UNIVERSITY of INFORMATION TECHNOLOGY and MANAGEMENT in Rzeszow, POLAND

Erasmus+

Outline of the Courses for Information Technology

Summer semester 2022/2023

English Language (BA degree 4 ECTS, MA degree - 4 ECTS)	
Foreign language class	- Development of vocabulary resources in accordance with the obligatory textbook at a given level, including vocabulary in the field of learning and disciplines relevant to the field of study. - Grammatical structures in accordance with the obligatory textbook at a given level. -Practical understanding of the written text in accordance with the textbook at a given level, taking into account the field of learning and disciplines relevant to the field of study. - Practice listening comprehension in accordance with the textbook at a given level. - Developing the ability to prepare oral presentations in accordance with the textbook at a given level, taking into account the subject area of learning and disciplines relevant to the field of study. - Development of writing skills in accordance with the textbook at a given level, taking into account the subject area of learning and disciplines relevant to the field of study.
Algorithms and Data Structures (BA degree - 5 ECTS)	
Lecture	- Mathematical foundations of computational complexity of algorithms; - Introduction to the design of algorithms; - Construction and features of data structures: arrays, lists, queues, stacks, graphs; - Methods of designing algorithms: recursion, divide-and-conquer method, dynamic programming, greedy method, return algorithms. Use of algorithms to solve problems; - Estimating the computational complexity (time and memory) algorithms; - Use of searching and sorting algorithms in data processing problems; - Using of graph algorithms in transport problems; - Design problems of concurrent algorithms.
Laboratory	- Implementation of data structures: arrays, lists, queues, stacks and operations on these structures; - Designing and implementing algorithms for sorting and searching for elements in known data structures. Estimating time and memory complexity of individual algorithms; -Design and implementation of algorithms based on recursion, the divide and conquer method, dynamic programming and greedy algorithms. Estimating time and memory complexity of individual algorithms; - Implementation of graphical representation of graphs and graph searching methods. Estimating time and memory complexity of individual algorithms; - Advanced methods of operations on graphs and their implementation.
Fundamentals of Statistics (BA degree - 3 ECTS)	
Lecture	- Random events and probability; - Probability distributions of random variables and their parameters; - Selected probabilistic models; - Parametric description of the distribution in the population; - Assessment of interacting variables in statistical processes.

Laboratory	- Probability distributions of random variables; - Measures of location and scale parameters in the population; - Asymmetry and kurtosis in the population; - Assessment of the dependence of quantitative variables; - Methods of describing the dependencies of qualitative variables.
Physics (BA degree - 4 ECTS)	
Lecture	- Mathematical description of motion and its characteristics, types of motion; - Newton's laws, conservation of energy, momentum and angular momentum; - Periodic and harmonic motion, artificial Earth satellites, Solar System model; - Electric field, Coulomb's law, electric field of point charges, dipoles; - Electric current, Ohm's law, work and power of an electric current; - Magnetic field and its interaction with electric charge, relation with electrical conductors; - Electromagnetic induction, Faraday's law, mutual inductance, self-inductance; - Alternating current circuits, RLC circuits, generation of electromagnetic waves; - Electromagnetic waves and their spectra, selected applications.
Laboratory	- Introduction to laboratory: preparing a report covering conducted experiment, measurement uncertainty analysis; - Measurement of basic electric quantities (equivalent resistance by various methods, verification of Ohm's law); - Measurement of refractive index of glass with the help of an optical spectrometer; - Measurement of specific heat of water; - Measurement of the speed of sound in air; - Measurement of density of solids; - Measurement of wavelength with the use of diffraction gratings.
Mathematics (BA degree - 4 ECTS)	
Lecture	- Vectors. A linear independence of vectors. Bases; - Matrix algebra; - Determinants. The inverse of a matrix; - Linear equations in linear algebra. Kronecker-Capelli theorem; - Limit of a Function and Limit Laws; - Derivative of a function and its interpretation; - Application of derivatives. Extreme values of function. Monotonic functions. Concavity and curve sketching; - Indefinite integral; - Definite integral. Application of definite integrals; - Functions of several variables. Partial Derivatives.
Recitation class	- Linear combination of vectors. Linear independence of vectors. Bases; - Matrix algebra; - Determinants. Properties of determinants; - The inverse of a matrix. Dimension and rank; - Linear equations in linear algebra. Number of solutions to systems of linear equations; - Limit of a Function and Limit Laws; - Derivatives; - Application of derivatives. Extreme values of function. Monotonic functions. Concavity and curve sketching; - Indefinite integral; - Definite integral. Application of definite integrals (area between curves); - Partial derivatives of a function of two variables.

Programming (BA degree - 5 ECTS)	
Lecture	- Pointers - the role of pointers in the program; - Memory management - dynamic memory allocation; - Using pointers to work with arrays and to pass arguments to functions; - References - using a reference to pass arguments to a function; - Pointers to functions; - Basic concepts of object oriented programming - class, object, encapsulation; - Defining classes and creating objects in an object-oriented programming language, valuable and dynamic objects, structures; - Class components - data fields, methods, constructors; - Containers and algorithms in the STL library; - Stages of the software development process - requirements specification, design, implementation, testing, implementation, cascade model.
Laboratory	- Working with pointers; - Dynamic memory allocation - dynamic one- and multidimensional arrays; - Passing arguments to functions - passing by value, pointer, reference; - Pointers to functions; - Defining classes and creating objects, header files; - Access modifiers, data fields, methods; - Constructors, initialization list, overloading constructors and methods; - Dynamic objects, arrays of objects; - Fundamentals of working with containers and algorithms in the STL library; - Fundamentals of working with the version control system, documenting the code with; documenting comments.
Project	- Developing project specification; - Program implementation; - Presentation of the result.
Computer System Architecture (BA degree - 5 ECTS)	
Lecture	- Computer logic; - Arithmetic of computers; - Classic computer architecture; - Processors. Command lists. Assembler language basics. Organization of computer on assembler language level; - Hierarchy of memory in computer systems; - Interfaces. Magistralls. External devices; - Modern computer architectures. Multiprocessor architectures; - Architectures and features of embedded systems. Microcontrollers. Microcontrollers programming; - Reliability of computer systems.
Laboratory	- Numerical systems, logic gates, design of combination systems; - Implementation of assembler language programs for a PC; - Implementation of assembler language programs for the microcontroller; - Simulation and testing of the operation of a programmable logic controller (PLC).
Team Project (BA degree - 4 ECTS)	
Project	- Preparation of an outline - project specification. - Project implementation. - Development of documentation. Team implementation of a practical task. Work on the project is characterized by several stages and a longer implementation time (semester). It includes the acquisition, collection of information, its processing, development and presentation of results to others. The result of work on the project is the creation of a concept of practical (concrete product) solution to a computer problem along with documentation.

Databases (BA degree - 3 ECTS)	
Lecture	- Introduction to the issue of databases. Information models. Data modelling. Database systems; - A great database model - definition, structure and ownership. Relationship Algebra; - Database query languages. Manipulating data with SQL queries. Extending SQL language with procedural programming mechanisms; - Modeling conceptual and implementation diagrams in a relational model. Standardization of logical database schemas. Organization of files used for data storage. Indexing; - Transactions - ownership, transaction diagrams, isolation, seriality, concurrency handling and management; - Database management system: indexing (construction of dense and rare indices, tree structure B-), query optimization; - Scattered databases and client-server architecture. Data warehouses. Non-relational databases
Laboratory	- Constructing simple and complex SQL queries. Verification of results; - Instructions for manipulating data; - Implementation of databases. Data import; - T-SQL language. Declaring variables and constants. Overview of basic control structures of T SQL language; - T-SQL Language: Triggers, stored procedures and functions, perspectives, cursors.
Software Engineering (BA degree - 5 ECTS)	
Lecture	- Genesis, scope and goals of software engineering. The processes that determine the success of a software project; - Requirements engineering and the process of capturing and formalizing business, functional, and non-functional level requirements, as well as system constraints, integration constraints, and business rules for the software being developed; -Models for managing the phases of the software development process. Software development life cycle; - Static validation and verification, and dynamic verification and validation in the IT product delivery process; -Designing software architecture using UML notation; - Use case, class, state and activity diagrams in relation to the "4+1" model perspectives; - API documentation and the process of creating it; - Automation of activities related to the software development process; - Creational design patterns as a concept for solving repeatedly recurring problems; - Structured design patterns as a concept for solving repeatedly recurring problems; - Activity-based design patterns as a solution concept for repeatedly recurring problems.
Laboratory	- Methods of building module tests with the use of dedicated structural unit testing tools; - Verification and validation of the produced software product; - Requirements specification. Construction and modeling of software components with the use of use case diagram notation; - Building and modeling of the software components using the class diagram notation; - Building and modeling of the software components using the activity diagram notation; - Building and modeling of the software components using the state diagram notation; - Creating API code documentation; -Creational design patterns and their implementation; -Structured design patterns and their implementation; -Activity design patterns and their implementation.
Project	- Development of the SRS document, developing a project dictionary and checking its consistency with the requirements specification; developing a diagram of use cases; selection of the functional implementation module and building interaction; designing classes and interfaces for the indicated functionality; compilation and code implementation; building API documentation and module tests.

Programming Languages (BA degree - 7 ECTS)	
Laboratory	- Familiarization with selected environments, compilers and interpreters of programming languages; - Elements of program design in imperative programming; - Elements of the program design in structural programming; - Elements of the program design in functional programming; - Elements of program design in procedural programming; - Elements of program design in event-driven programming; - Elements of program design in declarative programming; - Creating user applications - selected solutions for desktop technologies; -Selected applications of programming languages - internet applications, data science, computer games.
Project	- The subject of the project is to create a small computer application in a chosen language and programming technology. The topic of the implemented application is determined individually with the teacher. The task will be divided into several stages: problem specification, program design, implementation and testing. The completed project must be presented by the realizing team on the group forum.
Software Development Techniques (BA degree - 7 ECTS)	
Laboratory	- Application development in selected architectures - development techniques and tools; - Application of selected design patterns; - Object-relational model for data access; - Techniques of implementing business logic components; - Mechanisms for maintaining the application status; - Techniques of implementation of the presentation and distribution layer; - Application integration techniques; - Distribution, implementation and maintenance of applications.
Project	- Determining the design assumptions of the application - requirements specification; - Determining the application architecture and technologies used - preparing the application design; - Implementation, launch and testing of applications, Post-development documentation (including instructions for installation / deployment); - Application presentation.
Animation and Motion Capture Techniques (BA degree - 3 ECTS)	
Laboratory	- Basic animation techniques; - Stop-motion animation; - Interpolation animation; - Inverse kinematics - the bone system; - Basics of character animation; - Character movement registration - motion capture systems; - Exercises in correction of animation records and combining recorded motion with models; - Importing the animations into the game engine.
Preproduction (BA degree - 6 ECTS)	
Laboratory	- Introduction to computer game design; - Preparation of the concept (specification); - Creating a project architecture; - Analysis of business assumptions; - Scenario development; - Development of a functional project; - Game level design; - Multi-platform game design; - Analytical assumptions of the game;

	- Game distribution channels.
Project	- Game design - preparation of a complete game specification (game concept with assumptions, creating architecture, business assumptions, scenario, functional design, game levels, multi-platform, game analytics) and project presentation.
Proseminarium (BA degree - 1 ECTS)	
Laboratory	- Analysis of the latest IT development trends - Methodologies/procedures for solving engineering/informatics problems - stages analysis of classical problem solving model - stages analysis of the classical product lifecycle model, - analysis of methodologies used during problem solving in various areas (two-application design: classical, web, mobile, human-computer interface design, computer graphics, computer networks, etc.). - Substantive and formal aspects of writing a thesis. **Substantive aspects.** Stages of writing the diploma thesis (the stage of assumption, search, decision): - development of a substantive plan (selection of the issue, formulation of the problem and determination of the objectives of the work, formulation of a working variant of the topic of the work, determination of the schedule of activities), - analysis of source materials, - writing the main part of the work (text structure and the meaning of the paragraph, style and language of the thesis, footnotes - types of footnotes, citations), - final proofreading of the content of the thesis (preparation of the Conclusion and final editing of the Introduction and the topic of the thesis, preparation of the literature list, linguistic proofreading). **Formal aspect** (instructions for writing thesis applicable at the University): - text formatting, margins, automatic table of contents, - formulas, figures (including charts, diagrams, photographs), tables and the rules of signing them, - footnotes and literature list.
Infrastructure of Electronic Services (MA degree - 1 ECTS)	
Lecture	- Electronic services - history and new trends; - Trust in the field of electronic communication; - Authentication mechanisms, PKI and its services; - Models and mechanisms of trust, Certificates and their management; - Cryptography - encryption algorithms and protocols Scaled computer networks; - Computer systems virtualization; - Data Centers; - Electronic data flow monitoring.
Sociology (MA degree - 1 ECTS)	
E-learning	- Acquainting with the principles of functioning of basic institutions and social structures; - Realizing the role of a human as a subject that constitutes the principles of the functioning of modern society.
Team Management (MA degree - 1 ECTS)	
E-learning	- Values and strategy of a company; - Management styles; - Motivation and management techniques: supervising, coaching, mentoring and active listening; - Change management and feedback; - Charisma of a leader.

Business Analysis (MA degree - 2 ECTS)	
Lecture	- Definition of basic concepts related to business analysis, its goals and the contexts in which it is used; - Characteristics of basic knowledge areas, which include business analysis, review of techniques, methods and tools as well as required skills; - Planning and monitoring of business analysis; - Strategic analysis; - Requirements extraction and cooperation with stakeholders; - Requirements management life cycle - specification, modeling, analysis, verification, validation and communication of requirements.
Laboratory	- Presentation of the problem area for which analytical activities will be carried out; - Planning business analysis - analytical activities in the context of project activities; - Identifying stakeholders and defining the business need and vision of the solution; - Business modeling - scope modeling, process map, business object modeling; - Business process modeling - introduction to BPMN notation; - Specification of requirements for the solution.
Monographic Lecture (MA degree - 1 ECTS)	
Lecture	- Stages of the control procedure; - Risk analysis; - Planning of inspections; - Data sources; - Inspection patterns and criteria; - Control activities - document analysis, direct testing (questionnaires, visual inspections, interviews, etc.); - Documenting the control results; - Editing of audit results and their use; - Collaboration with control institutions.
Introduction to Network Technologies (MA degree - 3 ECTS)	
Laboratory	- Analysis of communication methods - connection / connectionless and their applications; - Network services and the application, presentation and session layers of the OSI model; - TCP and UDP protocol analysis. Assessment of the suitability of both protocols; - Comparison of IPv4 and IPv6 protocols. Analysis of advantages and disadvantages of protocols; - Study of data link layer protocols and multiple access methods on the example of Ethernet, wi-fi, ppp; -Study of transmission paths and analysis of their properties; - The use of remote access in business; - Analysis of security solutions in different layers of the OSI model; - Examination of protocols ensuring safe transmission; - Computer network design methodology; - Analysis of business requirements for a planned or modernized computer network; - Formulating technical requirements for a computer network Planning of logical topology, addressing, selection of communication security solutions; - Selection of network technology (Ethernet, Wi-Fi), devices and types of media. Designing the physical topology of the network and the deployment of cables and devices; - Optimizing the operation of the computer network and services.
Cybersecurity Essentials (MA degree - 2 ECTS)	
Laboratory	- Identification of threats using professional bases. Preparing an environment based on virtualization; - Applying methods of authentication, authorization and accounting in operating systems; - Detecting basic threats in an operating system; - Encryption and password cracking; - Examining digital signatures. Configuring secure remote access; -Securing the operating system.

Data security in IT systems (MA degree - 1 ECTS)	
Lecture	- Data security issues; - Systems security requirements, models and standards; - Security vulnerabilities of physical devices in IT systems; - Communication security vulnerabilities in IT systems; - Security of IT applications and services; - Risk management.
Programming Languages for Data Science (MA degree - 5 ECTS)	
Laboratory	- Preparation of the environment for work and introduction to programming for Data Science in the selected scripting language (R and/or Python); - Basic and complex data types in the scripting language of your choice (R and/or Python); - Control statements and loops (R and/or Python); - Functions (R and/or Python); - Object-oriented programming (R and/or Python); - Data processing in various formats (e.g. JSON, XML, CSV, text, etc.) (R and/or Python); - Input/output operations and database access (R and/or Python); - Familiarization with the use of specialized libraries / modules (R and/or Python); - Selected issues in the field of data visualization (R and/or Python); - Selected issues in the use of scripting languages (R and/or Python) in Data Science and data mining (i.e. pattern discovery).
Project	Individual implementation of a large practical task regarding the design and implementation of applications in the area of Data Science in a specialized scripting language (R and/or Python), in accordance with the assumptions given by the teacher.
Network Security (MA degree - 5 ECTS)	
Laboratory	- Testing the vulnerability of IT systems to attacks. Information flow analysis; - Testing authentication methods. Testing the AAA model and the Radius and Tacacs+, SSH protocols; - Testing the operation of a network firewall. Adapting its operation to the needs of security and services; - Testing access control lists and the Cisco ZBPF firewall; - Implementing a firewall in a DMZ network architecture; - Testing the operation of the anti-attack system. Modifying IPS signatures and monitoring alerts; - Traffic analysis using NetFlow and NBAR solutions; - Network security at the Layer 2 level of the OSI models.
Project	The project requirements analysis. Design: - authentication mechanisms for selected systems, - network firewall for the selected organization, - attack counter system. A plan to implement new systems or modify existing ones. Preparation of project documentation.
CCNA Security Workshop (MA degree - 2 ECTS)	
Laboratory	- Algorithms and protocols used in VPN technology - comparison and analysis of use cases; - Site-to-site IPSec VPN deployment; - Analysis of various IPSec VPN solutions; - Implementation and analysis of SSL VPN; - Integrating VPN techniques with other security measures (e.g. firewalls); - Unified threat management on the example of Cisco ASA; - VPN implementation on the ASA platform.