Załącznik nr 2 do uchwały Senatu nr 61/2020

THE STUDY PROGRAMME

The programme is valid from the academic year: **2020/2021**

1. FIELD OF STUDY: **DATA ENGINEERING**
2. ISCED CODE: **0719**
3. FORM OF STUDY: **FULL-TIME, FIRST-CYCLE DEGREE**
4. NUMBER OF SEMESTERS: **7**
5. DEGREE TO BE GET: **ENGINEER**
6. PROFILE OF EDUCATION: **ACADEMIC PROFILE OF EDUCATION**
7. FIELD OF SCIENCE: **NATURAL SCIENCES**
8. DISCIPLINES OF SCIENCE: **PHYSICAL SCIENCES (55% ECTS),**
   MATHEMATICAL SCIENCES (25% ECTS),
   COMPUTER SCIENCE (20% ECTS)
9. **The total number of ECTS credits required for graduation: 210**
   1) the number of ECTS credits a student be required to achieve during the classes that demand direct participation of academic teachers: **112**
   2) the number of ECTS credits a student be required to achieve during the classes connected with research in the disciplines of science associated with the a given field of study (at least 50% of ECTS credits required for graduation): **113**
   3) the number of ECTS credits a student be required to achieve during the electives (at least 30% of ECTS credits required for graduation): **79**
   4) the number of ECTS credits a student be required to achieve during the classes in the area of Humanities and Social Sciences: **5**
10. **The total number of student working hours: 5361 – including the number of class hours demanding direct participation of academic teachers: 2901**

11. **Conception of study and educational goals**:

The prime goal is the education of specialists which will have practical skill in processing of the data with computer tools involving the newest information technologies (Big Data, Data Mining, artificial intelligence, machine learning).

The graduates of Data Engineering will possess:

- knowledge and abilities in data engineering, based on newest technologies and software tools,
- ability of a practical use of basic software platforms and computer codes devoted to data analysis, deep learning, artificial intelligence,
- ability of basic programming in Python and the use of basic libraries of dedicated software,
- knowledge in the general problematic of the studied fields,
- ability of practical applications of the acquired knowledge and skills in professional career,
- ability of solving professional problems, ability of team work,
- ability of using the professional literature and computer data bases,
- knowledge of English at B2 level, acquaintance with the special vocabulary in data engineering.

Data Engineering graduates will have opportunities to find employment in institutions and companies specializing in data acquisition and processing or data protection (such as statistics/accounting offices, various businesses, universities, research laboratories, software development companies), at positions requiring fluent practical skills in data analysis.

The received degree entitles to apply for admission to second-degree studies in the given or related field of science and any higher-education institution, as well as to enlist into postgraduate courses.

The basic offer for continuation at UJK for Data Engineering graduates are the second-degree studies in mathematics (Data Analysis) and physics (Medical Physics, Nanotechnologies).

12. **LEARNING OUTCOMES:**

Codes of learning outcomes	after completing a degree the graduate:	Reference to the learning outcomes:		
	LEARNING OUTCOMES	universal characteristics for a given level of the Polish Qualifications Framework (Act on ZSK)	second level characteristics of learning outcomes for the levels 6-7 of the Polish Qualifications Framework (the Polish Ministry of Science and Higher Education regulation)	d level characteristics of learning outcomes for the levels 6-7 of the Polish Qualifications Framework including **engineering** competences (the Polish Ministry of Science and Higher Education regulation)
	in terms of **KNOWLEDGE**			
ID1A_W01	has knowledge of the basics of higher mathematics, including mathematical analysis, logic, linear algebra and discrete mathematics	P6U_W	P6S_WG	
ID1A_W02	knows the basics of probability calculus, stochastic processes and mathematical statistics, basic methods of inference and statistical modelling	P6U_W	P6S_WG	
ID1A_W03	knows terminology, symbolism, basic concepts and physical laws	P6U_W	P6S_WG	
ID1A_W04	possesses knowledge in the field of physics enabling understanding of physical phenomena and processes as well as their application in science and technology	P6U_W	P6S_WG P6S_WK	P6S_WG
ID1A_W05	has basic knowledge of electrical engineering, electronics and metrology	P6U_W	P6S_WG	P6S_WG
ID1A_W06	has knowledge of information technology used in data analysis	P6U_W	P6S_WG	P6S_WG
ID1A_W07	knows the basic methods, techniques and programming tools used to solve engineering tasks in the field of data analysis	P6U_W	P6S_WG P6S_WK	P6S_WG
ID1A_W08	knows basic numerical methods and data analysis algorithms	P6U_W	P6S_WG	
ID1A_W09	has a structured, theoretically founded knowledge in the field of databases	P6U_W	P6S_WG	
ID1A_W10	has in-depth specialist knowledge in the field of study	P6U_W	P6S_WG	
ID1A_W11	has basic knowledge of related disciplines related to the field of study	P6U_W	P6S_WG	

ID1A_W12	has the basic knowledge and skills to use professional literature, databases and other sources of information to obtain the necessary information and the basic ability to assess the reliability of the obtained information	P6U_W	P6S_WG P6S_WK	
ID1A_W13	has basic knowledge necessary to understand social, economic and other non-technical conditions of engineering activities	P6U_W	P6S_WK	P6S_WK
ID1A_W14	has elementary knowledge in the field of industrial property protection, copyright law and is able to use patent information resources; knows the basic principles of health and safety at work	P6U_W	P6S_WG P6S_WK	
ID1A_W15	has elementary knowledge about designing the path of own development and forms of individual entrepreneurship in the field of data engineering	P6U_W	P6S_WG P6S_WK	P6S_WK
	in terms of **ABILITIES**			
ID1A_U01	can use a mathematical apparatus to formulate and solve typical tasks in the field of data analysis	P6U_U	P6S_UW	P6S_UW
ID1A_U02	is able to analyse and explain observed physical phenomena and processes	P6U_U	P6S_UW	P6S_UW
ID1A_U03	is able to use basic physical instruments and apparatus to plan and perform physical measurements with the assessment of the reliability of the determined physical values; identifies measuring techniques	P6U_U	P6S_UW	P6S_UW
ID1A_U04	is able to build a measuring system based on the presented diagram and make measurements, can design and build an electrical and electronic circuit and a simple technical device	P6U_U	P6S_UW	P6S_UW
ID1A_U05	can interpret and explain relationships included in the form of formulas, tables, charts, diagrams and apply them in practical issues	P6U_U	P6S_UW	P6S_UW
ID1A_U06	knows how to use selected IT technologies to collect, search, analyse and visualize data	P6U_U	P6S_UW	
ID1A_U07	uses a selected high level programming language and appropriate IT tools in the form of computer programs in the field of data engineering	P6U_U	P6S_UW P6S_UK P6S_UO P6S_UU	P6S_UW
ID1A_U08	is able to analyse and solve typical problems related to the major of studies and find solutions using known methods	P6U_U	P6S_UW	P6S_UW
ID1A_U09	has the ability to plan and perform basic scientific research as part of his major of studies and analyse their results	P6U_U	P6S_UW	P6S_UW
ID1A_U10	knows the English language to the extent necessary to use the basic professional literature in the field of data engineering in accordance with the requirements set for the B2 level of the European System of Language Description	P6U_U	P6S_UK	
ID1A_U11	has the ability to obtain information from literature, databases and other sources, integrate this information, interpret and draw conclusions and formulate opinions	P6U_U	P6S_UW P6S_UU	P6S_UW
ID1A_U12	can present current issues related to data engineering, including a short presentation in Polish and English using various sources of knowledge and multimedia resources	P6U_U	P6S_UW P6S_UK	P6S_UW

ID1A_U13	he knows how to organize his own work properly and is able to work together and work in a team with responsibility for his own and for the tasks he has carried out jointly	P6U_U	P6S_UO P6S_UU	P6S_UW
ID1A_U14	has the ability to prepare a written description/project on specific issues related to the field of study using the basic theoretical concepts and data engineering methods using different sources of information	P6U_U	P6S_UW P6S_UO	P6S_UW
ID1A_U15	identifies problems related to the profession, understands the need to raise professional and personal competences, can implement the process of self-education	P6U_U	P6S_UU	P6S_UW
	in terms of **SOCIAL COMPETENCES**			
ID1A_K01	can define priorities for the task and plan work	P6U_K	P6S_KK P6S_KR	
ID1A_K02	is aware of the need to comply with the principles of professional ethics and respect for the law, including copyrights	P6U_K	P6S_KR	
ID1A_K03	understands the social aspects of the practical application of the acquired knowledge and the need to popularize selected achievements of science and technology	P6U_K	P6S_KO	
ID1A_K04	is able to formulate and argue opinions on professional issues, is innovative, solves problems with the inclusion of socio-economic effects, works in an entrepreneurial way	P6U_K	P6S_KK P6S_KO	

13. **LIST OF COURSES WITH THE ECTS CREDITS, LEARNING OUTCOMES AND SYLLABUS CONTENT:**

Courses		Minimum number of ECTS credits	Syllabus content	Relation to learning outcomes
GENERAL COLLEGE COURSES:				
1.	Foreign Language Course	9	Lexis: • The elements of specialist vocabulary related to a given field of study • The University, the subject of study, forms of study, significance of education • The remaining contents including everyday life, culture, social phenomena and well-known problems of modern world and in conformity with syllabus of textbooks intended for Level B2. Grammar: In conformity with syllabus of textbooks intended for Level B2 and in conformity with requirements of Common European Framework of Reference for Languages Linguistic: In conformity with syllabus of textbooks intended for Level B2 and allowing students to: communicate foreign language fluently, take an active part in discussions, debates, argue and develop compromise solutions, express emotions and represent opinions, defend one's own point of view in oral and written form	ID1A_W12 ID1A_U10 ID1A_U11 ID1A_U12 ID1A_U14
2.	Information and Communications Technology	1	Fundamentals of computer and communication technologies. Using computers. Word processing and spreadsheets. Creating graphics and slideshows. Databases. Web browsing and electronic mail.	ID1A_W06 ID1A_U06 ID1A_K02
3.	Intellectual Property Protection	0,5	Conception of intellectual property. Copyright laws and theirs protection. Trade property – contrivances, patents, trademarks. Protection of trade property. Knowledge as intellectual property	ID1A_W14 ID1A_K02
4.	Enterprise	0,5	Fundamental terms: entrepreneur, entrepreneurship, entrepreneurial person, enterprise. Attributes of successful entrepreneurs. Proper management: management process, effectiveness, business plan. Factors determining an enterprise development. Establishing an enterprise. Institutions and tools supporting entrepreneurship. Active seeking employment: CV, a motivational letter, an interview. Seeking employment in Internet.	ID1A_W13 ID1A_W15 ID1A_K04
5.	Optional courses covering content in the humanities or social sciences	5	Philosophy of nature Interpersonal communication Copywriting	ID1A_W13 ID1A_U15 ID1A_K03
6.	Optional courses in the scope of student support in the learning process	2	Self-education technique Social communication Methods of learning support Coaching	ID1A_W13 ID1A_U15 ID1A_K03

	General college courses in total	**18**		
FUNDAMENTAL AND FIELD OF STUDY COURSES:				
1.	Basics of Mathematics	6	Elements of mathematical logic: propositional calculus, propositional functions, laws of calculus of quantifiers. Sets. Relations. Properties of relations. Equivalence relation. Basic properties of real functions of the real variable. Sequences and series. Differential calculus of functions of one variable. Matrix account.	ID1A_W01 ID1A_U01 ID1A_U05 ID1A_U11 ID1A_K01
2.	Physics 1	5	Position vector, coordinate system, reference frame. Velocity of the material point as a derivative of the position after time and movement at constant speed. Acceleration and motion with constant acceleration. Road as an integral of speed over time. Galilean transformation. Three principles of dynamics. Movement under constant force. Static and kinetic friction. Kinetic and potential energy, the principle of mechanical energy conservation. Momentum and principle of momentum conservation. Inertial, non-inertial frames and fictitious force. The law of universal gravitation, work in the gravitational field and potential energy. Earth satellite movement, first and second cosmic velocity. Microscopic and macroscopic description of system of many bodies, Avogadro number, mole. Atoms, molecules, gases, liquids and solids. Basic thermodynamic quantities: volume, pressure, work. Temperature and zeroth law of thermodynamics. Ideal gas equation and absolute temperature scale. The principle of energy equipartition and ideal gas energy. The first law of thermodynamics. Processes: isothermal, isobaric, isochoric, adiabatic. Heat capacity, specific heat. Van der Waals gas as a real gas model. Carnot engine and its efficiency.	ID1A_W03 ID1A_W04 ID1A_U02 ID1A_U09
3.	Programmer's Environment	2	Linux bash shell command: operations on files and directories, operations on file attributes. Input – Output: redirections and pipelines. Operations on text files, regular expressions(searching, sorting). Bash scripts: passing arguments, variables, environmental variables. Bash scripts: arithmetic and logical expressions. Bash scripts: interaction with user, conditional expression, loops, functions. LaTeX – a document preparation system: creating document, typesetting mathematical formulae. LaTeX: creating presentation – beamer class. Editing source file in C language, execution of source file, compilation with GCC. make – tool to automating compilation	ID1A_W07 ID1A_U07 ID1A_U08 ID1A_U13 ID1A_K03 ID1A_K04
4.	Introduction to Programming	4	Overview of fundamental programming paradigms. Python interpreter, running programs. Data types in Python (numbers, strings, lists, dictionaries, tuples, files), dynamic types. Python statements, if tests and syntax rules, while and for loops, iterations. Functions basics: coding, calling, polymorphism. Scopes. Arguments. Modules and packages, module coding basics.	ID1A_W07 ID1A_U07 ID1A_U08 ID1A_K03 ID1A_K04
5.	Fundamentals of Electrical Engineering and Electronics	7	Basics of electricity and magnetism. Direct and alternating current. Basic electrotechnical equipment. Basic laws of electrical circuits. Basic methods of electric circuit analysis. Analysis of circuit with RLC elements. Resonance in electrical circuits. Current in solids. Band model. Physical fundamentals of the operation of semiconductor devices, p–n junction. Basic semiconductor devices, models of semiconductor components. Integrated circuits. Basic electronic circuits, amplifiers, generators. Basic digital circuits, flip-flops and counters, semiconductor memories, microprocessor systems.	ID1A_W03 ID1A_W04 ID1A_W05 ID1A_U03 ID1A_U04 ID1A_K01

6.	Mathematics 1	5	Integral calculus of functions with one variable. Differential calculus of functions of several variables. Elements of optimization. Multiple integrals. Introduction to ordinary differential equations.	ID1A_W01 ID1A_U01 ID1A_U05 ID1A_U08 ID1A_K03
7.	Mathematics 2	5	Vector spaces: definition, examples. Vector systems: vector independence, the basis of a vector space. Linear mappings, matrix of a linear mapping. Matrices: matrix calculus, matrix determinant, the trace and the rank of a matrix. The inverse of a matrix. Linear equations systems, existence of solutions, methods of solving. Eigenvalues and eigenvectors, diagonalization of a matrix. Euclidean spaces: dot product, Euclidean space; orthogonality, orthogonal decomposition, orthogonalization algorithm for a set of vectors. Matrix decompositions and their applications.	ID1A_W01 ID1A_U01 ID1A_K01
8.	Physics 2	5	Electric charge, Coulomb's law, the principle of field superposition. Electrostatic field and electric potential, field lines and equipotential surfaces. Electrostatics in the matter. Constant electric current and Ohm's law. Magnetostatics. Biot-Savart's law and Amper's law. Magnetic properties of matter. Faraday's law of induction, electric generator and electric motor. Four Maxwell's laws. Electromagnetic waves. Wave phenomena and optics. Wave classification. Interference, diffraction and reflection of waves. Huyghens principle. Light as a wave. Diffraction and polarization of light. Basics of geometrical optics. Structure of matter and contemporary physics. Elements of the relativity theory. Elements of quantum mechanics. Elementary particles and atomic nuclei. Atoms and molecules. Structure of macroscopic bodies.	ID1A_W03 ID1A_W04 ID1A_U02 ID1A_U09
9.	Measuring Techniques	3	Basic concepts of electrical metrology, the most important measurement methods. Basics of error theory and measurement uncertainty. Standards of electrical units (electrical standards based on the definition of a physical phenomenon, material pat-terns of electrical quantities, reference multimeters and calibrators). Electromechanical measuring instruments (magnetoelectric and electromagnetic meters, electrodynamic wattmeters, induction meters). Recording devices (oscilloscopes). Bridge systems balanced and unbalanced. Compensation and comparison methods. Measurement signals and their processing. Conditioning of resistance, capacitance and inductance. AC/DC conversion. Voltage conversion to frequency. Amplification of signal (amplifiers). Feedback in measuring transducers. The quality of analog signal processing. Analog-to-digital conversion. Introduction to digital signal processing.	ID1A_W03 ID1A_W04 ID1A_W05 ID1A_U03 ID1A_U04 ID1A_K01
10.	Introduction to Algorithms	4	Basic terms relating to algorithms: algorithm, flowchart, iteration, recursion, data structure. Simple iterative and recursive algorithms: finding smallest number, factorial, Horner's rule. Divide and conquer method: Min-Max algorithm, binary search algorithm, Strassen algorithm. Algorithms of searching and sorting: linear, binary and interpolating search; selection, bubble, merge sort, quicksort. Data structures: tables, records, lists, stacks, graphs and trees. Dynamic programming: Fibonacci numbers, Floyd algorithm. Greedy algorithms and optimization: knapsack problem, minimum spanning trees. Backtracking algorithms: N-queen problem, maze solving algorithms. The analysis of algorithms: the size of data, dominant operations; time and memory complexity, asymptotic complexity, sensitivity of algorithms	ID1A_W01 ID1A_W09 ID1A_U01 ID1A_U05 ID1A_U06 ID1A_K01 ID1A_K03 ID1A_K04
11.	Probability Theory	4	Probability space. Axiomatic definition of probability. Properties of probability. Conditional probability. The law of total probability. Bayes' rule. Independence of random events. One-dimensional random variables and their probability distributions. Cumulative distribution function. Functions of a random	ID1A_W02 ID1A_U01 ID1A_U06

			variable. Parameters of the random variables. Examples of discrete and continuous distributions. Multidimensional random variables. Limit theorems.	
12.	Object Oriented Programming	4	Fundamentals of the object oriented paradigm: inherit, customize and extend, classes and instances, reusing code. Coding classes: attributes and methods definition, attribute access control, customizing constructors. Class objects: making instances, method calls. Inheritance: inheritance and composition, subclasses, coding class tree, polymorphism, operator overloading, namespaces, multiple inheritance. Advanced class topics: extending build-in types, static and class methods, decorators and metaclasses. Exceptions: coding, raising and catching, user-defined exceptions, try/except/else statement, coding termination action with try/finally statement, build-in exception classes. Iterators	ID1A_W07 ID1A_U07 ID1A_U08 ID1A_U13 ID1A_K03 ID1A_K04
13.	Discrete Mathematics	5	Recurrence. Definitions, examples: Hanoi towers, Fibonacci sequence, gambler's ruin. Methods of solving recurrence via t. he characteristic equation and generating functions. Divide and rule recurrences, universal recurrence. Techniques of combinatorial counting. Dirichlet's pigeon-hole principle, inclusion-exclusion rule, examples of advanced counting problems. Graphs. Basic definitions, Euler and Hamilton graphs, planar graphs, graph searches, weighted graphs. Algorithms on graphs: finding the minimal spanning tree, finding the shortest path. Steiner tree, Small World, vertex and edge colouring and applications, labelled rooted trees and representation of arithmetic expressions, Polish notation. Networks. Event networks, flow, minimum section – maximum flow theorem.	ID1A_W01 ID1A_W08 ID1A_U01 ID1A_U07
14.	Organization of Computer Systems	8	Review of basic standards for data representation. Boolean arithmetic. Combinational logic design. Methods for the optimization of combination systems. Sequential logic design. Analysis of data flow on time diagrams. How basic digital blocks work (adders, registers, memory). Basics of MIPS architecture. Basics of machine language. Microarchitecture (one-cycle, multi-cycle and pipeline architecture). Types of memory (cache, virtual memory).	ID1A_W11 ID1A_U05 ID1A_U06 ID1A_K03
15.	Numerical Methods	2	Introduction to error analysis. Systems of linear equations. Solution of nonlinear equations. Interpolation, approximation and extrapolation. Polynomials. Numerical integration. Numerical differentiation. Solution of differential equations. Basic concepts of numerical optimization. Random number generation. Monte Carlo methods and its applications	ID1A_W01 ID1A_W02 ID1A_W08 ID1A_U01 ID1A_U02 ID1A_U05 ID1A_U07 ID1A_U08 ID1A_U09 ID1A_U13 ID1A_K03 ID1A_K04
16.	Physics Laboratory	8	As part of the laboratory, students carry out experiments from different branches of physics (mechanics, thermodynamics, electricity, magnetism, optics). Students are obligated to have knowledge within the scope of the questions included in the documentation of the individual experiment. The topics of experiments, the order and methods of implementation, the requirements for the report and preparation of the results can be found in the documentation and program of the physics laboratory.	ID1A_W03 ID1A_W04 ID1A_U02 ID1A_U03 ID1A_U13

17.	Stochastic Processes	4	Sequences of random variables. Central limit theorem. Gaussian and Poisson distributions. Levy's stable distributions. Stochastic processes in discrete and continuous systems. Markoff and non-markovian processes. Markov chains. Random walk. Birth and death equations. Chapman-Kolmogorov equation. Stationary processes, spectral function, ergodic property. Wiener process. Poisson process. Correlation analysis of time series.	ID1A_W02 ID1A_W11 ID1A_W12 ID1A_U01 ID1A_U05 ID1A_U07 ID1A_U08 ID1A_U12 ID1A_U13 ID1A_K01 ID1A_K03
18.	Statistics 1	5	Basic statistical concepts. Classification of statistical features. Designing a statistical survey. Grouping and displaying data. Numerical characteristics of data: measures of location, dispersion, skewness and concentration. Random sample, sampling distributions. The concept of estimator, the properties of "good" estimators. Basic methods of obtaining estimators. Point and interval estimation for population parameters. The minimum sample size problem. Testing statistical hypotheses. Errors in statistical inference. The power of the statistical test. Testing hypotheses about population parameters (Student's t-tests, one- and two-factor analysis of variance). Nonparametric tests. Goodness-of-fit tests. Correlation analysis and introduction to the problem of linear regression.	ID1A_W02 ID1A_U01 ID1A_U05 ID1A_U06 ID1A_U13
19.	Statistics 2	4	Presentation forms of multivariate data. Graphical presentation. Summary statistics for multivariate data. Location and variability measures. Distance measures. Dependence measures. Principal component analysis. Graphical interpretation. Multidimensional normal distribution. Selected statistical tests. Multivariate analysis of variance. Modifications of multivariate analysis of variance for order variables. Selected issues of cluster analysis and classification. Model based cluster analysis. Bayesian classification.	ID1A_W02 ID1A_U01 ID1A_U05 ID1A_U06 ID1A_U13
20.	Basics of Neural Networks	5	Neuron models, sigmoid, perceptron, neural networks, biological analogy. Associative and heteroassociative memory. Supervised learning, backward propagation, unsupervised learning. Examples of applications in data processing. Computer modelling of simple neural networks and basic understanding how they work.	ID1A_W06 ID1A_W07 ID1A_U07
21.	Computer Networks	4	Basic concepts underlying computer networks. LAN networks in Ethernet technology. IP protocol. Transport layer: UDP and TCP protocols. DNS. Wireless networks. Dynamic routing protocols. Application layer: FTP and HTTP protocols. Elements of cryptography. Safety fundamentals: attacks and tunnels. Peer-to-peer networks, NAT and firewalls	ID1A_W10 ID1A_U08 ID1A_K01
22.	Databases	5	Types and models of modern databases. The conformation, integrity and normalization of the database. Relational model of databases: data organization, relations, the criteria of relations, constrains. Basic terms of the relational model of databases: tables and their construction, data types, primary key, foreign key, duplication of items, atomic values. Structured Query Language (SQL):data types; creation, modification and deletion of tables, filling table with data, queries, sub queries, table joins, aggregate functions, transactions. Database Management Systems (DBMS) and their functions.	ID1A_W07 ID1A_W09 ID1A_W12 ID1A_U06 ID1A_U11 ID1A_U13 ID1A_K03 ID1A_K04

23.	Data Visualization Techniques	5	Introduction to issues related to graphical presentation of data on the World Wide Web. Introduction to the D3 library. Basics of the technologies used (HTML, DOM, CSS, Javascript, SVG). Preparation of the work environment (WAMP server, a terminal with a Python interpreter, references to the D3 library). Data preparation (creating markup, data binding). Graphic data presentation (drawing with div tags, drawing with SVG markers, preparing various types of charts). Updates, transitions and traffic (order scales, event listening functions, updating scaling functions, combining data with keys). Interactivity (linking event listening functions, grouping of SVG tags, hints). Chart systems (including circular, cumulative, force). Geographical maps (GeoJSON, paths, projections, cartogram). Exporting (bitmaps, PDF files, SVG files)	ID1A_W06 ID1A_W07 ID1A_W08 ID1A_U05 ID1A_U06 ID1A_K02
24.	Databases Systems	6	Basic concepts: database, database system, database management system. Examples of commercial systems with databases. Tasks of the database management system (data management, concurrency, redundancy, consistency-integrity of the database, protection of databases). File processing and data-base systems. Principles and methods of access to relational databases - query interface, program in programming language with calling database operations. Data management. Query languages in relational databases - the division of languages and their short characteristics. Database protection. Methods to protect the integrity of databases - assertions, domain ties and global ties. Database protection against unauthorized access and before failure - methods. Concurrency and multiple access to the database. The concept of transactions. Transaction management. Methods for blocking database elements. Two-phase blocking and fill protocol. Transaction reliability. Deadlocks. Centralized and distributed database systems. Types of database dispersion. Classification of distributed systems. Fragmentation and replication in distributed database systems. The role of drivers in accessing databases. ODBC, JDBC, CGI drivers. Basic rules for the applicability of controllers. Methods for designing distributed data-bases. Concurrency management in distributed databases. The binding of SQL to programming languages. Creating applications that refer to the database together with the protection and development of access to the database using drivers.	ID1A_W09 ID1A_W10 ID1A_U06 ID1A_U07 ID1A_K01
25.	Computer System Security	5	Introduction to the subject of security, the basis of security of the local Unix system. Privacy, Storage and data protection issues. Security in the TCP/IP network, network security elements on Unix-like systems. Optimal configuration of network services, firewall configuration, intrusion detection systems. Introduction to the most important cryptographic methods and tools.	ID1A_W07 ID1A_W11 ID1A_W14 ID1A_U08 ID1A_K02
	Fundamental and field of study courses in total	**120**		
	ELECTIVES:			
1.	Courses in the scope of the preparation and submitting of the diploma thesis	16	**Undergraduate thesis seminar**: Report about resources related to the subject of diploma thesis. Searching for information. Presentation of the main points of diploma thesis. Bibliography. Discussion and error correction. Diploma examination agenda - criteria of assessment. **Diploma laboratory:** Presentation and discussion of the engineering project work. Individual consultations regarding the progression of project works (simulations, software implementation). **Preparation of undergraduate dissertation:** Collecting source materials, writing a dissertation.	ID1A_W01-15 ID1A_U09 ID1A_U11 ID1A_U14-15 ID1A_U15 ID1A_K01-02

2.	Optional courses expanding students range of interests	48	Team Project Social aspects of artificial intelligence Cryptography Evolutionary algorithms Quantum computers Machine learning Deep learning Data exploration algorithms Econometrics Financial engineering Biostatistics Analysis of images Survey method Forecasting methods Measuring Engineering Analysis of measurement data Computer Aided Design Java Programming C# Programming .NET Technologies Digital Image Processing Fundamentals of Multimedia Internet applications Fundamentals of Telecommunications Telecommunication Networks Mathematic Methods in Physics Structure of Matter Fundamentals of Quantum Physics Introduction to Nuclear Physics Medical informatics Content management systems Astronomy Econophysics History of Science Game Theory Basics of Psychology	ID1A_W01 – W15 ID1A_U01 – U15 ID1A_K01 – K04

3.	**PRACTICAL PLACEMENT:** 4 weeks Practical placement is organized in selected institutions, in accordance to the chosen field of study	8	The goals of the practical placement are: – development of skills to use the acquired knowledge in practice, – acquaintance with functioning of a given institution/company, – acquaintance with specific work on several positions in various branches related to the field of studies, – acquaintance with practical issues related to work at positions connected to the specialty of studies, – assessment of own opportunities on the employment market, – establishing of professional contacts.	ID1A_W10 – W15 ID1A_U06 – U11 ID1A_U13 ID1A_U15 ID1A_K01 – K04
	Electives in total	**72**		
Total – to achieve during the electives in study programme: 79 ECTS				
	TOTAL	**210**		

Full-time students are obligated to attend 60 class hours of physical education. No ECTS credits are assigned to physical education. Students are obligated to attend Health and Safety training related to the process of study and the infrastructure at the University, in amount of not less than 4 class hours. Students are obligated to attend library coaching in amount of 2 class hours.

Additionally foreign students have a duty to participate in:

Course	Minimum number of ECTS credits	Syllabus content	Relation to learning outcomes
Polish language course	4	Elementary course of Polish language concentrates on practical linguistics skills, conversations as well as elements of Polish history and culture. The main aim of the Polish language basic course is to prepare students to use everyday life expressions, to find relevant information in written text forms, and to be able to communicate with people in different life situations (also in a medical environment). 1. Basic everyday expressions – greetings and other polite expressions; introducing oneself; thanking, asking about people; numbers; alphabet; phonetics. 2. Asking for personal information. Formal and informal expressions. Personal particulars (nationality, country, age, address, phone number, occupation). Describing family relations. Verb to be. 3. Description of everyday items, people; adjectives, colours. Verb to have. 4. Asking about jobs. Job description. Professions, jobs, interests – basic communication. 5. Daily routines. Our everyday activities – listening and oral practice. Verbs. 6. Buying things, asking about food and prices. Shopping, prices, places, things to buy – useful vocabulary (listening and oral practice). Modal verbs. 7. Dishes from different countries. Restaurant guide. Asking and talking about preferences, describing the menu. 8. Telling the time. Talking about routines and frequency. Time expressions referring to the present, past and future. 9. Speaking about family and family members; likes and dislikes, personality features. 10. Describing places. 11. Body parts. Vocabulary practice. At the doctor's – basic expressions.	ID1A_W12 ID1A_W13 ID1A_U11 ID1A_U12 ID1A_U14 ID1A_U15

14. METHODS OF VERIFYING THE INTENDED LEARNING OUTCOMES ACHIEVED BY A STUDENT DURING EDUCATION :

A detailed description of learning outcomes and verification methods are determined by an academic teacher responsible for the course in the syllabus. Accomplishment of all requirements defined for individual courses results in the achievement of the intended learning outcomes for a given field of study. The verification of the learning outcomes achieved by a student is done by:

- **term works** – carried out by student during studies, such us: class tests, final works, reports, presentations, laboratory reports,
- **oral and written examinations** – form of examination is determined by an academic teacher responsible for the course in the syllabus,

- **credits and credits with grade** – class teacher determines criteria of assessment,
- **diploma process** – evaluation by the thesis tutor and reviewer, taking a diploma examination,
- **practical placement** – verification of the learning outcomes according to practical placement regulations,

Teaching and verification methods with criteria of assessment are determined in the syllabus.

All methods of verifying the intended learning outcomes achieved by a student during a given term are registered in semester achievement cards.