercises: 15	3	Exam	Obligatory subjects
Sum	**210**	**16**		

Semester 7

The last semester of studies - student prepares an engineering thesis.

Subject	Number of hours	ECTS points	Form of verification	Mandatory
Artificial Intelligence	Lecture: 30 Laboratory exercises: 15	4	Exam	Obligatory subjects
HS elective	Lecture: 30	2	Pass with grade	Mandatory group
Student chooses one subject				
Labor Law	Lecture: 30	2	Pass with grade	Elective subjects
Intercultural communication	Lecture: 30	2	Pass with grade	Elective subjects
Module 4	Lecture: 30	2	Pass with grade	Mandatory group
Student chooses one subject				
Module 4	Lecture: 30	2	Pass with grade	Elective subjects
Diploma seminar	Auditorium exercises: 30	2	Pass	Mandatory group
Diploma seminar	Auditorium exercises: 30	2	Pass	Elective subjects
Engineering Thesis	Diploma thesis: 0	15	Exam	Mandatory group
Engineering Thesis	Diploma thesis: 0	15	Exam	Elective subjects
Sum	**135**	**25**		

Speciality: Information systems engineering

Subject	Number of hours	ECTS points	Form of verification	Mandatory
Information Systems Engineering	Lecture: 30 Laboratory exercises: 45	5	Exam/pass with grade	Mandatory group
Business Intelligence Systems	Lecture: 15 Laboratory exercises: 30	3	Exam	Obligatory subjects
E-commerce Systems	Lecture: 15 Laboratory exercises: 15	2	Pass with grade	Obligatory subjects
Sum	**75**	**5**		

Speciality: Computer Systems Engineering

Subject	Number of hours	ECTS points	Form of verification	Mandatory
Computer Systems Engineering	Lecture: 45 Laboratory exercises: 30	5	Exam/pass with grade	Mandatory group
Mobile Systems and Wireless Communications	Lecture: 30 Laboratory exercises: 15	3	Exam	Obligatory subjects
Computer systems security	Lecture: 15 Laboratory exercises: 15	2	Pass with grade	Obligatory subjects
Sum	**75**	**5**		

Description of the learning outcomes assigned to the subjects and the curriculum content ensuring the achievement of these outcomes

Subject name:		Introduction to Programming	ECTS: 6
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	Basic data types	INj_K3_W06_inz
	W2	Conditional statements and methods for repeatedly executing instructions in a simple computer program.	INj_K3_W06_inz
Skills: (In terms of skills, the graduate can)	U1	Use basic data types in a simple computer program.	INj_K3_U10_inz
	U2	Control conditional and repeated execution of instructions in a simple computer program.	INj_K3_U10_inz
	U3	Use the function mechanism in simple computer programs.	INj_K3_U01_inz, INj_K3_U10_inz
	U4	Define the scope of variables in user-defined blocks in text or graphical form.	INj_K3_U10_inz
	U5	Use a programming environment to create simple computer programs.	INj_K3_U10_inz
Course content ensuring the achievement of learning outcomes:		Lab Topics: Introduction to the programming environment. Using variables. Data input and output. Conditional and multiple statement invocations. Arrays. Functions. Recursion. File handling. Exceptions. Bitwise operations. Recursive data structures (e.g., BST, linked list).	
Examination methods:		Test (written or computer based), Written exam	

Subject name:		Higher Mathematics Fundamentals	ECTS: 5
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	the rules of propositional calculus and their relationship to operations on sets (sum, intersection); the difference between rational and irrational numbers.	INj_K3_W01_inz
	W2	concepts of a mapping, of a function and of an invertible mapping; the basic properties of elementary functions.	INj_K3_W01_inz
	W3	different forms of equation of a line; equations of conics	INj_K3_W01_inz
	W4	concept of a complex number; basic calculations with complex numbers	INj_K3_W01_inz
	W5	matricies and operations on them; determinants and their relationship with system of linear equations.	INj_K3_W01_inz
Skills: (In terms of skills, the graduate can)	U1	find sums and intersections (in particular countable sums and intersections) and sketch them (e.g. on the plane)	INj_K3_U01_inz
	U2	verify whether a function is invertible and find the inverse function; solve equations and inequalities with elementary functions	INj_K3_U01_inz, INj_K3_U22
	U3	Sketch on the plane the sets given by the linear equations and inequalities and (some) quadratic ones; can recognize a conic curve (without rotation) and sketch it in the coordinates, can write the equation of the conic with the given properties.	INj_K3_U01_inz, INj_K3_U22
	U4	solve the quadratic equation with compex coefficients coefficient. Can sketch subsets with given properties on the complex plane, can find roots of a complex number.	INj_K3_U01_inz, INj_K3_U22
	U5	Efficiently (reduction) solve a system of linear equations, calculate the determinant of a matrix and find the inverse matrix.	INj_K3_U01_inz, INj_K3_U22
Social competences: (Within the scope of competence, the graduate is ready to)	K1	prepare and present the results of their individual or team work.	INj_K3_K04
Course content ensuring the achievement of learning outcomes:		Propositional calculus: conjunction, disjunction, implication and their negations; quantifiers. Set algebra: sums and intersections (also generalized); Cartesian products. Rational and irrational numbers. The concept of function (mapping); composition of mappings, invertibility. Basic properties and operations on real functions and their application to solving equations and inequalities. Review of elementary functions (polynomials, modular function, rational, logarithmic, exponential, trigonometric, cyclometric functions). Analytic geometry of the plane: scalar product of vectors, equations of a line (directional, general, through two points, segmental, parametric). Distance, distance of a point from a line. Area of a parallelogram. Conic sections. Complex numbers. Geometric interpretation, trigonometric form and de Moivre's formula. Roots of complex numbers. Fundamental Theorem of Algebra. Finding complex roots of quadratic equations. Systems of linear equations. Matrix algebra. Determinant, inverse matrix.	
Examination methods:		Written exam, Test (written or computer based), Assessment of activity during classes	

Subject name:		Mathematical Analysis Fundamentals	ECTS: 6
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	basic concepts of mathematical analysis.	INj_K3_W01_inz
Skills: (In terms of skills, the graduate can)	U1	apply differential calculus to investigation of functions in practical problems;	INj_K3_U01_inz, INj_K3_U04
	U2	apply integrals to practical problems;	INj_K3_U01_inz, INj_K3_U04
	U3	formulate simple problems in the language of mathematics;	INj_K3_U01_inz, INj_K3_U04
	U4	use simple approximation methods.	INj_K3_U01_inz, INj_K3_U04
Social competences: (Within the scope of competence, the graduate is ready to)	K1	prepare and present the results of individual or team work.	INj_K3_K02, INj_K3_K04
Course content ensuring the achievement of learning outcomes:		Functions of a Single Variable Basic concepts and properties. Number Sequences Sequence limits and the number e. Limit calculus and indeterminate forms. Limits and Continuity of Functions Properties of continuous functions. Derivative and Differential of a Function Mean value theorems. Determining extrema and analyzing function behavior. Taylor's formula. Integral Calculus: Indefinite and definite integrals. Upper limit function of integration. Improper integrals. Geometric and physical applications of single integrals. Approximate integration methods.	
Examination methods:		Written exam, Test (written or computer based)	

Subject name:		Discrete Mathematics 1	ECTS: 5
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	elements of mathematical logic, set theory, and the theory of relations (including elements of the theory of functions) useful for formulating and solving problems related to computer science.	INj_K3_W01_inz
Skills: (In terms of skills, the graduate can)	U1	to analyze problems, perform calculations, formulate justifications, and correctly carry out logical reasoning, as well as use the acquired knowledge to describe processes, create models, write algorithms, and perform other tasks in the field of computer science.	INj_K3_U01_inz, INj_K3_U22
Course content ensuring the achievement of learning outcomes:		Elements of mathematical logic: classical propositional calculus (CLC), logical functors, mention of the axiomatic approach to CLC. Elements of functional calculus: propositional functions (forms), quantifier calculus, methods of proving quantifier identities. Elements of set algebra: basic operations on sets (sum, product, difference, complement), power sets, equicardinality of sets. Infinite sets: consequences of the adopted definition of equicardinality of sets, countable and uncountable sets, cardinality of a set, naive and axiomatic set theory. Cartesian product of sets and generalized operations. Elements of the theory of relations and functions: relation as a subset of the Cartesian product, inverse relations, composition of relations, binary relations, surjective, injective and bijective functions, function as a relation. Equivalence relations, abstraction classes and theorems on set partition. Ordering relations: partial order relations, Hasse diagrams, least element, greatest element, minimal elements, maximal elements, lower and upper bounds, lattices. Linear orders, chains, Kuratowski-Zorn lemma. Well-ordered sets, formal justification of the principle of mathematical induction.	
Examination methods:		Written exam	

Subject name:		Basics of Physics	ECTS: 5
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	The student knows and understands the basic concepts, laws, principles, relationships, and physical phenomena in the fields of classical mechanics, electricity and magnetism, and quantum mechanics.	INj_K3_W02_inz, INj_K3_W03_inz
Skills: (In terms of skills, the graduate can)	U1	The student is able to solve physics problems using differential and integral calculus.	INj_K3_U22
	U2	When analyzing simple problems from the discussed areas of physics, the student is capable of performing multi-step reasoning that goes beyond merely substituting values into standard formulas.	INj_K3_U22
Course content ensuring the achievement of learning outcomes:		Topics covered by physics. Branches of physics. Fundamental interactions. Units used in physics. Mathematical introduction: derivative of a function of one variable, indefinite and definite integral, scalar and vector product, partial derivatives, differential operators. Kinematics of a material point. Description of position. Description of motion: trajectory, distance, velocity and acceleration. Classification of motions. Basic concepts of dynamics: mass, force and moment of force, momentum and angular momentum, energy, work, power. Newton's laws of dynamics. Equations of motion. Conservation principles. Selected topics of dynamics: motion in a central and uniform gravitational field, drag forces, motion in uniform electric and magnetic fields, harmonic motion. Electric field: Coulomb's law, electric field intensity, Gauss's law, superposition principle, capacitors, conductors and dielectrics. Magnetic field: magnetic induction vector, Biot-Savart law, Ampere's law, current-carrying conductor in a magnetic field. Electric current: electric conductivity, current intensity, Ohm's law, Kirchhoff's equations, work and power of direct current. direct current circuits, Faraday's law of induction, mutual and self-induction, alternating current circuits. Maxwell's laws. Electromagnetic wave. Continuity equation. Description of fields in various reference frames. Elements of quantum mechanics: experimental foundations, wave function, expected value of a physical quantity, energy and momentum operators, uncertainty principle, Schrödinger's equation, potential well and threshold, crossing a potential barrier, atomic structure. Elements of solid state physics: crystal structure, band model of conductivity, conductors, semiconductors and insulators.	
Examination methods:		Written exam, Test (written or computer based)	

Subject name:		Algorithmic Reasoning	ECTS: 2
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	basic methods and techniques for solving algorithmic problems.	INj_K3_W01_inz, INj_K3_W16_inz, INj_K3_W17_inz, INj_K3_W18_inz
Skills: (In terms of skills, the graduate can)	U1	applying acquired knowledge to analyze and practically solve algorithmic problems.	INj_K3_U01_inz, INj_K3_U02_inz, INj_K3_U03_inz, INj_K3_U22, INj_K3_U27_inz
Course content ensuring the achievement of learning outcomes:		Introduction to types of algorithmic reasoning and their specifics. General principles of effective problem solving. Heuristic and axiomatic methods. Introduction and discussion (in the context of puzzles, riddles, and logic games) of concepts such as optimization, probability, simulation, graph, strategy, and others.	
Examination methods:		Written credit	

Subject name:		Ergonomics and Health and Safety	ECTS: 1
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Skills: (In terms of skills, the graduate can)	U1	Use knowledge about hazards occurring in the work environment to protect human life and health, application of legal requirements in the organization of safe work	INj_K3_U20_inz, INj_K3_U24_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	Proper behavior in the event of danger, is aware of the obligations of the employee and employer in times of danger	INj_K3_K05, INj_K3_K07
Course content ensuring the achievement of learning outcomes:		Accidents at work and occupational diseases - statistical data, causes, possibilities of prevention. Basic concepts in the field of ergonomics. Legal requirements, threats, organization of a workstation equipped with a screen monitor. Basic principles of ergonomic design.	
Examination methods:		Written credit	

Subject name:		Object-Oriented Programming	ECTS: 6
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	The student knows and understands the basic principles of object-oriented programming. Student understands the importance of object-oriented programming for creating large computer systems.	INj_K3_W07_inz
	W2	The student knows and understands the programming environment supporting the work in the selected object-oriented programming language, knows the mechanisms of inheritance and polymorphism, abstract classes and interfaces.	INj_K3_W06_inz, INj_K3_W07_inz
	W3	The student knows and understands the usefulness of the object-oriented paradigm for solving various types of problems.	INj_K3_W08_inz
Skills: (In terms of skills, the graduate can)	U1	The student is able to formulate algorithms and program them using an object-oriented language.	INj_K3_U03_inz, INj_K3_U10_inz
	U2	The student is able to perform an object-oriented analysis of a domain and design a class structure for a given topic.	INj_K3_U01_inz, INj_K3_U10_inz
	U3	The student is able to assess the usefulness of a programming environment supporting the work in a selected object-oriented programming language. Student is able to select and use the tools for designing, implementing, testing, and debugging object-oriented programs.	INj_K3_U12_inz, INj_K3_U14_inz
Course content ensuring the achievement of learning outcomes:		Introduction to Object-Oriented Programming. Concept of Classes and Objects:Class components: fields and methods. Data protection, encapsulation, access specifiers for fields and methods, the this keyword. Static Members,Creation, initialization, and destruction of objects. Constructor overloading. Class design and object-oriented domain modeling. Inheritance, Inheritance vs composition. Class hierarchy, constructors and inheritance. Virtual functions and polymorphism. Abstract classes and interfaces; application of interfaces. Additional Concepts: Exceptions: Handling errors and exceptions. Namespaces: Managing code structure. Operator Overloading: Indexers and conversion functions. Streams and File Handling: Serialization techniques. Collections and Generics: Efficient data structures. Reflection Mechanism: Advanced runtime analysis and operations.	
Examination methods:		Written exam, Project, Assessment of work in the laboratory	

Subject name:		Mathematical Analysis	ECTS: 5
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	concepts of mathematical analysis presented in the lecture.	INj_K3_W01_inz
Skills: (In terms of skills, the graduate can)	U1	expand functions into power and trigonometric series.	INj_K3_U01_inz, INj_K3_U02_inz, INj_K3_U22
	U2	use differential calculus to determine extreme values.	INj_K3_U01_inz, INj_K3_U02_inz, INj_K3_U22
	U3	use multiple integrals in practical tasks.	INj_K3_U01_inz, INj_K3_U02_inz, INj_K3_U22
	U4	represent a simple process using a differential equation.	INj_K3_U01_inz, INj_K3_U02_inz, INj_K3_U22
Social competences: (Within the scope of competence, the graduate is ready to)	K1	prepare and present the results of individual or team work.	INj_K3_K02, INj_K3_K04
Course content ensuring the achievement of learning outcomes:		Number Series and Functional Series Power series, Taylor series, and Fourier trigonometric series. Differential Calculus of Multivariable Functions Partial derivatives, directional derivatives, Taylor's formula. Local and global extrema, conditional extrema (Lagrange multiplier method). Implicit functions. Integral Calculus of Multivariable Functions Double and triple integrals, integration over normal regions. Change of variables (polar, cylindrical, and spherical coordinates). Geometric and physical applications of multiple integrals. Ordinary Differential Equations Examples of phenomena leading to differential equations. Elementary first-order equations.	
Examination methods:		Written exam, Test (written or computer based), Assessment of activity during classes	

Subject name:		Linear Algebra	ECTS: 5
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	the properties of matrices (including matrices of linear mappings) and their applications.	INj_K3_W01_inz
	W2	the concept of vector space, its basis and dimension.	INj_K3_W01_inz
	W3	properties of linear mappings.	INj_K3_W01_inz
	W4	selected concepts of geometry	INj_K3_W01_inz
Skills: (In terms of skills, the graduate can)	U1	solve advanced systems of linear equations and analyze their properties.	INj_K3_U01_inz, INj_K3_U02_inz, INj_K3_U22
	U2	apply the properties of the scalar product to orthogonality problems.	INj_K3_U01_inz, INj_K3_U02_inz, INj_K3_U22
	U3	determine the eigenvalues and eigenvectors of the matrix and give the canonical form of the matrix.	INj_K3_U01_inz, INj_K3_U02_inz, INj_K3_U22
Social competences: (Within the scope of competence, the graduate is ready to)	K1	prepare and present the results of their individual or team work.	INj_K3_K02, INj_K3_K04
Course content ensuring the achievement of learning outcomes:		Matrices, their extended properties and applications (relations, graphs, networks). Solving systems of linear equations - Cramer's methods, matrix methods and Gaussian elimination. Interpretation of solutions. Linear spaces (in particular linear spaces of matrices and functions). Linear independence of vectors. Basis and dimension of space. Decomposition of a vector in a basis, change of basis problem, transition matrix. Linear mappings, their connection with matrices and properties. Kernel and image of a mapping. Matrices of a linear mapping in different bases. Characteristic polynomial, eigenvalues and eigenvectors of a mapping (matrix). Basis of eigenvectors. Diagonalizable matrices and their applications. Selected concepts of n-dimensional space geometry, equations of lines and hyperplanes. Orthogonal mappings and isometries of space. Quadratic forms, canonical forms, matrices and definiteness of forms. Application to the description of second-degree curves and surfaces.	
Examination methods:		Written exam, Test (written or computer based), Assessment of activity during classes	

Subject name:		Electronics Basics	ECTS: 5
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	The student knows and understands the basics of operation, analysis and calculation of electronic systems and recognizes the components of more complex systems, also used in computer technology.	INj_K3_W04_inz
Skills: (In terms of skills, the graduate can)	U1	The student is able to calculate electronic systems, apply the laws and principles that apply to the analysis of electronic systems, and correctly select computational methods.	INj_K3_U03_inz, INj_K3_U07_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	Student jest gotów do kształcenia ustawicznego, rozumie tendencje zmian zachodzących w elektronice i w technikach komputerowych.	INj_K3_K01, INj_K3_K02, INj_K3_K03
Course content ensuring the achievement of learning outcomes:		Perspectives of modern electronics. General issues and basic concepts of electronics. Materials used in electronics. DC circuits. AC circuits. Laws used in calculating op.p.s. Complex number calculus. Fundamentals of analog circuits. Selected methods of circuit analysis. Feedback in electronic circuits. Amplifiers, classification, parameters, properties. Operational amplifier circuits. Selected nonlinear analog circuits. Generators. Digital circuits, properties and classification.	
Examination methods:		Test (written or computer based), Written exam	

Subject name:		Discrete Mathematics 2	ECTS: 5
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	methods and techniques of discrete mathematics and their connections to other branches of mathematics.	INj_K3_W01_inz, INj_K3_W07_inz
Skills: (In terms of skills, the graduate can)	U1	effectively apply methods and techniques of discrete mathematics to solve mathematical and computer science problems.	INj_K3_U01_inz
Course content ensuring the achievement of learning outcomes:		The principle of mathematical induction in various formulations and its applications. Binomial coefficients and their applications. Fundamentals of counting theory, including Dirichlet's pigeonhole principle and the inclusion-exclusion principle. Elements of combinatorics. Recursion. Generating functions and their applications. Elements of number theory. Modular arithmetic and its applications.	
Examination methods:		Written credit, Test (written or computer based)	

Subject name:		Physics Laboratory	ECTS: 2
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	Basic principles of measuring physical quantities	INj_K3_W02_inz, INj_K3_W03_inz, INj_K3_W18_inz
	W2	Basic principles of computer modelling of physical phenomena.	INj_K3_W02_inz, INj_K3_W16_inz, INj_K3_W17_inz
	W3	Methods of performing measurements and estimating measurement errors.	INj_K3_W02_inz, INj_K3_W03_inz
	W4	Tools for creating computer simulations of physical phenomena.	INj_K3_W02_inz, INj_K3_W16_inz
	W5	Principles of using measuring instruments.	INj_K3_W02_inz, INj_K3_W03_inz
Skills: (In terms of skills, the graduate can)	U1	Creates models of simple physical phenomena and perform a computer simulation based on them.	INj_K3_U01_inz, INj_K3_U07_inz, INj_K3_U08_inz, INj_K3_U28_inz, INj_K3_U29_inz
	U2	Plans and carries out measurements of any physical quantity	INj_K3_U08_inz, INj_K3_U22
	U3	Processes the results of measurement data.	INj_K3_U02_inz, INj_K3_U22
	U4	Documents and reports work results on time.	INj_K3_U03_inz, INj_K3_U04
Social competences: (Within the scope of competence, the graduate is ready to)	K1	Teamwork	INj_K3_K05
	K2	Adhering to principles of honesty and integrity	INj_K3_K04
	K3	Clear reporting and presenting the results of one's work	INj_K3_K07
Course content ensuring the achievement of learning outcomes:		Basics of physical measurements and estimation of their errors. Exercises in thermodynamics (isothermal process, determination of the adiabat constant, heat of fusion of ice). Exercises in mechanics (determination of friction coefficients, determination of the coefficient of elasticity, measurement of the acceleration of gravity using a mathematical pendulum, experimental determination of the principal moments of inertia). Exercises in optics (use of the diffraction phenomenon to measure the thickness of a diaphragm and the width of a slit). Exercises in electromagnetism (determination of ohmic resistance of conductors, significance of the thermocouple constant, relaxation phenomenon in an electric circuit). Block of exercises on computer simulation of physical phenomena: introductory lecture on tools for simulating physical phenomena. Choice of: Python language, MATLAB or Octave applications. Simulation of selected physical phenomena.	
Examination methods:		Report	

Subject name:		Psychology	ECTS: 2
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	basic concepts of psychology: cognitive processes, perception, reception and processing of information, speech and language, thinking and reasoning, learning and memory, the role of attention, emotions and motivations in the processes of regulating behaviour, abilities and talents, psychology of individual differences - differences in intelligence, temperament, personality and cognitive style	INj_K3_W16_inz
Skills: (In terms of skills, the graduate can)	U1	observe social behaviors and their determinants cope with stress and use coping strategies	INj_K3_U04
Social competences: (Within the scope of competence, the graduate is ready to)	K1	self-reflection on your own professional development	INj_K3_K06
Course content ensuring the achievement of learning outcomes:		The subject of psychology as a science, historical outline. Mental processes - division, characteristics of selected processes. Psychology of individual differences, genetics of behavior. Temperament and personality - review of concepts, functional significance. Well-being and mental health - indicators and models in psychology. Burnout - definitions, models, symptoms, course. Stress in health psychology - concept, concepts, causes, strategies for coping with stress. Models of occupational stress. Sources of health hazards in the work environment. Salutogenic factors and job satisfaction. Selected psychological experiments.	
Examination methods:		Report, Assessment of activity during classes	

Subject name:		Philosophy	ECTS: 2
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	the place of philosophy in the system of real sciences and knows the elementary terminology used in philosophy. The student knows and understands the sources of the main philosophical disputes conducted on the basis of ontology, epistemology and ethics. The student knows the subject and methodological connections of philosophy with other scientific disciplines, including social, natural and technical ones. The student knows the basic ideological disputes conducted in the field of philosophy and their sources and determinants	INj_K3_W16_inz
Skills: (In terms of skills, the graduate can)	U1	based on the knowledge of philosophy, critically evaluate their own cognitive limitations and analyze philosophical aspects of social and economic phenomena. The student is able to participate in a debate on basic philosophical disputes covering issues in the field of ontology, epistemology and ethics.	INj_K3_U03_inz, INj_K3_U06, INj_K3_U22
Social competences: (Within the scope of competence, the graduate is ready to)	K1	critically evaluate their knowledge and expand their knowledge of philosophy and specific disciplines. The student is ready to participate in a discussion on basic ethical issues.	INj_K3_K01, INj_K3_K06
Course content ensuring the achievement of learning outcomes:		Philosophy and Its Branches: Metaphilosophical Issues: The nature and purpose of philosophy. History of Philosophy and Its Periodization: Philosophical problems from a historical perspective. Ontological Issues: Debate on the structure of being; being and consciousness. The mind-body problem. The debate on universals. The debate on the causal nature of the world. The debate on the teleological nature of the world. Epistemological Issues: Classical and non-classical concepts of truth. Knowledge: the debate on the sources and methods of knowledge, the debate on the limits of knowledge. Moral Philosophy and Philosophy of Religion: Metaethical issues. Ethics and morality; the ethical stance. Major positions in normative ethics. The debate on the existence and nature of God.	
Examination methods:		Test (written or computer based)	

Subject name:		Sociology	ECTS: 2
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	the foundations of social sciences, their place in the system of sciences and their relations to the exact and technical sciences, basic information about humans as entities creating socio-economic structures and the principles of their functioning, as well as those acting within these structures.	INj_K3_W18_inz
Skills: (In terms of skills, the graduate can)	U1	analyze socio-economic phenomena.	INj_K3_U22
Social competences: (Within the scope of competence, the graduate is ready to)	K1	using and processing information in order to acquire the knowledge necessary for personal development and functioning within the information society.	INj_K3_K01
Course content ensuring the achievement of learning outcomes:		Sociology as a Scientific Discipline: Sources and Stages of the Development of Sociology: The subject of sociological research, distinguishing sociology as scientific knowledge from non-scientific knowledge. Culture as the Foundation of Social Life: The role of cultural norms, values, and practices in shaping social interactions and structures. Social Inequalities and Power in Sociological Theories: Analysis of how power and inequality are structured and maintained in society. Social Consciousness in Sociology: Mechanisms of its formation and processes of social pathology. Social Change: Social dynamics and the processes of globalization.	
Examination methods:		Presentation, Test (written or computer based)	

Subject name:		Algorithms and Data Structures	ECTS: 6
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	basic algorithms and methods of algorithm design (divide and conquer, greedy and dynamic programming) and how to use them in programs	INj_K3_W07_inz, INj_K3_W17_inz
	W2	basic knowledge of the computational complexity of algorithms and its impact on the practical operation of information systems	INj_K3_W06_inz, INj_K3_W17_inz
Skills: (In terms of skills, the graduate can)	U1	ability to use mathematical knowledge to construct and analyze algorithms	INj_K3_U01_inz
	U2	the ability to formulate algorithms for IT tasks and to program them in practice and use dynamic data structures	INj_K3_U10_inz
	U3	ability to assess the computational complexity of algorithms and problems	INj_K3_U13_inz
Course content ensuring the achievement of learning outcomes:		Basic concepts and principles of algorithm analysis. Correctness and finiteness of algorithms. Computational and memory complexity, asymptotic notations. Methods of constructing algorithms (greedy, divide and conquer, dynamic programming). Elementary sorting methods (selection, insertion and bubble sort). Half-sort, quick and merge insertion sort. Parallel sort. Linear-time sorting algorithms. Heaps and heap sort. Elementary data structures and their array and link representation. Trees and their bracket notation. BST trees – their construction and application. Graph representation and basic algorithms on graphs – depth-first and breadth-first search. Search algorithms (sequential search, ordered sequence search, binary search, highlighted element search, median search). Pattern search algorithms. Dynamic programming (longest paths in graphs, longest increasing subsequence, longest common subsequence, edit distance, knapsack problem, matrix multiplication). Greedy algorithms (fundamentals of greedy strategy, class selection problem, Huffman codes).	
Examination methods:		Written exam, Project, Assessment of work in the laboratory	

Subject name:		Software Engineering	ECTS: 5
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	The student knows and understands issues in software engineering and databases.	INj_K3_W06_inz, INj_K3_W15_inz
	W2	The student knows and understands various software engineering tools, especially CASE.	INj_K3_W08_inz, INj_K3_W15_inz
	W3	The student knows and understands methods of developing various types of advanced software.	INj_K3_W12_inz, INj_K3_W15_inz
Skills: (In terms of skills, the graduate can)	U1	The student can develop and analyze software using CASE tools.	INj_K3_U04, INj_K3_U21_inz, INj_K3_U25_inz, INj_K3_U27_inz
	U2	The student can use extensive knowledge of analysis and modeling various processes using IT tools.	INj_K3_U05, INj_K3_U12_inz, INj_K3_U21_inz, INj_K3_U27_inz
	U3	The student can write unit and integration tests, correctly find the most common errors in the code, and perform system and acceptance tests.	INj_K3_U20_inz, INj_K3_U21_inz, INj_K3_U27_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	The student is ready to work in a team.	INj_K3_K04, INj_K3_K05
Course content ensuring the achievement of learning outcomes:		The subject includes presentation of software engineering concepts and tools from this field. IT project management methods are presented, including quality and security issues, methods and tools supporting software development (CASE), UML diagrams and issues related to software testing, from program debugging to acceptance testing. Using knowledge from lectures to write and test an application, including the negotiation stage. A group of laboratory students works together during classes on the implementation of the project.	
Examination methods:		Written exam, Project	

Subject name:		Computer Architecture	ECTS: 5
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	The structure of a modern computer system	INj_K3_W06_inz, INj_K3_W10_inz
	W2	The principles of program execution by a computer system	INj_K3_W06_inz, INj_K3_W10_inz
	W3	Classification of modern computer systems based on processing parallelism, pipeline size, and the number of execution units.	INj_K3_W06_inz, INj_K3_W10_inz
	W4	Addressing modes and their impact on the structure of machine instructions.	INj_K3_W06_inz, INj_K3_W10_inz
	W5	Structures and operating principles of cache memory.	INj_K3_W06_inz, INj_K3_W10_inz
	W6	Principles of operation and organization of main memory, as well as its management by the operating system.	INj_K3_W06_inz, INj_K3_W10_inz
	W7	Contemporary development trends in computer hardware.	INj_K3_W06_inz, INj_K3_W10_inz
Skills: (In terms of skills, the graduate can)	U1	Program in low-level languages for various computer architectures.	INj_K3_U02_inz, INj_K3_U10_inz, INj_K3_U21_inz
	U2	Integrate low-level code with high-level programming languages.	INj_K3_U02_inz, INj_K3_U10_inz, INj_K3_U21_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	Understand the rapid pace of change in computer technologies and continuously expand their knowledge and skills as part of their professional career	INj_K3_K01

Course content ensuring the achievement of learning outcomes:	History of Computer Systems. Generations of Computers and Processors: Performance gap, Moore's Law. Intel x86 Processor Assembly (via DOSBox):Organization of single-processor systems (elements of traditional computer organization). Von Neumann architecture and its modifications (Harvard architecture). Structure of processors, memory, and system bus devices. Principles of Program Execution in Computer Systems: Programming methods for CISC and RISC machines (use of processor registers, arithmetic operations, and string processing). Data representation in computer systems: binary code, integer and floating-point number representations. Binary arithmetic operations. IEEE 754 standard. Hardware Design for Arithmetic and Logical Operations: Arithmetic and logic units (ALU) and floating-point units (FPU). Use of the stack, index registers, floating-point registers, and MMX technology. Machine Instructions and Arguments: Instruction utilization, processor registers, vector computation instructions. Low-level programming: assembler, memory access modes, addressing modes in instructions, stack operations. Interaction between programs and the operating system, memory management. Addressing methods and their use in instructions. Memory Classification and Efficiency: Memory and processor efficiency, memory timing parameters. Main memory, external (virtual) memory, and cache memory. Creating assembler inserts in high-level languages. Mass Storage: Organization and management, virtual memory, physical structure of data storage on disks. Utilization of floating-point units. Input-Output Devices: Performance parameters of peripheral devices, communication methods with external devices, input-output modules, expansion buses, and DMA technology. Applications: Developing simple programs for mathematical operations and string processing. Modern Processor Organization: Pipeline, super-pipeline, and superscalar architectures. Multi-threaded and vector processors. Programming in 16- and 32-bit Modes: Using the Win32 API, comparison of RISC and CISC architectures. IA-64 architecture, MIPS 2000 processor assembly (via PC-Spim simulator).
Examination methods:	Written exam, Project, Test (written or computer based), Assessment of work in the laboratory

Subject name:		Probability and Statistics	ECTS: 5
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	basic schemes and formulas of combinatorics, introductory notions of probability theory (random experiment, elementary event (outcome), sample space, sample (random) event, σ-algebra of events, probability space), axioms of probability, properties of probability;	INj_K3_W01_inz
	W2	basic formulas and theorems of probability theory, notion of independence of sample (random) events;	INj_K3_W01_inz
	W3	notion of univariate random variable and its properties, types of univariate random variables, notion of cumulative distribution function of univariate random variable and its properties, notion of probability mass function of univariate discrete random variable and its properties, notion of probability density function of univariate continuous random variable and its properties, examples of univariate probability distributions, definitions and interpretations of numerical characteristics (parameters) of univariate random variable;	INj_K3_W01_inz
	W4	notion of bivariate random variable and its joint distribution, types of bivariate random variables, notion of marginal distribution, notion of cumulative distribution function of bivariate random variable and its properties, notion of probability mass function of bivariate discrete random variable and its properties, notion of probability density function of bivariate continuous random variable and its properties, notion of independence of two univariate random variables;	INj_K3_W01_inz
	W5	basic inequalities and limit theorems of probability theory;	INj_K3_W01_inz
	W6	key terms of statistical inference - simple random sample, sample statistic, estimator, point estimators, interval estimators (confidence intervals);	INj_K3_W01_inz
	W7	basic notions of hypothesis testing (null hypothesis, alternative hypothesis, test statistic, critical value, critical (rejection) region, significance level, power of a test, p-value), types of tests (parametric tests, nonparametric tests);	INj_K3_W01_inz
	W8	basic procedures concerning statistical tests, commonly used statistical tests;	INj_K3_W01_inz
	W9	point estimation and interval estimation of unknown parameters of probability distributions.	INj_K3_W01_inz
Skills: (In terms of skills, the graduate can)	U1	determine sample spaces and sample (random) events, conduct operations on events, identify schemes of combinatorics and use combinatorical formulas in order to calculate the corresponding probabilities;	INj_K3_U01_inz
	U2	solve problems of probability theory by using: classical probability, geometric probability, inclusion–exclusion principle, chain rule, formula for total probability, Bayes' formula, check independence of events and use Bernoulli scheme;	INj_K3_U01_inz
	U3	determine cumulative distribution functions, mass functions and density functions of univariate random variables, calculate their numerical characteristics (parameters) and probabilities related to univariate random variables;	INj_K3_U01_inz
	U4	determine joint distributions of bivariate random variables and the corresponding marginal distributions, check independence of two univariate random variables, calculate probabilities related to univariate random variables;	INj_K3_U01_inz

	U5	use basic inequalities and limit theorems of probability theory;	INj_K3_U01_inz
	U6	enumerate and define basic notions of statistical interference;	INj_K3_U01_inz
	U7	solve problems regarding the verification of statistical hypotheses;	INj_K3_U01_inz
	U8	interpret the notion interval estimator, calculate numerical confidence intervals (realizations of confidence intervals).	INj_K3_U01_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	to share the knowledge in probability theory and statistical inference with representatives of socially useful professions and areas of research.	INj_K3_K02
Course content ensuring the achievement of learning outcomes:		Random Experiments and Probability Theory Random Experiment: Definition, elementary outcomes, sets of elementary outcomes, and random events. Frequency of an Event: σ-algebra of events, probability space. Axioms of Probability and Its Properties: Classical probability. One-Dimensional Random Variables Definition of a one-dimensional random variable and its distribution. Types of random variables. Concepts of the cumulative distribution function (CDF) and probability density function (PDF). Properties of the CDF and PDF. Examples of one-dimensional random variable distributions. Properties of the normal distribution. Numerical characteristics of one-dimensional random variable distributions: expected value, variance, standard deviation, moments, and quantiles. Introduction to Statistical Inference Random Sample and Statistics from a Sample: Concepts of point estimation and estimators. Point Estimation: Examples of point estimators. Interval Estimation: Concept of a confidence interval, confidence intervals for the mean, proportion, difference of means, and difference of proportions. Introduction to Hypothesis Testing Concepts of test statistic, critical value, critical region, significance level, and power of a test. Hypothesis Testing for One and Two Populations: Tests for mean and proportion, equality of means, and equality of proportions. Chi-square goodness-of-fit test. Chi-square test of independence	
Examination methods:		Written exam, Written credit	

Subject name:		Electronics Laboratory	ECTS: 2
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	The student knows and understands the principles of connecting electronic systems in a measurement system, connecting measuring devices and reading results.	INj_K3_W03_inz, INj_K3_W04_inz
Skills: (In terms of skills, the graduate can)	U1	The student is able to connect measuring devices to an electronic system, read their readings and interpret the obtained results.	INj_K3_U03_inz, INj_K3_U04, INj_K3_U07_inz, INj_K3_U22
Social competences: (Within the scope of competence, the graduate is ready to)	K1	The student is ready for teamwork, sharing competences, responsibility and compromise solutions.	INj_K3_K02, INj_K3_K04, INj_K3_K05
Course content ensuring the achievement of learning outcomes:		Discussion of health and safety rules in the laboratory. Discussion of laboratory reports. Measurement of resistance using an ohmmeter in series, parallel and mixed circuits. Measurement of capacitor capacitance. Application of a digital multimeter to measure DC and AC voltage. Application of a digital oscilloscope to visualize and measure parameters of harmonic, rectangular and triangular/sawtooth alternating signals. Checking Kirchhoff's voltage law. Determination of characteristics of amplifier circuits. Calculation of logarithmic characteristics and their interpretation. Application of a function generator as a source of an alternating signal. Transformations of functional signals: rectangle to harmonic or sawtooth and vice versa. Integrator and differentiator circuit. Single- and multi-stage transistor circuits. Operational amplifiers: basic properties of WO, basic circuits. Application of negative feedback. Computer simulations of selected electronic circuits.	
Examination methods:		Project, Report, Assessment of work in the laboratory	

Subject name:		Forms of Economic Activity	ECTS: 2
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	basic economic concepts relating to IT investments and IT projects, such as return on investment, fixed and variable costs, financial risk, revenue and profit, and profit and cash flow.	INj_K3_W12_inz
	W2	basic issues related to running and managing a business.	INj_K3_W14_inz
Skills: (In terms of skills, the graduate can)	U1	choose the most advantageous form of running a business depending on external market conditions and internal economic factors	INj_K3_U22
	U2	prepare a comprehensive business plan for own business venture	INj_K3_U05
Social competences: (Within the scope of competence, the graduate is ready to)	K1	conducting economic analyses of business entities operating in various industries	INj_K3_K06
	K2	taking action to organize own business activity	INj_K3_K04
Course content ensuring the achievement of learning outcomes:		Socio-economic phenomena and processes shaping the modern economy. Economic activity, entrepreneur, enterprise – essence, basic characteristics and functions in the organization and socio-economic system. Motives and goals of undertaking economic activity. Entities conducting economic activity – organizational and legal forms of enterprises operating in the modern economy. An enterprise of a natural person as an individual economic activity of an entrepreneur. Commercial law companies: partnerships, capital companies. Cooperatives and other forms of economic activity. External and internal conditions for undertaking economic activity, its conduct and development. Economic freedom and liberty in a market economy and restrictions on conducting business activity: concessions, licenses, consents and permits for economic activity, public and legal obligations of enterprises. Economic and financial information on the activities of an economic entity – needs and obligations in the scope of collecting information for various groups of recipients. Scope, methods and detail of basic groups of information on the financial status, assets and course of conducted activity. Information on types of socio-economic activity - Polish Classification of Activities. Legal forms and general conditions for conducting business activity in European Union countries (selected examples). Social, economic and legal determinants of conducting business activity. Principles of starting, conducting and liquidating business activity in an individual's enterprise and in civil partnerships. Procedures related to starting and conducting business activity, formal requirements and public-law obligations and similarities and differences in commercial law companies: general partnerships, professional partnerships, limited partnerships, limited joint-stock partnerships, limited liability companies and joint-stock companies - organization and functioning. Resources and finances of the economic entity and their characteristics. Sources and forms of financing business activity on the example of selected business entities. Financial statement as a synthesis of basic information on the structure of assets, financial situation and effects of business activity. Preliminary analysis of the financial situation and results of the enterprise's activity. Tax and non-tax burdens of entities conducting business activity. Factors shaping the economic activity of entities operating in Poland. Development opportunities and barriers in conducting business activity for small and medium-sized enterprises.	
Examination methods:		Test (written or computer based), Project, Presentation	

Subject name:		Building Internet Services	ECTS: 2
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	the principle of operation of the client-server technology	INj_K3_W06_inz
	W2	basics of internet languages and technologies	INj_K3_W09_inz
Skills: (In terms of skills, the graduate can)	U1	Select the appropriate technology to solve a specific problem.	INj_K3_U17_inz
	U2	Use databases in the development of web services.	INj_K3_U17_inz, INj_K3_U19_inz
	U3	Create a simple user interface.	INj_K3_U18_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	Independent expansion of knowledge in internet technologies.	INj_K3_K02
Course content ensuring the achievement of learning outcomes:		Introduction to client-server technology. Introduction to HTML. Structure of a webpage in HTML (tables). Forms and their elements in HTML. Cascading Style Sheets (CSS). Introduction to JavaScript. Data validation using JavaScript and regular expressions. Basics of XSL+XML. Introduction to PHP. Sessions in PHP – implementing login functionality. PHP – connecting to a MySQL database – creating a database application. Introduction to ASP.NET. Creating a web application in ASP.NET. CMS systems.	
Examination methods:		Project	

Subject name:		Physical education	ECTS: 0
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	how physical exercise affects the development and functioning of the body.	
	W2	the aspects of morphological, anatomical and physiological foundations of the functioning of the human body and the consequences and risks associated with lack of physical activity.	
	W3	how physical activity affects health at every stage of life.	
	W4	the relationship between effort and systematic work and the effect obtained.	
Skills: (In terms of skills, the graduate can)	U1	analyze the level of own physical fitness, correctly interpret and identify problems occurring during the performance of tasks and make the right decisions to solve them.	
	U2	prepare the body for the effort, control and assess the state of the body's efficiency, use the acquired movement habits in the correct performance of everyday motor activities.	
	U3	use various forms of physical activity taking into account the current state of health, physical capabilities and age.	
	U4	cooperate in a team with commitment and full responsibility in order to achieve a specific result.	
	U5	undertake tasks adequate to their own talents and abilities.	
Social competences: (Within the scope of competence, the graduate is ready to)	K1	control their own physical development at every stage, taking care of the body in health and illness.	
	K2	build social relationships and knows how to use it to achieve individual and team goals.	
	K3	take responsibility for the state of their own health and that of others, including their own family in the future.	
Course content ensuring the achievement of learning outcomes:		Familiarizing the student with safety rules in physical education classes. Provide the student with basic movements, movement and body function during the selected motor activity. Familiarizing the student with the rules and regulations in the selected sport discipline. Familiarizing the student with the organization and conduct of competitions as part of the selected physical activity.	
Examination methods:		Assessment of activity during classes	

Subject name:		English	ECTS: 6
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Skills: (In terms of skills, the graduate can)	U1	describe phenomena, processes and procedures	INj_K3_U30
	U2	correspond and take notes	INj_K3_U30
	U3	provide explanations, give reasons, express opinions or present plans	INj_K3_U30
Social competences: (Within the scope of competence, the graduate is ready to)	K1	prepare and give a presentation	INj_K3_K07
	K2	work in a group and discuss	INj_K3_K05
	K3	communicate in most everyday and professional situations without preparation	INj_K3_K07
Course content ensuring the achievement of learning outcomes:		Vocabulary related to education, work, science, health, culture and entertainment, sports, technology, information exchange, and the environment. Grammatical structures: correct use of word forms and sentence constructions, word formation. Language functions: practicing communication, pronunciation, and spelling.	
Examination methods:		Test (written or computer based), Assessment of activity during classes	

Subject name:		German	ECTS: 6
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Skills: (In terms of skills, the graduate can)	U1	describe phenomena, processes and procedures	INj_K3_U30
	U2	correspond and take notes	INj_K3_U30
	U3	provide explanations, give reasons, express opinions or present plans	INj_K3_U30
Social competences: (Within the scope of competence, the graduate is ready to)	K1	prepare and give a presentation	INj_K3_K07
	K2	work in a group and discuss	INj_K3_K05
	K3	communicate in most everyday and professional situations without preparation	INj_K3_K07
Course content ensuring the achievement of learning outcomes:		Vocabulary related to education, work, science, health, culture and entertainment, sports, technology, information exchange, and the environment. Grammatical structures: correct use of word forms and sentence constructions, word formation. Language functions: practicing communication, pronunciation, and spelling.	
Examination methods:		Test (written or computer based), Assessment of activity during classes	

Subject name:		Russian	ECTS: 6
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Skills: (In terms of skills, the graduate can)	U1	describe phenomena, processes and procedures	INj_K3_U30
	U2	correspond and take notes	INj_K3_U30
	U3	provide explanations, give reasons, express opinions or present plans	INj_K3_U30
Social competences: (Within the scope of competence, the graduate is ready to)	K1	prepare and give a presentation	INj_K3_K07
	K2	work in a group and discuss	INj_K3_K05
	K3	communicate in most everyday and professional situations without preparation	INj_K3_K07
Course content ensuring the achievement of learning outcomes:		Vocabulary related to education, work, science, health, culture and entertainment, sports, technology, information exchange, and the environment. Grammatical structures: correct use of word forms and sentence constructions, word formation. Language functions: practicing communication, pronunciation, and spelling.	
Examination methods:		Test (written or computer based), Assessment of activity during classes	

Subject name:		Spanish	ECTS: 6
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Skills: (In terms of skills, the graduate can)	U1	describe phenomena, processes and procedures	INj_K3_U30
	U2	correspond and take notes	INj_K3_U30
	U3	provide explanations, give reasons, express opinions or present plans	INj_K3_U30
Social competences: (Within the scope of competence, the graduate is ready to)	K1	prepare and give a presentation	INj_K3_K07
	K2	work in a group and discuss	INj_K3_K05
	K3	communicate in most everyday and professional situations without preparation	INj_K3_K07
Course content ensuring the achievement of learning outcomes:		Vocabulary related to education, work, science, health, culture and entertainment, sports, technology, information exchange, and the environment. Grammatical structures: correct use of word forms and sentence constructions, word formation. Language functions: practicing communication, pronunciation, and spelling.	
Examination methods:		Test (written or computer based), Assessment of activity during classes	

Subject name:		Database Technologies	ECTS: 6
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	Has detailed knowledge of relational database design and programming.	INj_K3_W07_inz
	W2	Has a basic knowledge of the SQL standard.	INj_K3_W10_inz, INj_K3_W17_inz
	W3	Has basic knowledge of methods of collecting, processing and analyzing data (regardless of its origin) and drawing conclusions based on it.	INj_K3_W18_inz
Skills: (In terms of skills, the graduate can)	U1	Can obtain information from literature, databases and other sources, integrate it, interpret it, and draw conclusions and form opinions on IT problems and proposed solutions.	INj_K3_U03_inz
	U2	Has the ability to build simple database systems, using at least one of the most popular database management systems, and has the ability to maintain database systems.	INj_K3_U19_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	Understands the speed of the process of change in computer technology; is prepared to continuously expand his knowledge and skills in his professional work.	INj_K3_K01
Course content ensuring the achievement of learning outcomes:		Lecture topics: Introduction to SQL Server 2016 environment. Basic tools. SQL language, its application, and syntax. Extracting data from databases. Filtering data and formatting results. System functions and procedures. Displaying metadata and information about SQLOS. Modifying data and working with transactions. Working with database objects. Laboratory exercise topics: Elements of SQL Server Management Studio, working with projects and files. Working with sqlcmd. Simple queries. Formatting and filtering results. Working with system functions. Grouping data, ROLLUP, and CUBE clauses. Modifying data. Working with transactions. System and user procedures. Working with user-defined functions. Working with database objects. Creating scripts.	
Examination methods:		Written exam, Assessment of activity during classes	

Subject name:		Operating Systems	ECTS: 5
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	The student knows and understands topics related to data structures, computational complexity of problems, and algorithms used to solve them; computer system architecture; operating systems; networking technologies; programming languages and paradigms; graphics and human-computer interaction; artificial intelligence; databases; software engineering; and embedded systems.	INj_K3_W06_inz, INj_K3_W15_inz
	W2	The student knows and understands the basic methods, techniques, and tools used in solving simple IT tasks related to the analysis of algorithmic computational complexity, computer system architecture, operating systems, computer networks, programming language implementation, computer graphics, artificial intelligence, databases, software engineering, and embedded systems.	INj_K3_W09_inz, INj_K3_W15_inz
Skills: (In terms of skills, the graduate can)	U1	The student is able to communicate effectively using various techniques in professional environments and other settings, including the use of IT tools.	INj_K3_U05
	U2	The student is able to plan and conduct simulation and practical experiments, interpret the results obtained, and draw conclusions.	INj_K3_U07_inz
	U3	The student is able to work with operating systems at the API level and as a system administrator.	INj_K3_U14_inz, INj_K3_U23_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	The student is prepared to provide examples and understands the causes of malfunctioning IT systems that have led to significant financial, social, or even severe health-related consequences, including loss of life.	INj_K3_K03
Course content ensuring the achievement of learning outcomes:		Introduction to Operating Systems: Definitions, history, and the role of operating systems. Architecture of Operating Systems Monolithic, microkernel, hybrid systems. Process Management: Process lifecycle, process scheduling, inter-process communication. Multithreading Threads, modeling, synchronization. Memory Management Virtual memory, segmentation, paging. File System Management Hierarchy, access rights, file systems. Device Drivers Introduction, interaction with the operating system, writing drivers. Security in Operating Systems Security policies, protection mechanisms, system auditing. Real-Time Operating Systems (RTOS) Characteristics, applications, RTOS systems. Networking in Operating Systems Network protocols, TCP/IP, network management. Virtualization and Containerization Introduction, technologies, applications. Distributed Operating Systems Architecture, communication, data consistency. Open-Source Operating Systems Linux, FreeBSD, applications and comparison. Operating Systems for Mobile Devices Android, iOS, Linux-based operating systems. New Trends in Operating Systems Operating systems for cloud computing, IoT, and big data.	
Examination methods:		Written exam, Assessment of work in the laboratory	

Subject name:		Numerical Methods	ECTS: 5
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	The student knows and understands the causes of calculation errors and their impact on the accuracy of calculations	INj_K3_W01_inz
	W2	The student knows and understands the mathematical foundations of numerical methods used to perform interpolation and mean square approximation, solving systems of linear and nonlinear equations, basic decompositions of matrices into matrix products, determining the eigenvalues and eigenvectors of matrices, numerical integration, solving ordinary differential equations.	INj_K3_W01_inz, INj_K3_W06_inz
Skills: (In terms of skills, the graduate can)	U1	The student is able to solve a simple mathematical problem in the form of a numerical algorithm.	INj_K3_U01_inz, INj_K3_U08_inz
	U2	The student is able to distinguish basic numerical methods according to their complexity and computational precision	INj_K3_U02_inz, INj_K3_U08_inz, INj_K3_U13_inz
	U3	The student is able to write a simple numerical algorithm in the Python programming language.	INj_K3_U10_inz, INj_K3_U29_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	The student is ready to independently analyze and solve simple computational tasks	INj_K3_K06
Course content ensuring the achievement of learning outcomes:		Floating-Point Arithmetic: Computational Errors: Analysis of errors in numerical methods. Conditioning of Numerical Problems: Understanding stability and sensitivity of problems. Computational Complexity of Algorithms: Evaluation of algorithm efficiency. Basic Algorithms: Heron's algorithm, Horner's scheme. Exact Methods for Solving Systems of Linear Equations: Gaussian elimination and Gauss-Jordan elimination. Choice of pivot element. LU decomposition and Cholesky-Banachiewicz decomposition. Iterative Methods for Solving Linear Systems: Richardson method. Jacobi method. Gauss-Seidel method. Least Squares Approximation: Least Squares Method and its Generalization. Orthogonal polynomials. Nonlinear Equations: Convergence and efficiency of methods. Methods: Bisection, Newton's method, Secant method. Stopping criteria. Multidimensional Methods: Multidimensional Newton’s method. Optimization Using Derivatives of Functions: Golden Section Method. Bisection Method. Newton’s method and Secant method. Multidimensional Newton’s method. Quadratures: Basic methods: rectangle rule, trapezoidal rule. Newton-Cotes Quadrature: Composite trapezoidal rule, Simpson’s rule. Gaussian Quadrature: Advanced integration methods. Monte Carlo Quadrature: Integral mean of a function, hit-or-miss method. Eigenvalue Problems: Power method for finding eigenvalues. Jacobi and QR methods:Gram-Schmidt orthogonalization. Householder transformation. Givens rotations. Differential Equations: Explicit Euler method. Runge-Kutta scheme.	
Examination methods:		Test (written or computer based), Written credit	

Subject name:		Graphs and Networks	ECTS: 3
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	fundamentals of graph theory, methods of construction and cost analysis of graph algorithms	INj_K3_W01_inz, INj_K3_W07_inz
	W2	basic graph algorithms used to formulate and solve simple computer tasks	INj_K3_W06_inz
Skills: (In terms of skills, the graduate can)	U1	is able to use acquired mathematical knowledge to describe processes, create models and perform other activities in the field of computer science using graph algorithms.	INj_K3_U01_inz
	U2	has the ability to formulate algorithms and program them using at least one of the popular tools and design environments	INj_K3_U10_inz
	U3	is able to assess the computational complexity of algorithms and problems, plan and conduct simulation experiments	INj_K3_U13_inz
Course content ensuring the achievement of learning outcomes:		Introduction to graph and network theory. Definitions of simple graphs and multigraphs: graph part, subgraph, empty and full subgraphs, graph basis, route, path, road, cycle, distances, vertex degrees, methods of describing graphs. Properties of graph classes: Eulerian graphs, Hamiltonian graphs, bipartite and planar graphs, notions of separation points, bridges and cuts. Basic graph algorithms: breadth-first search, depth-first search, topological sorting. Graph connectivity: edge classification. Connectivity of undirected graphs: cyclic paths in digraphs, strong digraph connectivity. Strongly connected components of a digraph. Shortest paths: Dijkstra's algorithm, Bellman-Ford algorithm, single-source shortest paths in directed acyclic graphs, shortest paths between all pairs of vertices. Floyd-Warszall algorithm. Trees: the concept of forests, properties of trees, minimum spanning trees, Kruskal's and Prim's algorithms. Flows and capacities in networks: flow networks. Maximum flow: Ford-Fulkerson method, maximum matching in bipartite graphs. Issues related to graph coloring: minimal covers of sets, matchings and coverings in graphs, graph chromatics. Estimation of the chromatic number, graph coloring methods.	
Examination methods:		Written exam, Written credit, Project	

Subject name:		Intellectual property protection	ECTS: 1
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	The student knows and understands the basic concepts of intellectual property and the regularities and connections that govern them.	INj_K3_W10_inz, INj_K3_W13_inz
Skills: (In terms of skills, the graduate can)	U1	The student is able to find the necessary information in collections of legal acts and has the skills to use the acquired knowledge in practice	INj_K3_U03_inz, INj_K3_U22, INj_K3_U24_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	The student is ready to use in practice the knowledge acquired in the field of intellectual property protection and seek cooperation with experts in the event of difficulties in solving the problem independently	INj_K3_K02, INj_K3_K04, INj_K3_K06
Course content ensuring the achievement of learning outcomes:		As part of the lecture hours, students are introduced to fundamental issues in the field of intellectual property protection, including copyright and related rights, industrial property law, database protection, combating unfair competition and monopolistic practices, as well as authorities responsible for granting exclusive rights.	
Examination methods:		Written credit	

Subject name:		Data Analysis Methods	ECTS: 2
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	Practical issues in which methods of linear ordering of multidimensional objects and issues of clustering /classification are used, understand the theoretical basis of selected methods of data analysis	INj_K3_W16_inz, INj_K3_W18_inz
	W2	Principles of diagnostic feature selection, data acquisition and transformation, knows basic techniques for visualizing multivariate data, filling missing data and removing outliers	INj_K3_W16_inz, INj_K3_W18_inz
Skills: (In terms of skills, the graduate can)	U1	Apply selected methods of data analysis, using the R package or the Python language, and choose the right method to analyze a specific practical problem	INj_K3_U28_inz, INj_K3_U29_inz
	U2	Use Excel/R/Python related to data analysis, can apply appropriate machine learning methods to selected practical problems	INj_K3_U28_inz, INj_K3_U29_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	Apply selected multidimensional data analysis	INj_K3_K05
	K2	Work in a team as a leader as well as a team member.	INj_K3_K05
Course content ensuring the achievement of learning outcomes:		Elements of Multidimensional Data Analysis Methods of Feature Selection: Diagnostic feature selection, normalization, and feature weighting. Methods of Linear Ordering of Objects: Synthetic indicators and synthetic development indicators. Unsupervised Clustering Methods: Cluster analysis methods: hierarchical, k-means, model-based, multivariate normal distribution. Linear and logistic regression. Selected Classification Methods (Supervised) LDA (Linear Discriminant Analysis), QDA (Quadratic Discriminant Analysis), Fisher's method, SVM (Support Vector Machines), decision trees, random forests, boosting classifiers. Data Reduction Methods Principal Component Analysis (PCA), Correspondence Analysis, Factor Analysis. Introductory Information on Basket Analysis and Bayesian Networks. Preparation for Student Projects and Own Analyses Creating indicator variables, analyzing atypical observations, handling missing data (EXCEL/R/Python). Regression Analysis, Clustering, Classification, PCA, Factor Analysis, Correspondence Analysis (EXCEL/R/Python). Data Visualization Techniques (EXCEL/R/Python).	
Examination methods:		Test (written or computer based), Project	

Subject name:		Confirmation of B2 Foreign Language	ECTS: 1
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Skills: (In terms of skills, the graduate can)	U1	use a foreign language at the B2 level.	INj_K3_U06, INj_K3_U30
Course content ensuring the achievement of learning outcomes:		Independent preparation for taking a foreign language exam at B2 level	
Examination methods:		Written exam	

Subject name:		Algorithms theory	ECTS: 4
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	general issues related to the computational complexity of computational problems and the algorithms used to solve them	INj_K3_W06_inz
	W2	theoretical foundations of algorithms, formal languages and their connections with practical aspects of algorithms and programming paradigms	INj_K3_W17_inz
Skills: (In terms of skills, the graduate can)	U1	to use acquired mathematical knowledge to describe processes, create models, record algorithms and other activities in the field of computer science	INj_K3_U01_inz
	U2	to formulate algorithms and program them using at least one of the popular tools and design environments	INj_K3_U10_inz
	U3	to assess the computational complexity of algorithms and problems	INj_K3_U13_inz
Course content ensuring the achievement of learning outcomes:		Introduction. Basic concepts and properties of algorithms. Principles of algorithm analysis, classes of tasks, types of algorithms, methods of algorithm design. Basic models of computation: complexity of algorithms; recursive functions; random-access memory (RAM) machine. Formal grammars and languages: alphabets and languages; finite representations of languages. Finite-state automata: deterministic finite-state automata; nondeterministic finite-state automata; finite-state automata and regular expressions; algorithms for finite-state automata. Context-free languages: context-free grammars; algorithms for context-free grammars. Turing machines: Turing machine as the simplest model of computation: extensions of Turing machine; random-access memory Turing machine; grammars; numerical functions. Undecidability: Church–Turing thesis, universal Turing machines; algorithmic unsolvable problems. Computational complexity: class P; class NP; NP-complete problems	
Examination methods:		Written exam, Written credit, Project	

Subject name:		Fundamentals of teleinformatics	ECTS: 3
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	basics of signal theory.	INj_K3_W02_inz, INj_K3_W03_inz
	W2	basics of information theory.	INj_K3_W01_inz, INj_K3_W05_inz
	W3	basics of fiber optic technology.	INj_K3_W02_inz
Skills: (In terms of skills, the graduate can)	U1	design the architecture of a data transmission system between computer devices.	INj_K3_U01_inz, INj_K3_U07_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	conceptual work in the field of transmitting information using teleinformatics technologies.	INj_K3_K01, INj_K3_K05, INj_K3_K06
Course content ensuring the achievement of learning outcomes:		Lecture topics. Phenomena of electric current flow in RLC circuits. Optical phenomena in geometric and wave approach. Maxwell's equations. Types of transmission media - copper and fiber optic cables, radio and satellite communication. Fundamentals of signal theory. Analog and digital signals. Signal sampling, Shannon criterion, signal compression, delta coding. Analog-to-digital and digital-to-analog signal processing. Modulation and detection issues. Teletransmission systems - linear coding, PCM, ATM, PDH, SDH networks. Data protection and archiving, basics of cryptography. Laboratory exercises topics. Computer simulations of fiber optic mode formation, transmission bandwidth, coding, frequency characteristics of signals and transmission channels. Measurements in teleinformatic networks. Examination of electrical connections and attenuation of symmetrical and coaxial teletransmission paths. Study of transmission properties of optical fibers. Data transmission methods using this medium.	
Examination methods:		Written credit, Assessment of work in the laboratory	

Subject name:		Software Architecture	ECTS: 4
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	technologies and tools to support the design and development of software architecture. Has knowledge of software architecture design using quality attributes.	INj_K3_W09_inz
	W2	knowledge of the information system business cycle.	INj_K3_W12_inz
Skills: (In terms of skills, the graduate can)	U1	should analyze the software architecture of information system based on module decomposition . Knows how to document the software architecture. Knows how to evaluate the architecture of existing systems.	INj_K3_U21_inz, INj_K3_U26_inz
	U2	design a software architecture model based on the UML notation and modular decomposistion, refactor and modify a software architecture of simple systems.	INj_K3_U12_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	implementation of software projects based on the designed software architecture.	INj_K3_K06
Course content ensuring the achievement of learning outcomes:		Lecture: The Business Cycle of Architecture Creation. What is Software Architecture? Understanding Quality Attributes. Achieving Quality Features. Designing Architecture. Documenting Architecture. Architecture Reconstruction. Modular Decomposition. Case Studies. Laboratories: UML Diagrams in Architecture Design. 4+1 View Model of Architecture. Design Patterns – Practical Applications. Client-Server Architecture. Modular Decomposition. MVC Architecture. ASP.NET MVC. Analysis of the Architecture of Sample Systems. Project: Designing Architecture and Developing a Simple System.	
Examination methods:		Test (written or computer based), Project, Assessment of work in the laboratory	

Subject name:		Component Programming	ECTS: 3
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	specificities of procedural, object-oriented and component-oriented programming paradigms in the selected programming language.	INj_K3_W08_inz
	W2	concept of program component and the basics of creating and using the selected component technology.	INj_K3_W08_inz
Skills: (In terms of skills, the graduate can)	U1	create programs using procedural, object-oriented and component-oriented paradigms, including design, manufacture, implementation and maintenance of software components using the selected component technology.	INj_K3_U10_inz
	U2	design complex applications using self-created objects and components, including reusable modules with the usage of selected programming language.	INj_K3_U04, INj_K3_U17_inz, INj_K3_U18_inz, INj_K3_U20_inz
	U3	find and eliminate dependencies between parts of the software.	INj_K3_U20_inz
Course content ensuring the achievement of learning outcomes:		Reminder of the basics of procedural programming in a selected programming language: data input and output, conditional statement, WHILE iteration statement, FOR iteration statements, sequences – strings, tuples, lists and dictionaries, functions and their use to create your own modules and packages, programs with positional arguments, exception handling, file operations. Reminder of the basics of object-oriented programming in a selected programming language: classes, methods, objects and fields, constructors and class attributes, polymorphism and inheritance. Creating GUI graphical interfaces using a selected programming language as an example of using the object-oriented programming paradigm. Use of graphical and multimedia elements. he concept of an interface. Examples of using interfaces in object-oriented programming. Introduction to component programming. Theory and engineering of component software. Inverted control pattern. The concept and role of a container. Review of selected component technologies. Use of an appropriate package (library) of a selected programming language to create components. Types of components and their use. Component life cycle. Component versioning. Creating applications in the selected component technology.	
Examination methods:		Test (written or computer based), Project, Practical colloquium checking programming skills	

Subject name:		Computer Networks	ECTS: 6
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	principles of operation and basic characteristics of networks computer networks	INj_K3_W05_inz, INj_K3_W06_inz
	W2	basic methods of configuring devices active in computer networks	INj_K3_W11_inz
Skills: (In terms of skills, the graduate can)	U1	Assess the performance of existing network connections	INj_K3_U15_inz, INj_K3_U17_inz
	U2	Create, configure simple LAN, WAN networks.	INj_K3_U10_inz, INj_K3_U15_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	Interaction and teamwork.	INj_K3_K04
Course content ensuring the achievement of learning outcomes:		Introduction to computer networks, history of networks, directions of development. Types and physical topologies of networks, structured network cabling, standards, wired media. OSI models and the TCP/IP model. Ethernet networks. Technologies and functioning of packet networks. IPv4 and IPv6 protocols, IP addresses, network masks, division into subnets. VLSM addressing and network division. Switched networks, VLAN segmentation. Dynamic routing. Distance vector routing protocols, features, metrics. Dynamic routing. Link state routing protocols, features, metrics. WiFi networks, 802.11 standards, security. DHCP protocol, address translation. QoS transmission quality. Security mechanisms in computer networks. Division of computer networks, address, mask, broadcast. Study and analysis of network traffic, wireshark analyzer. Physical layer design, standards. IOS operating system, configuration. Switch configuration, VLAN networks. Static routing configuration. Dynamic routing configuration. DHCP server configuration. Network services. Security mechanisms in computer networks. Computer network project - case study.	
Examination methods:		Written exam, Assessment of work in the laboratory	

Subject name:		Digital Techniques and Embedded Systems Fundamental	ECTS: 5
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	how combinational and sequential digital circuits (synchronous and asynchronous), ROM and RAM semiconductor memories, analog-to-digital and digital-to-analog converters work.	INj_K3_W04_inz
Skills: (In terms of skills, the graduate can)	U1	design various classes of combinational and sequential digital automata.	INj_K3_U02_inz
	U2	perform minimization of the logical function for a given digital circuit.	INj_K3_U01_inz
	U3	identify and eliminate unfavorable phenomena occurring during the operation of a digital machine, such as race phenomena.	INj_K3_U07_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	conceptual work in the field of digital systems, both individually and in groups.	INj_K3_K05
Course content ensuring the achievement of learning outcomes:		Lecture topics: Introduction to digital technology, Boolean algebra, transformation of Boolean expressions. Minimization of Boolean functions (Karnaugh maps). Synthesis of combinational circuits. Combination digital automata (circuits) - multiplexers and demultiplexers. Dynamics of digital automata, hazard and race phenomena. Code converters. Sequential digital automata (circuits). Asynchronous sequential automata. Synchronous sequential automata. Registers and counters. Analog-to-digital and digital-to-analog converters. Laboratory topics: the laboratory will in a practical way deepen the theoretical knowledge obtained during the lecture in the field of synthesis, analysis and launching of various classes of digital automata - combinational and sequential. The hazard and race phenomena in digital automata and methods of computer design of digital devices will be discussed. The topics of the exercises include research and design of digital circuits.	
Examination methods:		Written credit, Assessment of work in the laboratory	

Subject name:		Programming Paradigms	ECTS: 4
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	methods of building algorithms using various programming paradigms	INj_K3_W09_inz, INj_K3_W17_inz
	W2	basic algorithmic paradigms	INj_K3_W06_inz, INj_K3_W07_inz, INj_K3_W08_inz, INj_K3_W17_inz
	W3	general programming issues, algorithms and their computational complexity	INj_K3_W09_inz, INj_K3_W17_inz
	W4	topics of different programming paradigms and programming languages (imperative, object-oriented, functional, logical, script, virtual machine, translation basics, declarations and types, dereferencing, abstraction mechanisms); student knows the methods in detail object-oriented design and programming (encapsulating and hiding information, classes and subclassing, inheritance, polymorphism, class hierarchies)	INj_K3_W09_inz, INj_K3_W17_inz
Skills: (In terms of skills, the graduate can)	U1	student writes, runs and tests programs in the selected programming environment	INj_K3_U02_inz, INj_K3_U11, INj_K3_U27_inz
	U2	student independently plans and implements the own learning throughout the life	INj_K3_U05
	U3	student assesses the usefulness of different paradigms and related programming environments to solve different types of problems	INj_K3_U09_inz, INj_K3_U11, INj_K3_U16_inz, INj_K3_U27_inz
	U4	student creates an interpreter of a simple programming language	INj_K3_U28_inz
	U5	student is able to plan and organize work individually and in a team, also of an interdisciplinary nature; manages the time and takes action commitments and meeting deadlines	INj_K3_U11, INj_K3_U27_inz, INj_K3_U29_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	working with intellectual honesty in one's own and other people's actions; observing the principles of professional ethics and demanding the same from others, and caring for the achievements and traditions of the IT profession	INj_K3_K02
	K2	recognizing the importance of knowledge in solving cognitive and practical problems and searching for information in the literature and seeking expert opinions	INj_K3_K03
Course content ensuring the achievement of learning outcomes:		Procedural programming. Functional programming. Imperative programming. Object-oriented programming. Visual programming. Generalized programming. Event-driven programming. Logical programming (Prolog). Aspect-oriented programming (AspectJ). Declarative programming. Agent-oriented programming. Algorithmic paradigms: machine learning. Algorithmic paradigms: recurrent neural networks. Algorithmic paradigms: convolutional neural networks. Algorithmic paradigms: generative adversarial neural networks.	
Examination methods:		Written credit, Assessment of work in the laboratory, Case, Report	

Subject name:		Internships	ECTS: 4
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	IT issues, which are the subject of the tasks carried out in the practice; basic techniques, methods and IT tools used in the performance of tasks.	INj_K3_W01_inz, INj_K3_W04_inz, INj_K3_W05_inz, INj_K3_W06_inz, INj_K3_W07_inz, INj_K3_W08_inz, INj_K3_W09_inz, INj_K3_W10_inz, INj_K3_W13_inz, INj_K3_W15_inz, INj_K3_W16_inz, INj_K3_W17_inz, INj_K3_W18_inz
Skills: (In terms of skills, the graduate can)	U1	Properly diagnose and solve simple IT tasks, using various tools; analyze and evaluate the usefulness of information systems, coming from different departments of the enterprise and formulate correct conclusions and decisions based on them; develop teamwork skills; diagnose and solve problems related to the IT profession.	INj_K3_U01_inz, INj_K3_U03_inz, INj_K3_U04, INj_K3_U05, INj_K3_U06, INj_K3_U08_inz, INj_K3_U22, INj_K3_U24_inz, INj_K3_U26_inz, INj_K3_U27_inz, INj_K3_U28_inz, INj_K3_U29_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	to further his education and is able to do so effectively; to complete in the workplace and improve his acquired knowledge and skills in an entrepreneurial manner; to demonstrate responsibility for his own work and that of his team members, to demonstrate an ethical attitude in the workplace, to communicate with people from different departments, organizations and backgrounds; to correctly identify and solve dilemmas related to the practice of the IT profession.	INj_K3_K01, INj_K3_K02, INj_K3_K03, INj_K3_K04, INj_K3_K05, INj_K3_K06
Course content ensuring the achievement of learning outcomes:		The scope of the internship may include: Working in a team preparing utility software. Working in a team responsible for IT support within the company. Working in a team analyzing empirical data. Working in various administrative units to familiarize with issues and work methods. Assisting in managing a local computer network and software. Other tasks assigned by the company manager.	
Examination methods:		Report	

Subject name:		Information Protection and Computer System Security	ECTS: 5
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	how to identify typical vulnerabilities and threats occurring in information systems, knows basic information protection mechanisms, including cryptographic methods, authentication mechanisms, access control methods, information exchange protocols, etc.	INj_K3_W11_inz
Skills: (In terms of skills, the graduate can)	U1	analyse typical vulnerabilities and threats occurring in information systems, is able to formulate security requirements, select security mechanisms at the level of applications, operating systems and networks.	INj_K3_U15_inz, INj_K3_U16_inz, INj_K3_U21_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	works in a team, knows the rules of professional ethics	INj_K3_K05
Course content ensuring the achievement of learning outcomes:		Introduction to information protection (security properties, authentication and authorization, the concept of trust and credibility, threats and attacks). Information system security management; risk analysis and assessment, risk treatment, security policy, business continuity management, basics of symmetric and asymmetric cryptography, symmetric and asymmetric cryptography, advanced cryptographic protocols. Data authentication and access control methods. Secure communication protocols (SSL/TLS, SSH, HTTPS protocols, attacks on the TLS protocol, IPsec and VPN protocols). Study of the operation and properties of cryptographic ciphers, symmetric and asymmetric cryptography. Securing information exchange (e.g. e-mail). Secure communication protocols.	
Examination methods:		Written exam, Assessment of work in the laboratory	

Subject name:		Internet Programming	ECTS: 4
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	How client-server technology works	INj_K3_W10_inz
	W2	the concept of client technology	INj_K3_W10_inz
	W3	basic frameworks used on the application side (Server side)	INj_K3_W10_inz
	W4	basics of ASP.NET and MVC .NET technologies	INj_K3_W10_inz
	W5	basics of rights and restrictions related to creating web applications	INj_K3_W10_inz
Skills: (In terms of skills, the graduate can)	U1	build a basic website structure	INj_K3_U17_inz
	U2	design and implement website layouts	INj_K3_U17_inz
	U3	add cascading style sheets to the page	INj_K3_U18_inz
	U4	use JavaScript	INj_K3_U18_inz
	U5	determine the direction of technology development and search for the latest knowledge in the field of creating web applications	INj_K3_U27_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	assessment and verification of the need and usefulness of individual elements of the prepared website in relation to their application	INj_K3_K03
Course content ensuring the achievement of learning outcomes:		Introduction, Web Applications, Websites. Page Layout, HTML5 and CSS3. JavaScript - client-side scripting language. Responsive Web Design, Preprocessors, Advanced page layout. Regular expressions in JavaScript, form validation and custom actions on the page. Introduction to Server Communication POST, GET, SOAP and other related communication methods. Server side languages C# ASP .NET and MVC .NET, JavaScript Node.JS, PHP (Zend), Python (Django). Communication with Databases and User Authentication. Presentation of projects made during the course.	
Examination methods:		Test (written or computer based), Project, Assessment of work in the laboratory	

Subject name:		Data Processing Systems	ECTS: 4
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	knows the structure of a modern data processing system	INj_K3_W18_inz
	W2	knows and understands individual data transformations	INj_K3_W07_inz
	W3	Can administer the data processing system	INj_K3_W18_inz
Skills: (In terms of skills, the graduate can)	U1	Can use Integration Services at the user level - creating and running packages	INj_K3_U01_inz, INj_K3_U02_inz, INj_K3_U19_inz
	U2	Can configure, secure and run packages periodically	INj_K3_U08_inz, INj_K3_U19_inz
Course content ensuring the achievement of learning outcomes:		Data processing and analysis systems (SPD) – definitions, functions and characteristics of components. Evaluation of systems in the aspects of: creating models and data analysis. Architecture of data processing systems (SPD). Multidimensional data model, SPD logical models. Creation of SPD schemas based on requirements. ETL - data extraction, transformation and loading part 1. ETL - data extraction, transformation and loading part 2. Query processing and optimization. Basics of creating reports in SQL Server Reporting. Graphical presentation of analyzed data.	
Examination methods:		Test (written or computer based), Written credit	

Subject name:		Data Warehouses	ECTS: 3
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	Has extended knowledge of methods and tools , including techniques for obtaining quantitative and qualitative data, derived from observations of socio-economic, natural phenomena and surveys, appropriate for the study of computer science and econometrics, allowing to describe and study economic structures and institutions, as well as the processes in and between them with the help of advanced techniques (including using multi-equation models, autoregressive models, computer simulation techniques, etc.)	INj_K3_W05_inz, INj_K3_W07_inz
	W2	Has extended and structured knowledge of algorithms and their computational complexity, computer systems architecture, operating systems, network technologies, programming languages and paradigms, artificial intelligence, databases, software engineering	INj_K3_W06_inz
	W3	Has expanded knowledge of methods, techniques and tools used in solving simple computer tasks in the areas of computational complexity analysis of algorithms, computer systems architecture, operating systems, computer networks and network technologies, programming languages implementation, artificial intelligence, databases, software engineering, and computer information systems.	INj_K3_W09_inz, INj_K3_W10_inz, INj_K3_W16_inz
Skills: (In terms of skills, the graduate can)	U1	Is able to acquire information in an advanced way from literature, databases and other properly selected sources, including in English, and correctly interpret and explain economic and social phenomena and mutual relations between them.	INj_K3_U03_inz, INj_K3_U05
	U2	Has the ability to analyze, design and test information systems using methodologies, techniques and tools supporting project management.	INj_K3_U07_inz, INj_K3_U10_inz
Course content ensuring the achievement of learning outcomes:		Lecture Topics: Introduction to data warehouses. Basic objects in a data warehouse. Principles of creating and managing data warehouses. Introduction to MDX (Multidimensional Expressions). Expanding the functionality of cubes. Implementing and processing the data warehouse and its elements. Security policies. Using the data warehouse for data analysis. Introduction to data mining. Laboratory Exercise Topics: Introduction to the Analysis Services environment. Defining data sources and creating cubes. Creating dimensions and hierarchies. Writing MDX queries for cubes and dimensions. Creating KPIs, actions, and translations. Implementing the data warehouse and its elements on the server. Configuring data warehouse object processing. Managing permissions. Creating and using data mining models. Comparing models.	
Examination methods:		Test (written or computer based), Assessment of work in the laboratory	

Subject name:		Embedded Systems	ECTS: 5
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	The structure of a microcontroller, the ability to identify its components, provide examples, and classify them.	INj_K3_W04_inz
	W2	Specific features of measurement and control systems.	INj_K3_W03_inz, INj_K3_W04_inz
	W3	Operations performed in an embedded system, understanding their significance.	INj_K3_W03_inz, INj_K3_W04_inz
	W4	Methods of communication between modules of digital systems.	INj_K3_W03_inz, INj_K3_W04_inz
Skills: (In terms of skills, the graduate can)	U1	Develop a program for an embedded system using both low-level and high-level programming languages.	INj_K3_U10_inz, INj_K3_U13_inz, INj_K3_U23_inz
	U2	Implement various algorithms in the DSM8051 dedicated assembler.	INj_K3_U10_inz, INj_K3_U13_inz
	U3	Diagnose faults in an embedded system.	INj_K3_U23_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	Teamwork	INj_K3_K05, INj_K3_K06
Course content ensuring the achievement of learning outcomes:		Definition and Control Diagram of an Embedded System Definition, Architecture, and Addressing Modes of a Microcontroller Block Diagrams and Elements of Control Systems Computer-Based Measurement and Control Systems Automation Channels - Input and Output Circuits Microcontroller Communication with the External World Software for Computer-Based Control Systems PLC Programming Diagnostics of Analog Circuits Transmission Protocols Architecture and Applications of Smart Building Technology DSM8051 Microcontroller Programming	
Examination methods:		Written exam, Project	

Subject name:		Distributed systems	ECTS: 5
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	The structure of a distributed system, and they can describe its elements, and classify it.	INj_K3_W06_inz
	W2	Distinguishing features of a distributed system.	INj_K3_W10_inz
	W3	Operations performed in a distributed system, and their meaning and importance.	INj_K3_W10_inz
	W4	Programing rules for languages used in the intermediate layers.	INj_K3_W07_inz
Skills: (In terms of skills, the graduate can)	U1	Can implement and apply various communication tools in a distributed system.	INj_K3_U17_inz
	U2	Can harden a distributed system, enforce authentication and authorization in it.	INj_K3_U16_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	Understand of the social, ethical and legal issues associated with the use of distributed systems; particularly in cloud computing.	INj_K3_K03
Course content ensuring the achievement of learning outcomes:		Characteristics of a distributed system: transparency (location, access, migration, replication, concurrency, durability, failure), openness (protocols and interfaces), scalability, synchronization issues (lack of global clock), synchronous and asynchronous communication. DNS as an example of a distributed system. Communication via network sockets. Remote Procedure Call (RPC) mechanisms; example implementations: XML-RPC, JSON-RPC, etc. Architecture of web services and microservices. REST architecture. Interoperability of network services and components. REST API and Web API in modern distributed systems. Message-Oriented Middleware tools using RabbitMQ (or Kafka, Iris Message Queue, etc.). Distributed file systems: NFS, Samba, Lustre, Ceph, etc. Security and authorization in distributed systems. Kerberos, TLS, JWT, OAuth2, etc. Clusters, grids, clouds, and supercomputers. Tools used in cloud computing. Security and risks associated with cloud computing.	
Examination methods:		Oral exam, Project	

Subject name:		Network Services	ECTS: 3
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	the methods, techniques and tools used in solving simple IT tasks in the field of network services.	INj_K3_W05_inz, INj_K3_W09_inz
	W2	algorithms and their computational complexity, computer systems architecture, operating systems, network technologies, programming languages and paradigms, artificial intelligence, databases, software engineering.	INj_K3_W07_inz, INj_K3_W09_inz, INj_K3_W10_inz, INj_K3_W15_inz
Skills: (In terms of skills, the graduate can)	U1	use the acquired knowledge in various scopes and forms, extended by a critical analysis of the effectiveness and usefulness of the applied knowledge in practice.	INj_K3_U07_inz, INj_K3_U14_inz, INj_K3_U15_inz, INj_K3_U16_inz
	U2	analyse and test IT systems using methods, techniques and tools supporting project management.	INj_K3_U05, INj_K3_U09_inz, INj_K3_U27_inz, INj_K3_U28_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	correctly identify and resolve dilemmas related to the practice of the profession.	INj_K3_K03, INj_K3_K04, INj_K3_K05
Course content ensuring the achievement of learning outcomes:		Introduction to Network Services: Overview and Basic Concepts. DNS (Domain Name System): Principles, Configuration, and Troubleshooting. DHCP (Dynamic Host Configuration Protocol): IP Address Allocation and Management. Web Services: HTTP/HTTPS, Web Servers, and Hosting. Email Services: SMTP, IMAP, POP3, and Email Security. File Sharing Protocols: FTP, SFTP, and SMB/CIFS. Remote Access Services: SSH, Telnet, and Remote Desktop Protocols. VPN (Virtual Private Network) Services: Tunneling, Encryption, and Remote Access Network Directory Services: LDAP, Active Directory, and Authentication. Network Management and Monitoring: SNMP, NetFlow, and Monitoring Tools. Voice over IP (VoIP) and Unified Communications: Protocols and Services. Streaming Services: RTSP, RTP, and Content Delivery Networks (CDNs). Load Balancing and High Availability: Techniques and Protocols. Network Security Services: Firewalls, IDS/IPS, and Access Control. Cloud-based Network Services: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS).	
Examination methods:		Written credit, Assessment of work in the laboratory	

Subject name:		Hardware security	ECTS: 3
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	Understands the principles of hardware security, including the identification and mitigation of hardware-level vulnerabilities such as side-channel attacks, hardware Trojans, and reverse engineering.	INj_K3_W04_inz, INj_K3_W09_inz
	W2	Has knowledge of cryptographic mechanisms implemented in hardware, including secure boot processes, encryption modules, and physical unclonable functions (PUFs).	INj_K3_W04_inz
	W3	Understands the challenges and techniques associated with securing embedded systems and IoT devices.	INj_K3_W05_inz
Skills: (In terms of skills, the graduate can)	U1	Can analyze hardware-related security risks, assess their potential impact, and propose appropriate countermeasures.	INj_K3_U09_inz, INj_K3_U26_inz
	U2	Can implement and evaluate cryptographic algorithms in hardware using platforms such as FPGAs and ASICs to ensure secure system design.	INj_K3_U07_inz, INj_K3_U10_inz, INj_K3_U16_inz
	U3	Can utilize tools and techniques for assessing the security of hardware systems, including conducting vulnerability analysis, penetration testing, and fault injection experiments.	INj_K3_U06, INj_K3_U27_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	Is prepared to address hardware security issues in multidisciplinary teams, understanding the ethical and legal implications of security breaches.	INj_K3_K04, INj_K3_K05
	K2	Is ready to engage in lifelong learning to stay updated on emerging technologies and threats in hardware security.	INj_K3_K01, INj_K3_K02
Course content ensuring the achievement of learning outcomes:		Introduction to Hardware Security: Definition, history, and key concepts. Threats related to hardware security: Types of attacks, threat profiles, and sample scenarios. Memory and Data Storage Security: Attacks on RAM, security of hard drives and SSDs, encryption techniques. BIOS and UEFI Security: Attacks on BIOS/UEFI, security mechanisms, firmware updates. Microcontroller and Microprocessor Security: Attacks on processors, security mechanisms, and updates. Embedded Systems Security: Security challenges in embedded systems, IoT. Hardware Attacks and Detection: Side-channel attacks, fault injection, hardware Trojans. Hardware Security Mechanisms: TPM, HSM, Secure Boot, defensive techniques. Network Security and Network Hardware: Attacks on routers, switches, and network security mechanisms. Mobile and Hardware Security: Threats related to hardware security in mobile devices. Hardware Security Standards and Regulations: NIST, ISO, and other industry standards. Hardware Security Testing: Testing techniques, tools, practices. Case Study: Analysis of well-known hardware attacks: Spectre, Meltdown, Rowhammer. Future of Hardware Security: Trends, challenges, and directions for development. Practical Applications of Hardware Security Knowledge: Practical exercises, scenarios, and case studies.	
Examination methods:		Written exam, Assessment of work in the laboratory	

Subject name:		Computer Graphics and Computer Communication	ECTS: 5
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	theoretical foundations of computer graphics and human-computer interaction;	INj_K3_W01_inz, INj_K3_W06_inz
	W2	basic methods, algorithms, and tools used in solving computer science problems related to computer graphics and image processing;	INj_K3_W06_inz, INj_K3_W09_inz
	W3	guidelines and principles for creating human-computer interfaces (especially graphical ones).	INj_K3_W09_inz, INj_K3_W11_inz
Skills: (In terms of skills, the graduate can)	U1	apply her/his acquired theoretical knowledge to write algorithms and perform other tasks in the fields of computer graphics, image processing, and graphic user interface design;	INj_K3_U01_inz, INj_K3_U10_inz
	U2	assess the computational complexity of algorithms and problems in the fields of computer graphics and image processing;	INj_K3_U13_inz
	U3	define the requirements for specialized computer interfaces (especially graphical ones) and evaluate the quality of implemented solutions.	INj_K3_U09_inz, INj_K3_U18_inz, INj_K3_U26_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	monitor advancements in techniques and algorithms used in computer graphics, image processing, and the creation of computer interfaces.	INj_K3_K01
Course content ensuring the achievement of learning outcomes:		Graphic input-output devices. Basic concepts and definitions related to digital images (in raster and vector techniques) and color models. Point, local and global image transformation methods. Geometric transformations of graphic objects and filling of figures. Elimination of occluded elements, methods of drawing curves. Lighting and shading models. Morphological transformations and their applications. Transforms of images and sound signals (FFT, Hough, Radon). Selected methods of filtering one- and two-dimensional data. Selected models of human-computer interaction. Principles of design and analysis of computer interfaces. Interfaces for the disabled. Human-computer interaction for computers of the future.	
Examination methods:		Written exam, Test (written or computer based), Project, Report, Assessment of work in the laboratory	

Subject name:		Team Project	ECTS: 2
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	Topics in the field of data structures, computational complexity of computational problems and algorithms used to solve them, computer system architecture, operating systems, network technologies, programming languages and paradigms, graphics and human-computer communication, artificial intelligence, databases, software engineering and embedded systems.	INj_K3_W06_inz, INj_K3_W15_inz
	W2	basics of technical standards and norms in IT.	INj_K3_W10_inz
Skills: (In terms of skills, the graduate can)	U1	use English at a level that allows you to communicate, read and understand texts and software documentation.	INj_K3_U06
	U2	work individually and in a team of IT specialists, is able to manage his/her time, make commitments and meet deadlines.	INj_K3_U04, INj_K3_U11, INj_K3_U27_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	understands the speed of the process of changes in computer technology; is prepared to constantly expand his/her knowledge and skills as part of his/her professional work	INj_K3_K01
Course content ensuring the achievement of learning outcomes:		Project management techniques, such as Agile or Scrum. Teamwork: Techniques and strategies for effective teamwork, including communication, division of labor, and conflict management. Project Documentation: How to effectively document the design process, results, and decisions. Presenting Projects: How to effectively present your projects, including presentation techniques and communication skills. Prototyping and Testing: How to create and test prototypes of your projects, including rapid prototyping and user testing techniques. Risk Assessment: How to identify and manage risks in projects. Project Financing: Discussing the basic principles of project financing, including budgeting and fundraising. Ethics in Design: Ethical considerations when running projects, including the impact on the community and environment. Operation and Maintenance: How to plan and manage the operation and maintenance phase of the project life cycle. Collaboration Tools: A review of popular team collaboration tools, such as Trello, Slack, and GitHub. Technology Overview: Discussing current technology trends that can be used in projects. Project Practice: Practical sessions in which students work on their projects under the supervision of faculty. Introduction to Human Resource Management: Discussion of basic principles of human resource management in the context of a project, including recruitment, motivation, and evaluation of team members.	
Examination methods:		Assessment of work in the laboratory	

Subject name:		Social and Professional Problems of Computer Science	ECTS: 1
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	The student knows and understands the basic scope of knowledge concerning IT codes of ethics, knows the rules of netiquette, understands the threats related to electronic crime and the specificity of security-critical systems.	INj_K3_W11_inz
	W2	The student knows and understands the basic scope of knowledge concerning the Personal Data Protection Act.	INj_K3_W13_inz
	W3	Student zna i rozumie podstawowy zakres wiedzy dotyczącej prowadzenia działalności gospodarczej i zarządzania nią.	INj_K3_W12_inz, INj_K3_W14_inz
Skills: (In terms of skills, the graduate can)	U1	The student is able to – when formulating and solving IT tasks – perceive their social, economic and legal aspects	INj_K3_U09_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	The student understands the need for professional behavior and adherence to ethical principles, including honesty.	INj_K3_K04
Course content ensuring the achievement of learning outcomes:		Social Issues in Computer Science – Introduction IT Professions and Education for Computer Scientists Job Hunting Strategies Specific Characteristics of the IT Work Environment Foundations of Entrepreneurship and Effective Time Management Risk in IT Projects Basics of Data Protection Cybercrime Fundamentals of Professional Ethics and Ethics in Computer Science History of Computing Technologies and Career Paths of Selected Notable Figures	
Examination methods:		Written credit	

Subject name:		Diploma seminar	ECTS: 4
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	the principles of clear, legible presentation of concepts, projects and solutions, conducting independent work and drawing conclusions from its results.	INj_K3_W16_inz
Skills: (In terms of skills, the graduate can)	U1	acquire information from literature, databases and other sources, to integrate it, to interpret it, to draw conclusions and to formulate opinions on IT problems and solutions proposed to them.	INj_K3_U22
	U2	use information and communication techniques appropriate to perform tasks typical for engineering activities and is able to prepare a well-documented study of problems in the field of computer science, following the basic principles applicable in technical and scientific publications. The graduate is able to effectively process text files.	INj_K3_U22
	U3	demonstrate the ability to think logically and to organize information in the form of general knowledge. The graduate is able to correctly draw conclusions on the tasks completed while working on the thesis.	INj_K3_U22
Social competences: (Within the scope of competence, the graduate is ready to)	K1	understand the need for and to learn about the possibilities of further education (second and third cycle studies, postgraduate studies, courses and examinations conducted by universities, companies and professional organizations).	INj_K3_K06, INj_K3_K07
	K2	demonstrate effectiveness in implementing projects of a social, scientific and research or programming and implementation nature, included in the study program or implemented outside of studies. Such a project is the programming work in which data are prepared for the thesis, and the thesis itself.	INj_K3_K06
	K3	convey information about the achievements of computer science and various aspects of the computer science profession in a generally understandable manner. The graduate is prepared for this by preparing and making a presentation on the subject of the student's thesis.	INj_K3_K07
Course content ensuring the achievement of learning outcomes:		Choosing a Dissertation Topic. The Specificity of Technical Writing: Structure, content, and format of the dissertation (SGGW format requirements). Language and Style of Written Texts and Speeches: Fundamentals of good writing style and expressive communication. Editorial and Graphic Aspects of Dissertations and Presentations: General and specific recommendations. Citations and Literature: Selecting literature, citation methods, and bibliography creation. Common Dissertation Errors and Tips on How to Avoid Them: Practical advice for effective writing. Getting Started with Writing a Dissertation: Student Presentations: Most classes are dedicated to student presentations on the concepts, progress, and results of their work, delivered as oral presentations supported by multimedia. The presentations follow a conference-style format, including group discussions moderated by the instructor.	
Examination methods:		Presentation	

Subject name:		Mobile Systems and Wireless Communications	ECTS: 3
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	Knows and understands the fundamental principles of wireless communication, including signal propagation, modulation techniques, and the architecture of mobile systems.	INj_K3_W04_inz
	W2	Knows and understands the standards and protocols used in mobile systems (e.g., GSM, LTE, 5G) and wireless communication (e.g., Wi-Fi, Bluetooth).	INj_K3_W05_inz
Skills: (In terms of skills, the graduate can)	U1	Can design and analyze wireless communication systems, including evaluating their performance using modern tools and methodologies.	INj_K3_U01_inz, INj_K3_U02_inz, INj_K3_U03_inz, INj_K3_U05, INj_K3_U06, INj_K3_U07_inz
	U2	Can implement solutions for wireless communication challenges, such as mitigating interference or optimizing network coverage.	INj_K3_U09_inz, INj_K3_U10_inz, INj_K3_U15_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	Is prepared to continuously update knowledge and skills in the rapidly evolving field of wireless communication technologies and mobile systems.	INj_K3_K01, INj_K3_K02
	K2	Is ready to collaborate effectively in interdisciplinary teams, addressing challenges in wireless communication and contributing to innovative solutions.	INj_K3_K04, INj_K3_K05, INj_K3_K07
Course content ensuring the achievement of learning outcomes:		Fundamentals of digital signal processing. Sampling, quantization, reconstruction of signals. Digital filters, their design and importance in digital transmission systems. Analog modulations. Pulse modulations. Keying. Signal modulation and coding methods in WLAN, Bluetooth, cellular telephony and satellite navigation networks. Signal structure in wireless communication. Topology and architecture of cellular networks. Structure of WLAN and Bluetooth networks. Principle of operation of satellite navigation. Security issues in wireless communication.	
Examination methods:		Written exam, Assessment of work in the laboratory	

Subject name:		Computer systems security	ECTS: 2
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	Principles and methods of computer network security at the network layer.	INj_K3_W05_inz, INj_K3_W06_inz, INj_K3_W10_inz
	W2	Principles and methods of network security using ASA equipment.	INj_K3_W11_inz
Skills: (In terms of skills, the graduate can)	U1	Configure encrypted connections for LAN site-to-site.	INj_K3_U16_inz, INj_K3_U24_inz
	U2	Configure and detect network intrusions based on IPS and signatures.	INj_K3_U11
Social competences: (Within the scope of competence, the graduate is ready to)	K1	Interaction and teamwork.	INj_K3_K03, INj_K3_K05
Course content ensuring the achievement of learning outcomes:		Introduction to computer system security, history and development directions, basic security problems, standards and recommendations. Mechanisms of protection against intrusions into computer systems, problems of protection of popular services, methods and attacks, computer crimes, authentication mechanisms. Security of operating systems, Linux and Windows systems. Protection of systems based on firewalls. Intrusion detection, IPS/IDS systems. Protection of systems against DoS and DDoS attacks. Access control mechanisms to computer systems. Hash functions, passwords, attacks. Elements of cryptography, symmetric ciphers, asymmetric ciphers, key management (PKI), cryptographic authentication, tools, legal aspects of using cryptography. Data encryption, VPN networks and tunnels, IPSec. Methods of implementing security mechanisms based on ACL access control lists. Security of VoIP services. Security of user applications and services, traffic analyzers. Protection of computer systems, encrypted connections, passwords, access levels. Data encryption, hash functions, cryptography. Firewall configuration, implementation and testing. Intrusion Detection Systems IPS/IDS configuration. Data protection using IPSec tunnels. Typical attacks - reconnaissance, access, tools. VoIP security Data (file) security Password policy.	
Examination methods:		Presentation, Assessment of work in the laboratory	

Subject name:		Business Intelligence Systems	ECTS: 3
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	Student knows and understands technical standards and norms in IT, including those related architecture of BI system. Knows the goals and tasks set for Business Intelligence systems and understands the need to build BI systems.	INj_K3_W10_inz
	W2	Student knows and understands the methods of collecting, processing and analyzing data (regardless of their origin) and drawing conclusions on these basis. Has knowledge of data mining algorithms used to support decisions in Business Intelligence systems.	INj_K3_W18_inz
Skills: (In terms of skills, the graduate can)	U1	Student is able to use basic analytical and experimental methods, including simple computational experiments, to formulate and solve computer science tasks.	INj_K3_U08_inz
	U2	Student is able to implement computer techniques in areas that require their support, using appropriate methods and tools.	INj_K3_U28_inz
	U3	Student is able to use specialized applications or to design software for solving practical IT tasks and problems in areas such as retrieving data from source systems, performing data transformations, aggregation, presenting information in the form of OLAP cubes or ready-made reports/summaries.	INj_K3_U29_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	Student is able to work in a team on complex tasks.	INj_K3_K05
Course content ensuring the achievement of learning outcomes:		Introduction to Business Intelligence (BI): history of BI, BI as a field at the interface of business and technology, review of BI applications in selected areas of business practice, supporting management decisions using information technologies. Technological layer of BI systems: architecture of BI systems, data sources, extraction, transformation, loading process, data warehouse, OLAP tools, exploration tools, knowledge management tools. Data processing within BI systems, data model, basic data operations, data processing methods and data processing languages (including SQL, SAS 4GL), reporting and data analysis. Advanced business analytics: introduction to data mining, multidimensional data analysis, review of basic data mining techniques. Review of the offer of BI system providers (Oracle, SAS, Microsoft, GramSoftware, StatSoft). The content presented during lectures will be supplemented with exercises in the computer lab. and will concern the practical side, i.e. learning about solutions available within Business Intelligence systems, which will include in particular: data processing in BI systems, data processing languages (4GL and SQL), the composition of basic blocks of operations on data tables, data sets in the SAS system and operations on sets, loading data sets, reading selected variables in tables, combining tables, discussing basic data formats, operators and more important functions, calculations on data, iterative processing, loops, sorting, using basic knowledge exploration techniques (decision trees, association rules, neural networks). Practice of BI systems in finance, industry, medicine, science, telecommunications, among others.	
Examination methods:		Written exam, Project	

Subject name:		E-commerce Systems	ECTS: 2
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	The graduate knows and understands the trends in software development used in e-commerce.	INj_K3_W08_inz, INj_K3_W09_inz
	W2	The graduate knows and understands the principles of designing an effective online store.	INj_K3_W07_inz, INj_K3_W13_inz
Skills: (In terms of skills, the graduate can)	U1	The graduate is able to notice social, economic and legal aspects when designing a store.	INj_K3_U09_inz
	U2	The graduate is able to create a simple online store application.	INj_K3_U17_inz, INj_K3_U18_inz, INj_K3_U28_inz, INj_K3_U29_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	The graduate is ready to work in a development team creating an online store.	INj_K3_K05, INj_K3_K06
	K2	The graduate is ready to implement projects of a programming and implementation nature.	INj_K3_K01, INj_K3_K06
Course content ensuring the achievement of learning outcomes:		Analysis of online store elements related to legal requirements: policies, regulations, mandatory consents, optional consents, etc. Creation of a simple e-commerce solution compliant with SEO principles and sales psychology, e.g. Call for Action. Creation of a comprehensive, integrated online store based on open-source tools.	
Examination methods:		Test (written or computer based), Project	

Subject name:		Artificial Intelligence	ECTS: 4
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	Student has extended knowledge on data structure, complexity of the computational problems and the complexity of the algorithms used in implementing languages and their paradigm in Artificial Intelligence.	INj_K3_W06_inz
	W2	Student knows basic methods and techniques applied in solving simple computer science tasks within Artificial Intelligence range.	INj_K3_W09_inz
	W3	Student knows and understands the foundations of the standards and technical norms in computer science.	INj_K3_W10_inz
Skills: (In terms of skills, the graduate can)	U1	Student knows and understand how to formulate and impelement algorithms with the aid of at least one commonly available tools and project environments.	INj_K3_U10_inz
	U2	Student knows and understands how to impement the computer science techniques within the domains requiring their support.	INj_K3_U28_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	Student can collaborate and is ready to work within the team group.	INj_K3_K05
Course content ensuring the achievement of learning outcomes:		Deduction and inferability. Propositional Calculus and Predicate Calculus. Models, logical consequences, and satisfiability. Refutation, Horn clauses, and SLD resolution. Programming in PROLOG – declarative programming paradigm. Symbolic arithmetic and lists. Graph searching in PROLOG (cyclic and acyclic). Applications of PROLOG in artificial intelligence. Herbrand interpretations and models. The smallest Herbrand model. Introduction to programming (acyclic graph search). Symbolic arithmetic in Prolog. Lists in Prolog. Logic puzzles (Einstein's zebra puzzle). Cyclic graphs and their search (board game).	
Examination methods:		Written exam, Project, Test (written or computer based)	

Subject name:		Labor Law	ECTS: 2
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	Basics of labour law necessary to run a business.	INj_K3_W14_inz
Skills: (In terms of skills, the graduate can)	U1	interpret legal acts and draw conclusions based on them	INj_K3_U03_inz
	U2	Demonstrate the ability to think logically and organize information in the field of labour law	INj_K3_U22
	U3	identify basic provisions of labour law and health and safety regulations and know how to use them.	INj_K3_U24_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	comply with the provisions related to labour law and health and safety regulations, and also understands the differences between an employment contract, mandate contract or a contract for specific work	INj_K3_K04
Course content ensuring the achievement of learning outcomes:		Lectures: Introduction – Familiarization with the basic principles of law, concepts such as legal norms, sources of law, hierarchy of sources of law, and fundamental principles and regulations of civil law, as well as the positioning of labor law within branches of law. General Part of Labor Law: Subject, functions, principles, and sources of labor law. Individual Labor Law: Parties to the employment relationship, establishment of the employment relationship, types of employment contracts, comparison of employment contracts with civil law contracts (mandate contract and contract for specific work). Changes and Termination of Employment Relationships; content of the employment relationship: duties of the employer and the employee. Remuneration for Work, Working Time, Leave, Labor Protection; responsibility of the parties for violating labor law provisions; resolving disputes regarding claims from the employment relationship. Collective Labor Law: Trade unions, employee organizations, collective labor agreements, collective disputes. Social Security Benefits, Accidents on the Way to and From Work. Health and Safety Regulations (BHP) and the resulting duties of employers and employees. Differences in Attitudes Toward Work in Collectivist and Individualist Cultures. Business Approaches in Asian, American, European, Latin American, and Muslim Cultures.	
Examination methods:		Written credit, Assessment of work in the laboratory	

Subject name:		Intercultural communication	ECTS: 2
Effects:		The content of the effect assigned to the subject:	Directional effect reference:
Knowledge: (In terms of knowledge, the graduate knows and understands)	W1	basic concepts of intercultural communication	INj_K3_W12_inz
	W2	the influence of cultural factors on the course and nature of communication	INj_K3_W18_inz
Skills: (In terms of skills, the graduate can)	U1	acquire knowledge independently and develop critical thinking	INj_K3_U18_inz
Social competences: (Within the scope of competence, the graduate is ready to)	K1	diagnose the causes of cultural conflicts and prevent them	INj_K3_K04
Course content ensuring the achievement of learning outcomes:		Basic Concepts of Intercultural Communication. Culture shock, adaptation, integration, assimilation, culture. Communication, ethnocentrism, cultural relativism, stereotypes, prejudices. Cultural diversity in verbal and non-verbal communication. Barriers in intercultural communication. Cultural differences in uncertainty avoidance. Globalization and cultural change. Typology and characteristics of cultures. Intercultural communication in business and education.	
Examination methods:		Written credit	

Programme indicators

Name	Computer Systems Engineering	Information systems engineering
Potwierdzenie – na podstawie planu studiów, że student realizuje zajęcia z dziedziny nauk humanistycznych i/lub społecznych, którym przypisano nie mniej niż 5 punktów ECTS	8	8
Potwierdzenie – na podstawie planu studiów, że student ma możliwość wyboru zajęć, którym łącznie przypisano liczbę punktów ECTS nie niższą niż 30% ECTS określonych dla programu tych studiów	75/210 (35.71%)	75/210 (35.71%)
Potwierdzenie, że program studiów o profilu ogólnoakademickim obejmuje zajęcia związane z prowadzoną w uczelni działalnością naukową, w wymiarze większym niż 50% liczby punktów ECTS, określonej dla programu tych studiów	157/210 (74.76%)	157/210 (74.76%)
Potwierdzenie, że liczba punktów ECTS uzyskanych w programie studiów poprzez realizację zajęć z wykorzystaniem metod i technik kształcenia na odległość jest nie wyższa niż 75% ogólnej liczby punktów ECTS w programie studiów o profilu ogólnoakademickim	0/210 (0%)	0/210 (0%)
Liczba godzin w programie	2601	2601