COURSE CATALOGUE 2024/2025

VsiTe

Contents

1. University of Applied Sciences in Information Technology

College name: University of Applied Sciences in Information Technology, VSITE
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1.1 MISSION

The VSITE mission is to develop and implement the education of the highest quality that will motivate each participant (male student / female student, teachers and businesspeople) within their ambitions and interests to involve themselves into the management of modern information technology courses. Professional activity is achieved within projects in economy and other areas of general and public interest, which contribute to raising the applied knowledge in the areas of VSITE activity. University of Applied Sciences in Information Technology cooperates even outside of Croatia, which contributes to improvement of mission through the knowledge transfer and mobility of students and teachers. There is a strong emphasis on raising public awareness of the place and the role of information technology in broader social context.

1.2 VISION

University of Applied Sciences in Information Technology is a modern institution for professional study of information technology that educates professional engineers, Bachelors and Masters of Engineering in Information Technology. Its program is continually being aligned with contemporary world developments in information technologies and their application, conforming to the requirements and trends of domestic and international labour markets. In this approximation, it equally takes into account the needs of individuals, the labour market and society as a whole, through the prism of promoting innovation and excellence.

1.3 ABOUT US

VSITE, University of Applied Sciences in Information Technology is a private school in Zagreb, Croatia, which offers courses of undergraduate and graduate IT studies. Studying at the University of Applied Sciences in Information Technology is carried out in two segments:

1. Professional Undergraduate Study in Information Technology and
2. Professional Graduate Study in Information Technology

In this way the University of Applied Sciences in Information Technology ensures vertical mobility in education for students taking Professional Undergraduate Studies in IT and an opportunity for students from related undergraduate university professional studies to attend the Professional

Graduate program.

1.4 Professional Undergraduate Study in Information Technology

The three-year undergraduate program of information technology provides students with practical expertise, necessary to fit into the work environment with greatest possible efficiency.
The professional undergraduate study of information technology is organized for full-time and part-time students in two modes of study.
Full-time students study for three years with full annual requirements of approximately 60 ECTS credits.
Part-time students study for four and a half years, three of which require approximately 40 ECTS credits, and a fourth year requiring 50 ECTS credits, after that they have to complete professional practice and write a final paper for 8 ECTS credits.
Reduced annual workload allows part-time students to successfully study while working.
Upon completing the program, the student can achieve a minimum of 180 ECTS credits and receive the academic title of Bachelor of Engineering in Information Technology.
Four areas of specialization are provided through elective courses:

a) **designing user software support,** includes generating and testing parts of the program using program interpreters and application generators,
b) **integration and maintenance of computer systems and networks,** includes operations in stages of installation, usage and expansion of computer equipment and system software support, designing computer networks according to the principles of structured cabling and workgroups, constructing and testing networks, connecting the network to the Internet, and connecting individual computers to the network,
c) **designing databases and web sites,** includes designing, generating and testing parts of the database and the data access system using the database program and web scripting languages that are processed on the client or on the server computer, and
d) **designing and use of information systems,** includes the development cycle of an information system using the techniques of system modeling and CASE tools.

1.5 Professional Graduate Study in Information Technology

Professional graduate study in information technology is divided into two groups of courses.
The first group consists of the core subjects (mathematics, languages, systems, social sciences) where the Master of Engineering in Information Technology achieves advanced knowledge that is necessary for continuously monitoring the advancement of engineering in the field of IT.
The second group consists of elective specialist courses, and their content is improved according to professional requirements, each generation of students is given the opportunity to master particular contemporary technology and to accomplish the possibility of joining the work process without additional training.
This dual approach is in line with the latest findings, which are aimed at training the Master of Engineering in Information Technology to continuously monitor the progress of information technology.
This level also has two modes of study.
Full-time students study for two years with full annual requirements of 60 ECTS credits.
Part-time students study for three years and have an annual requirement of approximately 45 ECTS credits.
At the end of the study, the student acquires 120 ECTS credits, which means, in addition to the professional study credits, a total of 300 ECTS credits. At the end of the study the student receives the academic title: Master of Engineering in Information Technology.

Students choose one of the three specializations of the study:

a) **designing user software support and information systems** is advanced from the level of professional study, which includes:
   - basic bachelor training in programming and program implementation, to the level of the professional graduate study that trains the professional Master of Engineering to independently apply the paradigms of software engineering, management of software projects and to independently perform complex tasks of implementing software systems, and
   - databases, web applications and information systems design, at the graduate level. Trains the Master of Engineering in Information Technology for the implementation and management of complex information systems based on modern technologies and to actively advance the technology of information systems.

b) integration and maintenance of computer systems and networks is advanced from the level of the professional study, which provides knowledge which is important for work in stages of installation, usage and expansion of computer equipment and software support, and for designing and implementing computer networks, to the level of graduate studies that trains the Master of Engineering in Information Technology for strategic computer security and efficiency management, and mastering the complex technologies of fine-tuning, monitoring and controlling computer systems,

c) **embedded and mobile computers** is a new specialization derived partly from Programming, and partly from the course Computer Systems, which trains professional graduate engineers for work on the increasingly important segment of small mobile and embedded computers. Professional graduate engineers who choose to specialize in embedded computers will learn to design and implement software solutions for control systems and mobile computers, and to design dedicated connection hardware

In order to apply for this college, candidates must have a four year high school degree. The classification procedure is followed through on the basis of high school achievement and an interview with the candidate.

1.6 ECTS methodology

As full-time students, candidates must take 60 ECTS per year over a period of three years, whereas part-time students take only 40. This allows part-time students to successfully manage their work and studies over a period of four and a half years.
The tuition is calculated according to the number of ECTS.
With the introduction of the ECTS point system the possibility of measuring the total workload of students is achieved, which is required for mastering the material and achieving learning outcomes of individual courses. The workload of students includes participating in active teaching (lectures, exercises, practical work) and individual work (individual studying, writing homework, preparation for exercises, working in laboratories and the library, writing individual reports).

The full workload of regular students amounts to 60 ECTS points per study year. 1 ECTS is equal to 30 hours of student work, which represents the total workload of 1800 hours per year. All study materials of each separate course are defined in a way that is appropriate and achievable in relation to the 1800 working hours for a student per year.
In these 1800 hours, around 40% is active teaching, and around 60% is the individual work of the student. In principle, courses with 30 hours of lectures and 30 hours of exercises require total student participation of around 5 ECTS (150 hours), and courses with 45 hours of class require around 7 ECTS (6-8, depending on a course).

Duties of part-time students amount to around 40 ECTS per study year. According to that, a part- time student has 1200 hours of work, which enables him/her to study while working. By registering a smaller number of ECTS, and having classes and exercises in the afternoon hours, part-time students study with a full scope of schoolwork obligations, which is identical to the full-time students.

1.7 Compulsory and Optional Courses

Compulsory courses can be divided into groups of fundamental professional courses and social courses.

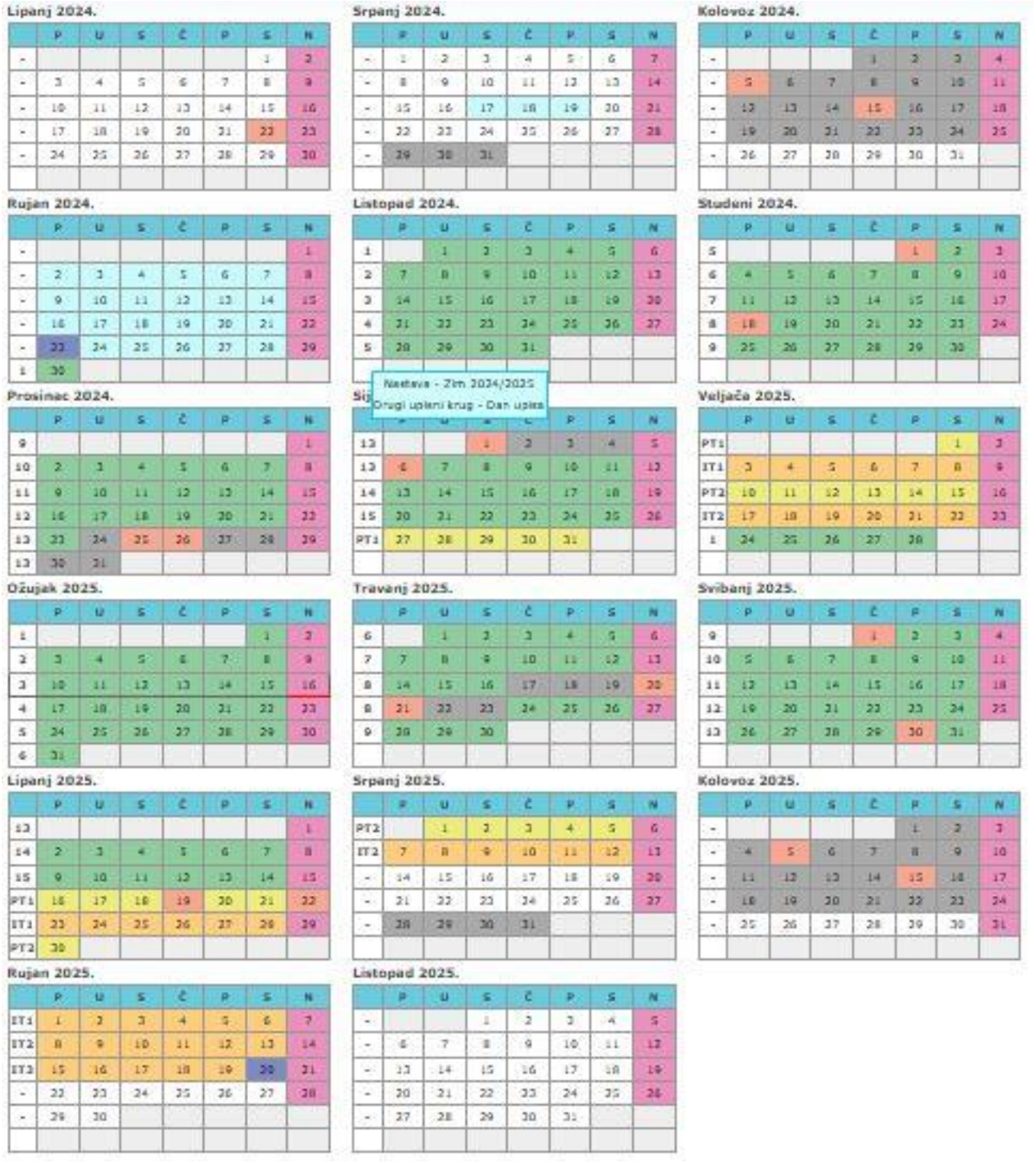
Compulsory fundamental professional courses include five courses of mathematics, physics, electrical engineering, electronics, digital technics, computer architecture, and computer networks, two courses of programming, databases and information systems. Achieved competences provide the bachelor with an engineering approach to problems, capability for designing and performing, analytics and modelling, and for active adjustment to the requirements of the future workplace.

Compulsory social classes include economics, ethics and three English language courses. Competences achieved through those are enabling the expert bachelor to see the wider aspect of the work process, and to involve into the work process on the basis of ethics and understanding of economical laws. English language courses as the language of the IT profession enable the student to use computer literature.

Optional courses are selected according to the four majors. Second year students select four out of eight offered optional courses, of which two are compulsory courses of the selected major. During the third year, students choose eight out of sixteen offered courses, with a recommendation of the course selection regarding the chosen major. Freedom of choice in the last year enables the student to correct the choices made in the second year.

- Optional courses of the Computer Systems and Networks major include the architecture of personal computers, computer networks design, server computer architecture, managing server computers, multimedia systems, and computer and data security. Competence which these courses provide is to ensure the successfulness of the professional bachelor as a system engineer of the server computers and computer networks in phases of design, implementation, and maintenance of the system functionality.
- Optional classes of the Software Development major include data structures and algorithms, object-oriented programming, advanced windows programming, java programming, c# programming, objective oriented modelling, Unix programming tools, distributed object programming, and project management and documentation. These courses provide competence for independent performing of programming tasks on Windows and Unix OS platforms.
- Optional courses of the Database major include database design, network services and programming, Internet programming and web page design. Competences include independent database design and creation of web-sites and applications.
- Optional courses of the Information Systems major include information systems design, informatization of management, e-business, public information systems and informatization of production. Courses provide competence in the field of creation, re-engineering and implementation of complex information systems.

1.8 Academic calendar 2024- 2025



Teaching weeks
Non-working days and holiday
Preparation weeks
Exam weeks
Collective vacation days

2 Professional Undergraduate Study in Information Technology – Study Program

Autumn courses -1st, 3rd, 5th semester
Summer courses – 2nd, 4th, 6th semester

1st Semester	Code	English*	Teaching hrs.	ECTS
Linear Algebra (LALG)	VSITE001	I	30+30	5
Physics (FIZ)	VSITE011		45+30	6
Fundamentals of Electrical Engineering (OET)	VSITE101	I	30+45	6
Digital and Microprocessor Technique (DIMT)	VSITE111	I	45+45	7
Computer and Program Usage (KRIP)	VSITE141	I	15+30	3
English Language 1 (ENG1)	VSITE041	III	30+0	2
Total:			**195+180**	**29**

2nd Semester	Code	English*	Teaching hrs.	ECTS
Mathematical Analysis 1 (MANA1)	VSITE002	I	30+45	6
Fundamentals of Electronics (OEL)	VSITE102	I	30+45	6
Architecture and Organization of Digital Computers (AODR)	VSITE112	I	45+45	7
Introduction to Computer Programming (UPROG)	VSITE121	I	45+60	8
Business Ethics (PET)	VSITE021		30+0	3
English Language 2 (ENG2)	VSITE042	III	30+0	2
Total:			**210+195**	**32**

3rd Semester	Code	English*	Teaching hrs.	ECTS
Applied and Numerical Mathematics (PNUM)	VSITE003		45+30	6
Programming Methods and Abstractions (PMA)	VSITE122		45+60	8
Databases (BPOD)	VSITE161		30+45	6
Information Systems (INFS)	VSITE171	I	60+0	6
English for Engineers (TENG)	VSITE043	III	45+0	3
Total:			**225+135**	**29**

4th Semester	Code	English*	Teaching hrs.	ECTS
Operating Systems (OST)	VSITE142		30+30	5
Computer Networks (RMR)	VSITE143		30+30	5
Elective course of the chosen Major			30+30	5
Elective course of the chosen Major			30+30	5
Elective course (from other Majors)			30+30	5
Elective course (from other Majors)			30+30	5
Total:			**180+180**	**30**

Elective Courses – Software Development	Code	English*	Teaching hrs.	ECTS
Data Structures and Algorithms (SPA)	VSITE123		30+30	5
Object-Oriented Programming (OBJ)	VSITE124		30+30	5
Elective Courses – Database and Web Design			**Teaching hrs.**	**ECTS**
Database Design (PBP)	VSITE162		30+30	5
Network Services and Programming (MUP)	VSITE163	I	30+30	5
Elective Courses – Computer Systems and Networks			**Teaching hrs.**	**ECTS**
Personal Computer Architecture (AOR)	VSITE144	I	30+30	5
Computer Networks Design and Management (PURM)	VSITE145		30+30	5

Elective Courses – Information Systems			Teaching hrs.	ECTS
Information Systems Design (PIS)	VSITE172	I	30+30	5
Informatization of Management (IPOSL)	VSITE173		30+30	5

5th Semester	Code	English*	Teaching hrs.	ECTS
Company Organization and Economics (EOP)	VSITE022		30+0	3
Mathematical Analysis 2 (MANA2)	VSITE004		45+30	6
Elective Course of the 5th Semester			30+30	5
Elective Course of the 5th Semester			30+30	5
Elective Course of the 5th Semester			30+30	5
Elective Course of the 5th Semester			30+30	5
Total:			**195+150**	**29**

6th Semester	Code	English*	Teaching hrs.	ECTS
Discrete Mathematics (DMAT)	VSITE005		45+30	6
Elective Course of the 6th Semester			30+30	5
Elective Course of the 6th Semester			30+30	5
Elective Course of the 6th Semester			30+30	5
Elective Course of the 6th Semester			30+30	5
Industrial Traineeship (PRAK)	VSITE018		0+0	0
Final Paper (ZAV)	VSITE019		0+0	8
Total:			**165+150**	**34**

Elective Courses – 5th and 6th Semester	Code	Courses	English*	Teaching hrs.	ECTS
Server Computer Architecture (APR)	VSITE151	Autumn		30+30	5
Server Management (UPR)	VSITE152	Summer		30+30	5
Computer and Data Security (SRP)	VSITE153	Autumn		30+30	5
Multimedia Networks and Systems (MMS)	VSITE154	Summer		30+30	5
UNIX Programming Tools (UNIX)	VSITE125	Autumn		30+30	5
Advanced Windows Programming (NWP)	VSITE131	Autumn		30+30	5
Java Programming (JAVA)	VSITE132	Autumn		30+30	5
C# Programming (CSH)	VSITE133	Autumn		30+30	5
Project Management and Documentation (VPD)	VSITE134	Summer		30+30	5
Object-Oriented Modelling (OOM)	VSITE135	Summer		30+30	5
Distributed Object Programming (DOP)	VSITE136	Summer		30+30	5
Internet Programming (PIN)	VSITE164	Autumn		30+30	5
Web Design (OWS)	VSITE165	Summer		30+30	5
E-Business (EPOSL)	VSITE174	Autumn		30+30	5
Public Information Systems (DIS)	VSITE175	Summer	I	30+30	5
Informatization of Production (IPRO)	VSITE176	Autumn		30+30	5
Introduction to artificial intelligence and machine learning (UUISU)	VSITE137	Summer	I	30+30	5

*** Explanation of English language levels:**

Level I: the course is given in Croatian, but the course literature is provided in English and individual consultations are provided in English

Level II: level I + lectures are given in Croatian but bilingual presentations during lectures contain English translation

Level III: the course is given in English

DESCRIPTION OF INDIVIDUAL COURSES

2.1 Linear Algebra

VSITE001

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures (hours)	30
Auditorium exercises (hours)	15
Laboratory exercises (hours)	15
Seminars (hours)	0
Individual work (hours)	90

Contents	Natural numbers, integers, rational and real numbers, complex numbers. Mathematical induction. Operations with numbers. Algebraic expressions, properties of algebra. Linear equations with one or several unknowns. Linear inequalities. Matrices, matrix representation of a system of linear equations, solving triangular systems, Gaussian elimination, linear independence, the rank of a matrix, inverse matrix, determinants, QR factorization and the method of least squares, vector space and linear operators, eigenvalues and eigenvectors. Vectors, basic operations with vectors, unit vector, linear independence of vectors and the base of Euclidean space, vector products and applications. Coordinate systems. Points, straight lines, planes and the applications of analytic geometry.
Learning objectives	General. Understanding the basic elements of the mathematical language and linear algebra required for easier understanding and following other mathematical and expert courses and modern scientific-technological development. Adopting the methods of mathematical and logical thinking, developing intuition and creativity. Specific. Ability for precise defining of notions, presentation in the mathematical language and algorithmic solving of problems of matrix and vector algebra while using modern technologies. Applying the content of the course for understanding and solving problems from the field of students' future expertise and other engineering problems while raising the level of knowledge and interest for mathematics by using computers in the class.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Calculate the value of the arithmetic expression, to simplify or expand algebraic expressions, to distinguish between different sets of numbers. 2. To solve linear equations, quadratic equations and inequalities, and to solve some of the higher order equations by the application of substitution method and factorization. 3. To sketch the straight line, parabola and circle that are given by equations and to find intersections between curves graphically. 4. To define terms related to complex numbers, to plot complex numbers in complex plane, to determine trigonometric and exponential form and to be able to perform calculations with complex numbers. 5. To define the following basic terms: matrix, determinant, vector, linear dependence and independence of vectors, vector space and its basis, Euclidean space, linear operator, eigenvalue. 6. To compute with matrices and vectors, to solve homogeneous and non-homogeneous systems of linear equations by Gaussian elimination method and by matrix method. 7. To determine the equation of a straight line and a plane in space by application of matrix and vector algebra, and to determine the mutual position of two straight lines, two planes, and straight line and plane. 8. To create functions and programs for solving tasks and problems with the use of computer software (such as MATLAB) or by combination of standard way of solving problems and computer software.
Skills	Mastery of the basic methods of matrix algebra and the vector algebra. Solving systems of linear equations, application of the method of least squares. Application of analytic geometry in space. Application of methods to engineering problems.

2.2 Mathematical Analysis 1

VSITE 002

ECTS	6
ECTS lectures	1
ECTS auditorium exercises	1
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3.5

Lectures (hours)	30
Auditorium exercises (hours)	30
Laboratory execises (hours)	15
Seminars (hours)	0
Individual work (hours)	105

Contents	Functions of real variable. Specifying and classifying functions, limits and continuity, asymptotes, review of elementary functions. Calculation of logarithm and general power. Exponential equations. Logarithmic equations. Sketching the graph of a function. Definition of trigonometric functions. Calculation of values of trigonometric functions. Derivation, differential, higher order derivations and differentials, mean value theorems, monotonicity, local extrema, curvature, examining the shape of a function. Integral calculus. Definition of an indefinite integral and basic methods of integration. Definition and properties of a definite integral. Newton-Leibnitz formula, improper integrals, applications of definite integrals. Sequences and series of real numbers, sequences and series of functions, Taylor's and Maclaurin's series.
Learning objectives	General. Use of differential and integral calculus for understanding and solving various problems in physics, engineering and studying other mathematical and expert courses. Development of conceptions by which the abstract contents are transformed into empirical and gaining basic, operational, creative and productive knowledge of mathematics. Specific. Understanding the basic idea, adopting and exercising basic algorithms and procedures and gaining the feel for application of mathematics of higher education. The ability for solving problems of differential and integral calculus and applications with the use of computers in symbolical, graphical and numerical fashion.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled, the student will be able to: 1. Precisely define the terms such as limit value of a function, continuity, derivation, indefinite, definite and improper integral and to list the properties and rules of the differential and integral calculus. 2. Calculate the limit value of a function, to determine the derivation of sum, product, quotient and composition of functions, and the derivation of implicit, parametric and inverse functions. 3. Explain the geometric and physical meaning of derivation, to apply derivation in various situations of measuring the speed of change of some quantity, to find the equation of tangent and normal line on the functions' graph and the linear approximation of a function. 4. Find the intervals of monotonicity and local extrema of a function, intervals of concavity and inflection points and to sketch the graph of a function. 5. Calculate the indefinite, definite and improper integral and to analyze the relations between them, to relate the indefinite integral and derivation. 6. Apply the integral calculus for calculation of the total position change, the distance, the work of a force, mean value of a function, area and volume. 7. Define sequence, series, and their convergence, name several convergence tests, and to examine the convergence of numeric series. 8. Find power series representation of a function and to determine the radius of convergence and to approximate functions with the Taylor's and Maclaurin's polynomial. 9. Define linear differential equation, general and particular solution and to solve the equation by the method of separation of variables and variation of parameters as well as by the Euler method. 10. Define the function of several variables, to define and sketch the domain for a function of two variables, to find partial derivatives, stationary points and total differential. 11. Create functions and programs for solving tasks and problems with the use of computer software (such as MATLAB) or by combining the standard way of solving problems and computer software.
Skills	Students gain basic knowledge about mathematical analysis of functions, differential and integral calculus, and sequences and series of numbers and functions. By adopting the terms and mastering skills in solving problems from the specified areas of mathematics enables them to follow other expert courses successfully.

2.3 Applied and Numerical Mathematics

VSITE003

ECTS	6
ECTS lectures	1.5
ECTS auditorium exercises	0
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3.5

Lectures (hours)	45
Auditorium exercises (hours)	0
Laboratory exercises (hours)	30
Seminars (hours)	0
Individual work (hours)	105

Contents	Ordinary differential equations: Definition and examples. First order ordinary differential equations. Solving certain types of first order differential equations. Second order ordinary differential equations. Linear differential equations of second order with constant coefficients. Laplace transform: Definition and properties of the Laplace transform. Application of the Laplace transform for solving the initial value problem of nonhomogeneous linear differential equations of second order with constant coefficients. Fundamentals of probability theory and statistics: Descriptive statistics. The concept of probability and basic theorems. Discrete and continuous random variables. Basic theoretical distributions. Adjustment of theoretical distributions to empirical data. Introduction to numerical mathematics: Approximate value and the error of approximate value. Numerical methods for solving nonlinear equations. Interpolation and approximation of a function. Numerical integration. Numerical solution of the initial value problem for the first order differential equations.
Learning objectives	General. Understanding laws, processes and phenomena in physics, biology and chemistry described by differential equations and their relation with the Laplace transforms. Understanding the phenomena and data from everyday life with the use of basics of descriptive and inferential statistics. Solving problems given by the empirical data through the use of methods of numerical mathematics. Specific. The ability to independently solve complex expert problems with the use of methods, basic algorithms and procedures of applied and numeric mathematics. Skills for writing programs and functions with the use of software package Matlab. Understanding the probability calculus with the application in everyday life.
Learning outcomes	It is expected that after the obligations determined by the curriculum are fulfilled, the student will be able: 1. To define Laplace transform of a function and to solve the problem with the use of Laplace transforms. 2. To define and describe basic terms of descriptive statistics and to calculate and interpret arithmetic mean, variance and standard deviation for grouped and ungrouped data. 3. To define the concept of permutation, combination and variation (with and without repetition), basic concepts of probability calculus and to calculate probability of simple events. 4. To define discrete and continuous random variable; to define, calculate and interpret mathematical expectation, variance and standard deviation of a random variable, probability density function and distribution function. 5. To describe and to apply the binomial, Poissons, uniform, normal and exponential distribution, to adjust theoretical distributions to empirical data and to determine theoretical frequencies. 6. To define absolute and relative (borderline) error, to compare and interpret them, to explain the problem of solving equations approximately, to find real solutions by bisection, tangent and secant method and to solve nonlinear system with the use of Newton's method. 7. To explain the problem of approximation of a function and to determine Lagrange interpolating polynomial and polynomial of 1st and 2nd order using the least squares method. 8. Numerical integration through the use of left and right rectangle formula, trapezoid and Simpson's formula, to evaluate the accuracy and to compare methods. 9. To write function m-files and programs in Matlab by which problems in numerical mathematics are solved.
Skills	Student is trained to model simple problems from the expert practice. He/she adopts the required knowledge of differential equations, numerical mathematics and statistics. He/she is introduced to software package MATLAB.

2.4 Mathematical Analysis 2

VSITE004

ECTS	6
ECTS lectures	1.5
ECTS auditorium exercises	1
ECTS laboratory exercises	0
ECTS seminars	0
ECTS individual work	3.5

Lectures (hours)	45
Auditorium exercises (hours)	30
Laboratory exercises (hours)	0
Seminars (hours)	0
Individual work (hours)	105

Contents	Basics of combinatorics. Binomial and polynomial theorem. Set of real and complex numbers. Complex functions: Derivative and integral of a complex function. The concept of analytic functions. Residues. Vectors: Operations with vectors. Vector space. Coordinate system. Plane and line in space. Functions of several variables: Derivative and integral of a function of several variables. Optimization problem. Vector functions of one and several variables. Divergence and curl of a vector field. Sequences and series of functions: Power series. Fourier analysis: Fourier series and Fourier integral. Orthogonal trigonometric systems, expansion of functions into Fourier series and applications, Parseval's equality.
Learning objectives	General. Understanding mathematics of changes in the finite dimensional spaces and its relation to the basic laws of classical physics, which, together with previous mathematical knowledge, provides a comprehensive basic mathematical competence for understanding and evaluating a wide range of problems in physics, engineering and other fields of work. Specific. Understanding of functions of multiple inputs and multiple outputs, understanding and the technique of their derivation and integration in a variety of conditions, and understanding its application on the formulation of basic laws of classical physics.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled, the student will be able to: 1. Through the use of vector language and system of linear equations know how to set up and solve problems with lines and planes. 2. Understand the relation between algebra of linear mappings and algebra of matrices and to apply that relation in solving problems with linear transformations and in interpreting operations with matrices. 3. Understand the basic ideas and techniques of mathematics of changes. 4. Know how to derive and integrate vector functions of a scalar variable and by using that apparatus know how to analyze motions and curves, and to understand mathematics which underlies Newtonian mechanics. 5. Know how to derive and integrate scalar function of a vector variable and know how to apply that to corresponding problems with scalar fields. 6. Know how to derive vector functions of a vector variable and to know how to apply that to analysis of transformation of space and coordinates. 7. Know how to integrate scalar and vector fields on curves and surfaces, analyze conservative fields, understand basic theorems about gradient, rotation and divergence, and to understand mathematics which underlies Maxwell's laws of electromagnetism.
Skills	The course provides broader knowledge of integrating techniques, definite integrals and their applications, Fourier series and applications, basics of differential equation, and functions of several variables and multiple integrals.

2.5 Discrete Mathematics

VSITE005

ECTS	6
ECTS lectures	1.5
ECTS auditorium exercises	1
ECTS laboratory exercises	0
ECTS seminars	0
ECTS individual work	3.5

Lectures (hours)	45
Auditorium exercises (hours)	30
Laboratory exercises (hours)	0
Seminars (hours)	0
Individual work (hours)	105

Contents	MATHEMATICAL MODELING. Mathematical structures. Language and formal procedures. Discrete and continuous models. MATHEMATICAL LANGUAGE. Symbolization and the use of variables. Elements of mathematical language. Definitions and proofs. LOGIC. Propositional logic. Introduction to predicate logic. Introduction to logical programming and Prolog. The problem of program correctness. SETS. Algebra of sets. Power set. Ordered pair and Cartesian product. RELATIONS. Ordering relations. Topological sorting. Equivalence relations. Application to the relational databases. FUNCTIONS. Introduction to functional programming and Lisp. STRUCTURES. Structures, isomorphism, specification and realization of structures. Algebra of modulo *n* and symmetric cryptography. Data structures. INDUCTION AND RECURSION. The structure of natural numbers. Principle of proving by induction. Principle of defining by recursion. Sums. Recursive modeling. COMBINATORICS. Principle of addition and principle of inclusion and exclusion. Multiplicative principle and the selection tree. Permutations and selections. ALGORITHM COMPLEXITY. Comparison of asymptotic behavior. Asymptotic estimate of complexity. Complexity of recursive algorithms. Practical non-computability and public-key cryptography. P, NP and NP complete problems. GRAPHS. Chinese postman problem. Traveling salesman problem. The connectivity problem. Shortest path problem. Minimal tree problem. Flow problem. FORMAL LANGUAGES AND AUTOMATA. Languages, automata and grammars. Regular languages and finite automata. Context-free languages and pushdown automata. Turing machines and computability.
Learning objectives	General. Knowledge of basic logical and mathematical concepts as well as certain eloquence in mathematical and logical languages, required for reading technical literature and precise modeling and expression of ideas. Art of recursive modeling and inductive proofs. Analysis of the algorithm complexity. Modeling with the help of graphs. Specific. Knowledge of elements of mathematical and logical languages. Knowledge of basic mathematical vocabulary. Knowledge of basic notions of theory of computation. Art of inductive proof and recursive description. Determining the complexity of algorithms. Knowledge of specified algorithms on graphs.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Understand the basic elements of mathematical language on a deeper level. 2. Understand the language of logic and basic concepts in logic. 3. Model problems in the language of logic. 4. Translate between natural language and the language of logic. 5. Know the basic mathematical vocabulary of sets, relations, functions and structures as well as their basic properties. 6. Know the terms related to computability and complexity of algorithms. 7. Understand the induction and recursion and to know how to use it in modeling and problem solving. 8. Know the basics of combinatorics and to know how to apply it to the analysis of the complexity of algorithms. 9. Know the basic concepts about graphs and to solve some sort of problems: the accessibility problem, the shortest path problem, the problem of minimal spanning tree, and sorting, inserting new elements and searching tree.
Skills	This course provides broader knowledge about discrete mathematics as the basis of technical studies.

2.6 Physics

VSITE011

ECTS	6
ECTS lectures	1.5
ECTS auditorium exercises	0
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3.5

Lectures (hours)	45
Auditorium exercises (hours)	0
Laboratory exercises (hours)	30
Seminars (hours)	0
Individual work (hours)	105

Contents	Modeling of physical phenomena: intuitive and formal models, transfer into other domains, e.g. economy; physical quantities and measurements - fractals. Kinematics: description of particle motion using diagrams, tables, graphics and mathematical formulas. Dynamics: Newton's laws of motion, difference equations, drag forces in fluids. Rotational motion: description of rotational motion. Laws of conservation of energy, momentum and angular momentum. Newton's law of universal gravitation: Kepler's laws, Newton's law of gravitation, high tide and low tide, rockets. Oscillations: description of oscillatory motion, harmonic oscillations, damped and forced oscillations, Q-factor, resonance. Waves: wave formation, plane wave, interference of waves, standing waves. Sound: acoustic pressure variation, sound intensity level in db, Doppler effect, Fourier's theorem. Fluids: kinetic theory of gases, internal energy and temperature, laws of thermodynamics, entropy - informational, thermodynamical and probabilistic definition, transport phenomena, airplane. Non-linear phenomena - complexity and chaos. Electricity and magnetism - qualitative introduction: electronic gas model, electric field and potential, magnetic dipole, electromagnetic induction, Hall probe. Electromagnetic waves: electric oscillatory circuit, plane electromagnetic wave, spectrum of e-m radiation. Light: mirrors and lenses, eye and camera, diffraction, resolution - computer graphics. Structure of matter - introduction to quantum physics: photo-electric effect, model of the hydrogen atom, model of the hydrogen molecule - wave function, LED, laser, QTM.
Learning objectives	General: How to formulate problem, to analyse it, to create a plan for problem solving (e.g. to choose an adequate tool), and to analyse the solution. Analogy usage in problem solving. Specific: Modeling of physical problems using mathematical and programming tools such as Matlab or C. Analogy usage in the analysis and problem solving from different fields of physics. Implementation and analysis of physical experiments conducted with the help of computers.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Solve conceptual problems in physics and to lead a quality discussion about them, and to solve some classes of problems analytically and/or numerically. 2. Relate different fields of physics to each other, and to relate physics to computer science, electrical engineering and mathematics. 3. Analyze physical model and to recognize the domain in which the model is a good approximation of the physical system described by the model. 4. Distinguish physical model from experimental data. 5. Identify and evaluate errors in experiments. 6. Present results of experiments in tables and graphically and to interpret them. 7. To fit the experimental data to the model.
Skills	Students are trained to: operationally use the kinematic and dynamic notions and laws within the context of mechanics and waves, recognize the elementary notions from quantum physics, model simple physical situations (and solve the corresponding difference equations), understand several types of data presentation (diagram, graph, table, formula, Euclidean and fractal geometry), and apply these procedures to solve problems in engineering and economy.

2.7 Industrial Traineeship

VSITE018

ECTS	2
ECTS lectures	0
ECTS auditorium exercises	0
ECTS laboratory exercises	0
ECTS seminars	1
ECTS individual work	1

Lectures (hours)	0
Auditorium exercises (hours)	0
Laboratory exercises (hours)	0
Seminars (hours)	30
Individual work (hours)	30

Contents	Industrial traineeship is being conducted with the aim to introduce a student to the working processes of real working environment and to gain first experiences in team work in everyday working tasks.
Learning objectives	General. Using team work in all life situations. Specific. Argument based discussion about various subjects from the domain of business life. Expressing views, negotiations and allowing others to express their views. Understanding processes which are important for the totality of conducting business.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Recognize the basic processes of working environment, 2. Understand the basic elements of team work.
Skills	It provides the candidate with insight into processes of actual working environment and it trains him/her for team work.

2.8 Final Paper

VSITE019

ECTS	8
ECTS lectures	0
ECTS auditorium exercises	0
ECTS laboratory exercises	0
ECTS seminars	2.5
ECTS individual work	5.5

Lectures (hours)	0
Auditorium exercises (hours)	0
Laboratory exercises (hours)	0
Seminars (hours)	75
Individual work (hours)	165

Contents	Based on the assigned problem, study states of the technique, propose an optimal solution, and verify it experimentally. Create the final thesis of approximately 40 pages.
Learning objectives	General. To use literature on his/her own to solve the assigned set of problems. Specific. Understand the process of writing professional papers and present them to the expert auditorium.
Learning outcomes	It is expected that the student will be able to: 1. Study literature by him-/herself 2. To create the theoretical part of the task. 3. To verify the solution experimentally. 4. To present the given problem and solution.
Skills	It trains him/her to study the literature on their own, to create solutions, to verify experimentally and to present the given problem and the solution.

2.9 Business Ethics

VSITE021

ECTS	3
ECTS lectures	1
ECTS auditorium exercises	0
ECTS laboratory exercises	0
ECTS seminars	0
ECTS individual work	2

Lectures (hours)	30
Auditorium exercises (hours)	0
Laboratory exercises (hours)	0
Seminars (hours)	0
Individual work (hours)	60

Contents	Descriptive, normative ethics, contemporary business ethical theories. Ethical principles. The position of the individual in society. Basic human rights. Co-existence in social relations. Forms of discrimination and their avoidance. Ethical relationships and realization of individual rights in the working environment. Business relations, confidential relationships. Basics of business ethics. Disloyal competition and its avoidance. Corruption. Conflict of interests. Protection of data confidentiality. Privacy and equality of workers. Accuracy and transparency of data. Gifts, services and entertainment. Abuse and health protection. Socially acceptable business conduct. Intellectual ownership protection. Law and other regulations from the domain of human rights, business conduct and intellectual property.
Learning objectives	The goal of studying business ethics is to present to students, in the framework of IT and communication technologies, the issue of interpersonal relations in a more transparent way, and those relations are dynamically changing under the influence of IT technology. The goal is to demonstrate the basic laws of moral conduct through the demonstration of changes in different social times. The goal is to encourage them to think and to actively participate in discussing ethical problems in the insufficient conduct policies in ICT within the undefined moral principles which are the result of quick changes in technologies (WWW and Internet).
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Understand modern ethical theories. 2. Understand the influence of the IT technological core on applied ethics and especially on ICT and business applied ethics. 3. Understand basic concepts, virtues and principles in ICT and business applied ethics. 4. Understand vacuums of conception and chaos of concepts in applied computer ethics. 5. Connect, interpret and describe behaviors according to virtues and principles in business and applied computer ethics. 6. Connect changes in basic human rights, social relations and in working environments related to changes in technologies, especially regarding changes encouraged by Internet and WWW. 7. Change ethical theory and recommendations of the ethical code of the profession for well personal behavior, conduct and behaving in new-coming situations in ICT. 8. Know the recommendations of the profession's ethic code and personal rights and obligations related to privacy, law and other regulations from the field of human rights, business and intellectual property, copyrights and license, environment protection, data accuracy, privacy protection and the security of users and workers at ICT.
Skills	Students gain basic knowledge and attitudes from the field of interpersonal relations and human rights, respectful professional and business relations, protection of human rights, protection of copyrights and intellectual ownership.

2.10 Company Organization and Economics

VSITE022

ECTS	**3**
ECTS lectures	**1**
ECTS auditorium exercises	**0**
ECTS laboratory exercises	**0**
ECTS seminars	**0**
ECTS individual work	**2**

Lectures (hours)	**30**
Auditorium exercises (hours)	**0**
Laboratory exercises (hours)	**0**
Seminars (hours)	**0**
Individual work (hours)	**60**

Contents	Company and business theory: theory, goals and values of the company (enterprise); the notion of an entrepreneur and entrepreneurship; participants in the enterprise and their relations; principles of enterprise business conduct; enterprise functions; sources of enterprise; measures of business success. Enterprise organization: the notion of an organization, theory of an organization, organizational structure, basic business functions in the enterprise. Cost theory: notion and the meaning of costs; nature and types of costs; places and cost bearers; cost feasibility and retentivity. Calculations: notion and element of calculation; types of calculations, calculation of equivalent numbers and related products; application of cost theory in price policy in different market situations. Production: basic notions; total, average and borderline productivity; capacities- notion, types and utilization; maintenance and the replacement of sources. Business result: expenses; incomes; business result (gain and loss); measuring of the business success- productivity, economy, profitability.
Learning objectives	General: This course enables gaining knowledge about basic notions of economy and business organizations and their mutual relations: enterprise, entrepreneurship, sources, work, pay, expenses, production, calculation, balance, gain, gain distribution. Special: Analyzing situations of economic relationships in practical examples of conducting business in IT technologies. Including students in analysis of concrete business situations, creation of calculations, formation of enterprise, tax issues.
Learning outcomes	It is expected that after fulfilling tasks defined by the curriculum the student will be able to: 1. Understand basic goals and values of the enterprise. 2. Understand mediums and sources of mediums. 3. Understand basic factors of working processes. 4. Connect the working process with the dynamics of cost motion. 5. Analyze costs and gain competence for creation of basic calculation of the product. 6. Apply cost theory for understanding pricing policy. 7. Use the accounting statement for understanding business results of an enterprise. 8. Understand the measures for tracking successfulness of conducting enterprise business.
Skills	This course provides basic knowledge about economics and the organization of the enterprise as a general social basis of technical studies and it enables the attendants for evaluation of economical and organizational goals of the work task.

2.11 English Language 1

VSITE041

ECTS	**2**
ECTS lectures	**1**
ECTS auditorium exercises	**0**
ECTS laboratory exercises	**0**
ECTS seminars	**0**
ECTS individual work	**1**

Lectures (hours)	**30**
Auditorium exercises (hours)	**0**
Laboratory execises (hours)	**0**
Seminars (hours)	**0**
Individual work (hours)	**30**

Contents	Extreme climatic conditions; reading and listening of various weather reports. Biographies of famous and creative people; interviews; writing about other peoples' lives; describing people. Media world; planning new TV programmes and giving propositions. Health and charitable health organizations; conversation about life experiences; giving advice about health. Tourist destinations and natural beauties of the world; reading tourist guides and describing places. Analysis of society and family; conversation about various types of families.
Learning objectives	General. Using basic language skills- talking, listening, reading and writing. Specific. Managing in everyday life situations, whether it is communication on the street, market, store, hotel, bank or is it some casual conversation with acquaintances about various areas of life. Writing simpler forms of text, such as short notifications, reports, e-mails, etc. Understanding spoken material, and reading simpler literal or newspaper articles, in the sense of finding relevant information.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled, the student will be able to: 1. Understand the main thoughts from general text or text from a prescribed literature and unfamiliar words within the context in which they were used. 2. Understand speaking or lecture about a familiar subject. 3. Describe subjects and contents related to interests. 4. Read, analyze and present a short written general material. 5. Ask questions and provide feedback. 6. Give advice, propositions, etc. 7. Follow and participate in discussion about familiar topics. 8. Write a short essay/report listing pros and cons. 9. Make short notes.
Skills	Student is enabled to use basic lingual skills- talking, listening, reading and writing. He/she can confidently get around everyday situations and in casual conversation with acquaintances about various areas of life. He/she is trained, in written communication, to write simpler forms of texts. He/she is trained, in the same fashion, to understand speaking material, as well as for reading simpler literary and newspaper articles.

2.12 English language 2

VSITE042

ECTS	2
ECTS lectures	1
ECTS auditorium exercises	0
ECTS laboratory exercises	0
ECTS seminars	0
ECTS individual work	1

Lectures (hours)	30
Auditorium exercises (hours)	0
Laboratory execises (hours)	0
Seminars (hours)	0
Individual work (hours)	30

Contents	Science and inventions; attitudes about various scientific questions; reading graphs. Scientific facts about sleeping, advantages and disadvantages of working during the night. Work and industry; negotiations and business deals. People and organizations related to various global questions. Care for environment; causes and consequences of global warming. Various topics related to sports; sport psychology and influence on health.
Learning outcomes	General. Using all language skills required in everyday life, i.e. speaking, listening, reading and writing. Specific. Argumentative discussing about various topics such as politics, religion and other forms of public life. Expressing views, negotiation. Presenting propositions and views on various topics without lingual difficulties. Writing short stories, essays, reports, formal e-mails, and description of processes. Understanding original speaking materials related to various aspects of life, as well as using written texts with the goal of finding relevant information.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Understand the main thoughts from a general text or a text from the prescribed literature and unfamiliar words from context within which they are said. 2. To understand a speech or lecture about a familiar topic. 3. To describe topics and contents related to interests. 4. Read, analyze and present general written material. 5. Discuss about some general topics with arguments. 6. Negotiate with the use of matching vocabulary. 7. Follow and participate in discussions about familiar topics. 8. Write an essay, report, short story. 9. Use written texts for finding relevant information.
Skills	Student is trained to use all language skills required in everyday life, i.e. speaking, listening, reading and writing. He/she can use English language for shopping, to talk about health and health issues, express his/her views on interests, hobbies and spending free time. He/she can present propositions and views on various topics, without lingual difficulties, talk about traveling, real-estates and various types of interests. Student can successfully participate in discussions related to religion, politics and all forms of public life. He/she also gains skills for understanding original speaking materials related to various aspects of life, and also using written texts with the goal of finding relevant information.

2.13 English for Engineers

VSITE043

ECTS	3
ECTS lectures	1.5
ECTS auditorium exercises	0
ECTS laboratory exercises	0
ECTS seminars	0
ECTS individual work	1.5

Lectures (hours)	45
Auditorium exercises (hours)	0
Laboratory exercises (hours)	0
Seminars (hours)	0
Individual work (hours)	45

Contents	Computer users; writing short descriptions; computer architecture; finding certain information within text; technical information exchange; writing instructions; computer applications; reading diagrams; neglecting unimportant information; describing process; peripheral devices; function description; operating systems, predictions; graphical user interface; reading diagrams; explaining; taking notes; recommending; multimedia; finding information in diagram and text; user support; providing instructions; networks; listing advantages and disadvantages; Internet; computerized communication. WWW; web pages; evaluation; transferring information; web page creator, definitions and collocations; communication systems; describing systems; data security; scanning, explaining criminal acts done with the use of computer technologies; reading tables; programme development; people in computer industry; comparing different types of text; presentation; writing reports; writing summaries; defending one's own decision.
Learning objectives	General. Using language skills required in the world of computer technology. Ability for clear and efficient written and oral expression in English language, including public presentation skills. Specific. Communicating in all fields of one's profession, describing how something works, comparing, describing functions, posing questions, reading and drawing diagrams, prediction, writing notes, understanding and writing simple and complex instructions, exchanging information, giving recommendations, finding relevant information in text; describing processes, describing advantages and disadvantages, writing and understanding warnings, explaining.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Define and describe the application of computers in a proper way, peripheral devices, operating system, GUI (graphical user interface), application programmes, multimedia, computer networks, Internet, WWW, communication systems, data security, software engineering. 2 Know and use terminology about the mentioned things in English language. 3. Describe topics and contents related to profession. 4. Read/understand, analyse and present written or audio-visual IT material with writing short notes. 5. Prepare and present a presentation. 6. Present a certain topic related to profession in a simple way, while emphasizing important elements and significant details. 7. To write, in a clear manner, a short, coherent written work (report, summary) within the framework of teaching units.
Skills	Student is trained to use language skills required in the world of computer technology. He/she can, in English language: communicate in all fields of his/her profession, describe how something works, compare, describe the function of something, pose a question, read and draw diagrams, predict, write notes, understand and write simple and complex instructions, exchange information, recommend, find relevant information within text; describe processes, describe advantages and disadvantages, write and understand warnings, explain.

2.14 Fundamentals of Electrical Engineering

VSITE101

ECTS	6
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3.5

Lectures (hours)	30
Auditorium exercises (hours)	15
Laboratory exercises (hours)	30
Seminars (hours)	0
Individual work (hours)	105

Contents	ELECTROSTATICS: Basic concepts of electricity. Electrostatic interference of charged objects (Coulomb's law). Electrical field. Electrical flux - Gauss' law. Potential energy and electrostatic field potential. Conductors and dielectrics in electrostatic field. Electrical capacitance and capacitors. Energy and force in electrostatic field. DIRECT CURRENTS: Electrical values. Basic laws of current flow in electrical circuit. Determining equivalent resistance. Basic electrical circuit. Electrical work, power and energy. Methods for linear DC circuit analysis. ELECTROMAGNETISM: Magnetic field intensity, magnetic flux and density. Magnetic field effects (law of electromagnetic induction, forces in magnetic field). Inductivity and mutual inductivity. Object in a magnetic field. Magnetic field energy. ALTERNATING CURRENTS: Sinusoidal EMPF and current. Loads in AC circuit. Resonance. Coil with magnetic core. Transformers. Three-phase systems.
Learning objectives	General: Knowing basic laws of electrical-engineering and electrical circuits analysis. Specific. DC and AC circuit design. Calculation of basic low-voltage electrical circuits characteristics. Knowing basic measuring methods in electrical engineering. Understanding influences on electrical devices functioning. Basic safety of electrical installations.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Know the basic laws of electrical engineering and basic characteristics of elements of electric circuits. 2. Use the basic measuring methods in electrical engineering. 3. Analyze simple low-voltage electrical circuits and dimension elements in DC and AC circuits. 4. Understand the influence on the operation of computers and other electrical devices. 5. Apply basic safety measures for low-voltage electrical installations.
Skills	This course provides basic knowledge in electrical engineering as a basis of technical studies, with adopting the engineering way of thinking, building on gained knowledge in physics and mathematics.

2.15 Fundamentals of Electronics

VSITE102

ECTS	6
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3.5

Lectures (hours)	30
Auditorium exercises (hours)	15
Laboratory exercises (hours)	30
Seminars (hours)	0
Individual work (hours)	105

Contents	Semiconductors: intrinsic, p and n type, generation and recombination process, drift and diffusional motion of carriers. PN junction: Contact potential, permeable and non-permeable polarization, current-voltage characteristic and equivalent circuits of semiconductor diode, capacitive diode, Zener diode, Light Emitting Diode. Bipolar transistors: types, modes of operation, parameters, static characteristics, equivalent models. Unipolar transistors: types, modes of operation, parameters, static characteristics, equivalent models (JFET, MOSFET, VMOS). Amplifiers: basic concepts, amplifier circuits with bipolar and field-effect transistors, Darlington amplifier, differential amplifier, level adjustment circuits. Power amplifiers: Class A, B, and AB, amplifiers with VMOS transistors. Voltage rectification and stabilization assembly. Half-wave and full wave rectifier. Operational amplifier: Inverting and non-inverting amplifier, voltage follower, differential amplifier and summing amplifier. Impulse signal and linear shaping: RC circuit, operational amplifier based derivator and integrator. Multivibrators: Bistable, monostable, astable and Schmitt trigger. Generator of saw-tooth and staircase waveforms.
Learning objectives	General: Working principles and main features of semiconductor electronic components and basic electronic circuitry. Specific: Knowledge about key phenomena in semiconductors and working principles of semiconductor diodes of various types and bipolar and unipolar transistors. Designing basic electronic circuits with diodes and transistors (rectifiers, limiters, amplifiers).
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Know physical basics of operation and characteristics of semiconductor elements. 2. Analyze the operation and apply the basic electronic circuitry (rectifiers, stabilizers, amplifiers with bipolar and unipolar transistors, operating amplifiers, oscillators, multivibrators). 3. Use the basic measuring methods in electronics.
Skills	This course provides basic knowledge in electronics as a basis of technical studies, with adopting the engineering way of thinking, based on previous knowledge in physics, mathematics and electrical engineering.

2.16 Digital and Microprocessor Technique

VSITE111

ECTS	7
ECTS lectures	1.5
ECTS auditorium exercises	0.5
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	4

Lectures (hours)	45
Auditorium exercises (hours)	15
Laboratory exercises (hours)	30
Seminars (hours)	0
Individual work (hours)	120

Contents	Digital and analog variables. Information. Coding. Numeric systems. Binary numeric system. Modulo arithmetics. Elementary logic circuits. Boole's algebra and logic algebra. Boole's functions. Minimization and realization of Boole's function through logic gates. Adder. Realization of Boole's function with the use of multiplexer and demultiplexer. Multiplexer-demultiplexer structure (ROM). Programmable logical structures. Time relations. Bistables. Synthesis of general bistables. Registers, shift registers and counters. Memories (RAM). Discrete finite digital automata. Specification and minimization. Structural synthesis. Programmable automata. Wilkie's model. Concept of micro-programming. Algorithms. Basis of micro-computer architecture. Processor. Memory, memory address circuit. Input-output circuit.
Learning objectives	General. This course provides basic knowledge about Boole's algebra and automata theory as a fundament of IT core. Specific. Practical knowledge of synthesis of combinatorial and sequential digital circuits, and programmable structures.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1.Use Boole's algebra and automata theory in synthesis of combinatorial and sequential digital circuits and programmable structures. 2. Know the principle of performance and structure of digital circuits of small, medium and large scale of integration. 3. Use basic measuring methods in digital electronics.
Skills	This course provides basic knowledge about Boole's algebra and theory of automata as the fundament of IT core, with practical knowledge of synthesis of combinatorial and sequential digital circuits, and programmable structures.

2.17 Architecture and Organization of Digital computers

VSITE112

ECTS	7
ECTS lectures	1.5
ECTS auditorium exercises	0.5
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	4

Lectures	45
Auditorium exercises	15
Laboratory exercises	30
Seminars	0
Individual work	120

Contents	Basic elements of electronic computers. Overview of computer development, their organization and architecture. Basic parts of a computer. Linking and data transfer. Buses and bus system. Interrupt mechanism. Direct memory access. Central processing unit. Arithmetic logic subsystem. Performing arithmetic operations. Register set. Execution control system. Integer arithmetic and fixed and floating point arithmetic. Command sets, RISC, CISC. Assembler. System memory unit. Memory elements. Memory system hierarchy. Memory record organization. Virtual memory. Addressing types. Basic functions of input and output unit. Computer input and output medium. Data entry. Data entry systems.
Learning objectives	Recognizing terms related to basic architecture of computers and recognizing terms related to creating complex digital circuits. Insight into fundamentals of computer operation. Setting the knowledge base required for development of hardware or complex hardware-software projects. Understanding basic processes which are going on in programmable circuits, possibility for individual learning and participation in teams which develop hardware solutions based on basic digital circuits.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1.Define basic parts of micro-computer and describe their function. 2. Define micro-processor and its position in relation to other electronic digital circuits, and also basic elements of its architecture. 3. Recognize and implement basic versions of programmable circuits which serve as building blocks of micro-processor technology. 4. Understand assembler programming. 5. Recognize basic problems and solutions when creating elements of micro-computer. 6. Gain starting knowledge for individual learning and participation in teams which create complex, micro-controller oriented solutions.
Skills	This course provides basic knowledge from the field of digital computer architecture as the fundament of computing science core, and it also provides insight into the principle of data processing on digital computers.

2.18 Introduction to Computer Programming

VSITE121

ECTS	8
ECTS lectures	1.5
ECTS auditorium exercises	0
ECTS laboratory exercises	2
ECTS seminars	0
ECTS individual work	4.5

Lectures	45
Auditorium exercises	0
Laboratory exercises	60
Seminars	0
Individual work	135

Content	Computer programs and programming languages. Bits and bytes. Number systems. Programming paradigms and Python programming language. A programming environment for writing and executing Python programs. Basic data types. Arithmetic operators and expressions. Variables, objects and assignment statements. Identifiers and naming rules. Data input and output. Relational and logical operators and expressions. Branching statements and loop statements. Using built-in functions. Defining own functions in Python. Creating your own modules. Documenting, testing and debugging. Compound data types. Sequences of characters (string). Lists in Python. Object oriented programming. Designing classes in Python. Python and artificial intelligence.
Learning objectives	General: To learn about software functioning, development and maintenance. To learn basic programming principles common to the majority of programming languages. Specific: To know in Python: Python IDLE environment, data types, variables and assignment statements, branching statements and loop statements, defining and using functions, creating and using modules, the importance of documenting, testing and debugging. manipulating strings and lists, defining classes and instantiating objects. Introduction to the basic concepts of artificial intelligence.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. To explain and to apply basic programming principles and approaches in developing program solutions, 2. To use Python IDLE environment. 3. To use basic programming elements 4. To use operators and expressions 5. To use branching statements and loop statements 6. To create program applications made of several functions, 7. To document, test and debug programs. 8. To manipulate lists, 9. To manipulate strings, 10. To apply basic principles of object-oriented programming and to create simple object-oriented program solutions. 11. Application of the k-nearest neighbor algorithm in supervised learning using the Python Scikit-Learn library
Skills	Student acquires the basic knowledge in programming as a pillar of computer science and educate students to develop applications in programming language Python.

2.19 Programming Methods and Abstractions

VSITE122

ECTS	8
ECTS lectures	1.5
ECTS auditorium exercises	0
ECTS laboratory exercises	2
ECTS seminars	0
ECTS individual work	4.5

Lectures	45
Auditorium exercises	0
Laboratory exercises	60
Seminars	0
Individual work	135

Contents	Introduction to C language. Coding and data types. Writing programs and programming documentation. Correcting program errors. Lexical and syntactic structure of C language: types, variables, expressions, control flow, functions, variable's visibility and scope. Arrays. Modular programming and functional decomposition. User's data structures: structure, union and enumeration. Working with textual and binary files. Standard libraries.
Learning objectives	General: Complete deterministic program analysis of problems with recognition and description of all the marginal cases. Abstract modeling of simpler programming problems by iterative methods. Specific: development of command-line applications in programming language C with the use of Visual Studio development environment. Using C standard function library. Possibility of reading and understanding technical documentation of any C program library, and their use in one's own project.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Analyze the posed program problem, recognize the level of its complexity, and to parse it into elementary steps and to implement it within programming language C, i.e. to propose pseudo-code of solution for some other structured programming language. 2. To model a programming solution by grouping atomic operations into separated and generic components (functional decomposition). 3. To understand and to be able to analyze (visually and with the use of debug tools) already proposed programming solutions in C programming language.
Skills	This course provides advanced knowledge from the field of programming as the fundament of computing science core, and it trains the attendant for programming in C programming language and MS Visual Studio environment.

2.20 Data Structures and Algorithms

VSITE123

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	0
Laboratory exercises	30
Seminars	0
Individual work	90

Contents	Programming strategies. Data structure. Arrays, list, vector, set, stack, tree, priority queue, graph, recursion. Ordered and unordered containers. Searching: sequential, binary, trees. Queues. Sorting: bubble, heap, quick, binary, radix. Dynamic algorithms: Fibonacci heap, binomial coefficients, optimal binary tree, multiplication of series of matrix. Graphs: minimum tree, Dijkstra's algorithm. Algorithm complexity basics. Solving more difficult problems: "Traveling salesman problem", "Chinese postman problem". Game theory: simpler solutions, alpha-beta algorithm.
Learning objectives	1. Understand the concept of abstract data type and its application in software development. Understand the basic data structure. Understand the methods of implementation of abstract data types with the use of data structure. 2. Knowing basic ATP's and differences in their behavior, way of application and performances in various scenarios. 3. Understanding and knowing how to describe the meaning of algorithm complexity. Finding complexity of more difficult algorithms. 4. Understanding algorithms' processes during the course, being able to describe algorithms, but also the course of executing those algorithms in concrete data. 5. Being able to choose and use algorithms, data structure and abstract data types independently, in given conditions and regarding the practical requirements of the developing software.
Learning outcomes	This course provides fundamental knowledge about using and features of often used data structures in C, about the performance of well-known algorithms, analysis of the performance time and the efficiency of algorithms, and the implementation of the given algorithms.
Skills	This course provides specialized knowledge from the field of programming as an upgrade to the computing science core, and it trains the attendant for efficient use of more complex data structures and the algorithms of a process.

2.21 Object-Oriented Programming

VSITE124

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	0
Laboratory exercises	30
Seminars	0
Individual work	90

Content	Structure and implementation of programs in C++ language: form, functions and primitive data types. Classes and objects. Arrays, streams and operators. Class interface, abstraction and implementation. Iterators and templates. Polymorphism and inheritance. Abstract classes. Generic classes. Handling exceptions. Fundamental dynamic data structures. Interaction with Windows operating system. Access to creating larger projects. Request analysis, creating tasks, system and object model, creating, testing and analysis of program use. Introduction to MFC classes.
Learning objectives	General. Principles of object and generic programming. Analysis of existing code. Running minor projects. Writing secure, simple and understandable code. Specific. Programming language C++: definition of classes and member functions; inheritance; polymorphism; templates; exceptions; standard library.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1.Understand the distinctions, foundations and principles of object programming. 2. Read, understand and analyze the existing code- examples, modules or projects. 3. Follow modern tendencies, standards and tools in object programming. 4. Design and run minor projects - problem analysis, specification, planning, documentation. 5. Perform minor projects independently - from definition of modules, libraries, classes and functions up to implementation. 6. To fit into larger (new or existing) projects within the developing team without any problems.
Skills	This course provides specialized knowledge from the field of programming as an upgrade to the core competencies and it enables attendants to program in C++ programming language.

2.22 UNIX Programming Tools

VSITE125

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	0
Laboratory exercises	30
Seminars	0
Individual work	90

Contents	Unix – multitasking and multi-user operating system. Historical development of Unix. Unix versions in use today. Linux and Open Source. Typical Unix session. Unix file system: characteristics, data types, naming, access permissions, Unix directory. File system hierarchy. Standard directory structure in Unix. Managing files and directories. Types of programming tools under Unix: Basic philosophy of Unix programming tools. Tools for manipulating files. Text editors. Tools for system administrating. Awk. Interpreters (Tcl/Tk). Shell: Definition. Types. Shell work. Basics of working with shell. Variables, expressions. Managing files. Standard files, input and output redirection, connecting processes via pipes. Basics of process managing. Scripts. Text editing: Text editor review in Unix. Vi editor. Basic work with vi and emacs editors. Regular expressions and their use. Basics of Unix administration: Process-definition, types, life cycle, attributes. Programming tools for tracking and managing processes. Programming in Unix: Source code editing. C, C++ programming translator for Unix. Gcc. Linker. Debuger. Typical project structure in C programming language. Make programming tool and its use. Basics of X-windows programming system: Client-server architecture, X -server. Display manager. Window manager. X-terminal. Graphical environments.
Learning objectives	GENERAL: Students will become familiar with the development cycle of writing applications which includes planning, writing, translating, connecting, testing and correcting errors. Students will come to know the basic roles that an operating system has. Students will become familiar with the formation, features and the role of TCP/IP. SPECIAL: Students will become familiar with features and roles: UNIX file system, user shells, writing and using scripts. They will learn about the importance and the ways of profiling programs. They will learn how to use, change and process textual files as basic units of data storage in script, in UNIX/Linux environment. They will come to know the anatomy of a graphical environment in UNIX/Linux systems, X-windows system, graphical environment, desktop. They will learn how to write, start and use UNIX/Linux system services. They will learn how to automatize the building of complex projects with the use of make/gmake tools. They will become familiar with the term of version repository and how it is used in developing versions of complex projects.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Log in to a UNIX/Linux system. Properly use a file system. Productively use and administrate his/her user account and shell. 2. To assemble and successfully use shell and awk scripts. 3. To write, translate, test and correct programs and program libraries in a UNIX/Linux environment with the help of gcc and gdb. 4. To productively use X-windows environment, graphical environments and desktop environments. 5. To successfully use TCP/IP stack in everyday work and in writing programs.
Skills	This course provides specialized knowledge in the field of programming as an upgrade to the computing core and it enables the attendant for using and developing programs for operating systems in the UNIX system family.

2.23 Advanced Windows Programming

VSITE131

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	0
Laboratory exercises	30
Seminars	0
Individual work	90

Content	Win32 architecture: Windows operating system, DLL's, Win32 API, Kernel, Win32 memory management. Win32 programming: Win32 program flow, SDK Windows programs, Windows versions, MFC. Dynamically loaded libraries: difference between dynamical and static linking, explicit and implicit linking. Threads: Win32 processes and threads, encapsulation of thread, thread synchronization, thread security. Win 32 processes: creating, synchronization, process termination. Standard windows controls: Win32 standard controls, MFC classes for standard controls. Windows system registry, Win32 registry API. Advanced Document/View architecture. Document templates, multiple document and view classes. Advanced menus and toolbars: dynamic menus and toolbars. Advanced GDI: transformation of coordinates, scrolling, print, metafiles, bitmaps.
Learning objectives	General. Event driven programming. Multilingual programming, Unicode. GUI. MDI applications. Database access. Specific. Win32: creating applications; communication towards OS and other applications; resources; GDI. MFC: basics of work and use; code generators, support in MS Visual Studio; print support.
Learning outcomes	It is expected that after the obligations defined by the curriculum the student will be able to: 1. Understand and explain the working principles of Windows OS and Win32 platform; the difference between console and Win32 application; the way of working and the communication of application under Windows; principles of event driven programming in relation to procedural programming. 2. Use the key parts of Win32 platforms with and without code generator; including basic modules for creating and controlling the window and dialog and advanced modules for GUI, printing or ODBC database access. 3. To design, implement and test minor to middle Win32 projects, independently- including the definition of the appearance and the application behaviour in more languages.
Skills	This course provides specialized knowledge from the field of programming as an upgrade to the computing science core and it enables the attendant for generating a complex user programs for Windows operating system.

2.24 Java Programming

VSITE132

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	0
Laboratory exercises	30
Seminars	0
Individual work	90

Contents	Introduction to JAVA programming. Object - oriented programming in Java. Basics of JAVA language. Working with objects. Fields, conditions, loops. Basic Java classes. Modifiers and access control. Writing Java applets. Working with graphics in Java. Using fonts and colors. Animations and sounds. Managing events and interactivity. Packages and interfaces. Java program and Web page. Basics of Java Servlet. Basics of Java Server Pages (JSP). Java Virtual Machine. Java development platforms.
Learning outcomes	General: Object-oriented programming. Understanding the sense and the relation of programming objects and classes with the real world. Specific: Introduction to JAVA platform: Java virtual machine and JAVA API. Understanding the importance of processing unexpected entries and program behavior. Using SWING package in creating applications with graphical interface. Distinguishing and implementing JAVA application and applet.
Learning outcomes	It is expected that after the obligations defined by the curriculum the student will be able to: 1.Implement JAVA applet. 2. Implement JAVA application. 3. Design structure of classes with interdependence. 4. Create graphical interface using SWING. 5. Understand processes in JAVA applications.
Skills	This course provides specialized knowledge in the field of programming as an upgrade to the computing science core and it enables the attendant to create programming support in Java programming language.

2.25 C# Programming

VSITE133

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	0
Laboratory exercises	30
Seminars	0
Individual work	90

Contents	Characteristics of structural and object oriented programming. Variables, operators, flow control statements. Polymorphism and inheritance. Structures and fields. .NET Framework. XML documentation in C#. Classes and objects. Exception handling. Inheritance, abstract classes. Interfaces, events and their processing. Creating Windows forms. Creating Windows applications. Developing application in web environment. Web services, web forms. Basics of ASP.NET applications. SOAP. Comparing C# to C/C++, Java, Visual Basic 6, and other .NET languages. Decomposing problems in larger projects. Problem analysis and creating software support. Testing a module and the entire application. Launching web application into working environment.
Learning objectives	It is expected that after the obligations defined by the curriculum the student will be able to: 1.Comprehend the C# language keywords and to write and understand program code written in C#. 2. Use most of the features provided by C# language and .NET framework. 3. Write simple and mid-complex programs in C# language using technologies available in .NET environment: Windows Forms, ASP.NET, WPF. 4. Use Visual Studio development environment to locate and fix errors in code.
Learning outcomes	Writing code in object oriented language. Using software development tools. Understanding how .NET framework works. Defining, using and understanding characteristics of particular types. Understanding principles of polymorphism, virtual methods, passing arguments to methods. Defining and using properties, interfaces, delegates and events. Handling exceptions. Using user defined attributes and generic types. Understanding how automatic memory management (garbage collector) works.
Skills	This course provides specialized knowledge from the field of programming as an upgrade to the computing science core and it enables the attendant to create software support in C# programming language.

2.26 Project Management and Documentation

VSITE134

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	0
Laboratory exercises	30
Seminars	0
Individual work	90

Contents	Project decomposition. Resource allocation. Resource load monitoring. Calculation of project costs. Linked tasks. Control points. Umbrella project design for workgroup monitoring. Workgroup definition and definition of their members' tasks. Comparison of the plan with its realization. Team organization and documentation. Reports on project progress. Reports on elapsed time. Risk control. Preparation of team meeting. Report on team meeting. Software modification monitoring. Software error registration. Analysis of change request. Testing of documentation and its importance for high quality software. Project delivery. Online customer support.
Learning objectives	General. Recognizing terms and requirements while defining and creating IT projects. Specific. Introduction to issues of creating and leading IT projects. Understanding and defining necessary requirements for successful creation and leading IT projects, and maintaining necessary documentation. Understanding required elements for creating EU projects. Knowledge necessary for working with MS Project.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Define component parts of the project while creating project charter. 2. Define necessary project resources with assigning required time. 3. Efficient managing of all types of resources for the project. 4. Efficiently manage the project using the MS Project software product. 5. Recognize the tasks of the project manager on IT projects as the assumption of the successful project completion and 6. Recognize project risks and treat them according to the selected approach.
Skills	The course provides students with professional knowledge of programming as an addition to the information technology core and trains a student to become a leader or member of a project team and to create documentation.

2.27 Object-Oriented Modelling

VSITE135

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	0
Laboratory exercises	30
Seminars	0
Individual work	90

Contents	General modeling techniques. Object oriented modeling. Introduction to UML (Unified Modeling Language). Developing process overview. Use cases. Class diagrams (attributes, association, aggregation, composition, generalization, parameterized classes). Direct and reverse design. Interaction diagrams: sequence diagrams, collaboration diagrams. State diagrams and activity diagrams. Introduction to object oriented design (inheritance, encapsulation, polymorphism, abstract interfaces, parameterized types). Design patterns. Interfaces, types and roles. Processes and threads. Modeling the source code. Modeling the executable.
Learning objectives	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1.Master basic principles related to object oriented technology. 2. Understand main methodologies of the object oriented development. 3. Understand and be able to create UML diagrams independently. 4. Understand and be able to apply the most common design patterns.
Learning outcomes	Being familiar with basic characteristics and terms related to object oriented modeling. Understanding the object model and its use in software development. Knowledge of iterative and incremental methodology of development. Ability to define use cases, modeling systems using various types of UML diagrams like: sequence diagrams, class and object diagrams, collaboration diagrams, activity diagrams. Recognizing and proper use of design patterns.
Skills	This course provides specialized knowledge from the field of programming as an upgrade to the computing science core, and it enables the attendant to model a prototype of a software system based on the user's requirement.

2.28 Distributed Object Programming

VSITE136

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	0
Laboratory exercises	30
Seminars	0
Individual work	90

Contents	Introduction. Object model. Component model. Three-layer architecture. Thin client. Independence of location and language. Scalability, reliability, security. Defining interface (IDL). CORBA, ORB, IIOP. COM/Distributed COM/COM+. Remote Procedure Call (RPC), Remote Method Invocation (RMI). Skeleton/proxy, proxy/stub. Interception, events. .NET architecture. Development platforms and languages.
Learning objectives	GENERAL: The student will gain detailed insight into characteristics and division of work in multi-layered applications. He/she will learn which safety and business requirements need to be fulfilled for applications that support large and complex business systems. SPECIFIC: The student will become familiar with CORBA object model and COM/DCOM system for MS Windows platforms. He/she will learn to write IDL definitions and translate them into a desired programming language. He/she will get to know JAVA Beans object model. He/she will learn to invoke objects from the distance through a network with the help of Java RMI and .NET remote technology. The student will become familiar with features and requirements of application framework for development of complex business systems, such as J2EE and .NET Enterprise. He/she will learn about ways to serialize objects for storing states and sending objects across the network. He/she will learn to process large amounts of non-structured data with the help of Hadoop MapReduce system.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Describe and properly use multi-layered structure of complex applications. 2. To set a communication structure within a multi-layered distributed object application in IDL. 3. To properly set the conditions and borders of transactions in different program models of multi-layered distributed object application. 4. To properly separate roles of different users according to their roles and rights within different objects of multi-layered distributed object application. 5. To successfully connect multi-layered distributed object application with data sources and databases.
Skills	This course provides specialized knowledge from the field of programming as an upgrade to the core of computing science, and it enables the attendant for programming of distributed user programs.

2.29 Introduction to artificial intelligence and machine learning

VSITE137

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	0
Laboratory exercises	30
Seminars	0
Individual work	90

Contents	Basic concepts of artificial intelligence and machine learning. Historical development. Models: SVM, NN, RNN, DNN, CNN, QNN. Perceptron: basic model, mathematical function, matrix representation. Activation functions: sigmoid, tanh, RELU. Neural network of perceptron layers, matrix representation. Evaluation of properties and evaluation of performance. Quantification of losses. Metrics. General approach to machine learning. Loss optimization. Gradient and gradient descent. Backpropagation. Chaining rule. Machine learning parameters: Learning Rate, Adaptive Learning Algorithms, Multiple Starting Algorithms (Batch). The problem of overfitting. Avoiding overtraining: regularization by Dropout, regularization by early stopping training (Early Stopping). Python as a language of artificial intelligence. Numerical analysis tools: numpy, scipy, pandas. Presentation tools: matplotlib. Machine learning and prediction systems: pytorch, keras-tensorflow. QNN: qkeras.
Learning objectives	Recognition of concepts related to artificial intelligence and machine learning. Evaluation and preparation of training data. Knowledge of basic models of artificial intelligence. Preparation of a model for machine learning. Training and use of trained models. Using model performance metrics.
Learning outcomes	It is expected that after completing the obligations provided by the curriculum, the student will be able to: 1. Preparation of data for models using packages in the Python programming language (NumPy, Pandas, SciPy). 2. Creating a machine learning model 3. Training and optimization of machine learning models 4. Implementation of the model in the real system and data visualization.
Skills	The course provides specialist knowledge in the field of artificial intelligence and machine learning and trains students to independently create and apply artificial intelligence models.

2.30 Computer and Program Usage

VSITE141

ECTS	3
ECTS lectures	0.5
ECTS auditorium exercises	0
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	1.5

Lectures	15
Auditorium exercises	0
Laboratory exercises	30
Seminars	0
Individual work	45

Contents	Fundamentals of IT. Hardware, software, computer networks, Internet. Basics of using computer and operating system (MS Windows). PC. Operating systems and applications. Adjusting desktop. Windows. Starting programs. Windows Explorer: managing directories and files. Recycle bin. Using Internet: Internet services: WWW, E-mail, FTP, News, Chat. Internet Explorer. Sending and receiving e-mail messages, attaching files to messages. Writing and processing text (MS Word). . Adding toolbars, working with documents, text formatting, printing, searching and replacing, page numbering, header and footer page formatting, inserting symbols and pictures, lists, tables, writing mathematical formulas. Using templates. Multiple recipients E-mail. Table calculations (MS Excel): Spreadsheet. Workbook, worksheets, cells. Data entry and formatting, elementary accounting operations, functions and formula entry, data sorting and filtering, printing, graph creating and formatting. Basics of vector computer graphics (Corel Draw): content of window. Creating basic graphic elements. Basic object formatting. Presentation order. Aligning. Text formatting. Multimedia presentations (MS Power Point): Different document views. Working with "wizards" and templates. Background formatting. Working with animations: applying animation to text, pictures and graphs. Sound effects.
Learning objectives	General. Recognizing terms and requirements related to basic computer components, Windows operating system and parts of MS Office package. Specific. Deep insight into specificities of working in Word, Excel, Outlook, Internet and e-mail, and also basics of computer hardware.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Efficiently use Internet and e-mail. 2. Efficiently use MS Windows operating system. 3. Efficiently use MS Office programs: Word, Excel, Power Point and Outlook.
Skills	Students gain basic IT knowledge and skills from the following fields: Basics of IT, basics of computer usage and operating system (MS Windows), using Internet and e-mails, word-processor (MS Word), spreadsheets (MS Excel), and multimedia presentations (MS PowerPoint).

2.31 Operating Systems

VSITE142

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	Operating system structure. System core. System calls, context switching. Processes. Communication between processes, signals, synchronization. Process sequencing, connecting processes. Interrupts. Managing memory, pages, virtual memory, segmentation. File system. Files. Directory. Allocation procedures. Network file systems. Security and protection. Distributed operating systems. Synchronization, latency, semaphores and indicators. Network operating systems. UNIX, WinNT.
Learning objectives	Operation modes of operating system and its subsystems. Recognizing potential problems in designing computer system regarding operating system operation mode. Knowledge of MS Windows API and its use in practice (C programming language). Knowledge of dynamic libraries operation (dll files) on MS Windows and their use in practice.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Define basic characteristics of an operating system (which computer parts are managed by an operating system and how) 2. Define basic terms related to operating systems (tasks, threads, mutual excluding, mutex, semaphores, indicators, etc.) 3. Defining programming solutions related to problems of multitasking and multithreading. 4. Recognize potential problems which may appear in programming solutions that use multitasking and multithreading. 5. Define initial parameters in designing system (hardware), regarding physical features and working mode of hardware parts managed by an operating system). 6. Knowledge of API functions and dynamic libraries (DLL) operation mode in operating system environment.
Skills	This course provides basic knowledge from the field of operating systems which is the fundament of the computing science core, and it trains a student to use standard operating system services with application programs.

2.32 Computer Networks

VSITE143

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	Development of data communication networks. Basic characteristics. Switching methods. Importance of standardization. Network elements. Channels, nodes, terminals. Computer and terminal network architecture. Hierarchical layered structures. ISO model. Protocols. Protocol mechanisms: synchronization, addressing, flow control and error control. Traffic control, congestion. PHYSICAL LEVEL: DTE-DCE, RS232, X.24 interface. Modem connections, intelligent modems. Signal codes. Local area networks. Access methods. Ethernet. Digital subscriber networks: ISDN, xDSL. ATM. DATA LINK LEVEL: Error control. Character and bit oriented protocols. Formal protocol specification. Local area networks: MAC, LLC, ATM networks. Frame-relay networks. NETWORK LEVEL: Packet networks. Traffic routing. Flow control. X.25. Internet. IP protocol (v4, v6), addressing, intranet, VOIP, IPsec. TRANSPORT LEVEL: TCP and UDP internet protocols. APPLICATION LEVELS: application and network services. Client-server concept. WWW, FTP, TELNET, e-mail, ping, trace route, ethereal. Quality of service. Network management. Basic security concepts. User accounts, passwords, access rights.
Learning objectives	Identifying basic features and computer network architectures. Explaining the way computer networks work. Recognizing ISO/OSI reference model and defining functions at each layer in detail. Identifying and explaining the TCP/IP group of protocols. Describing the way LAN and WAN technology works. Discussing trends in computer network technology development.
Learning results	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Define basic terms and computer network architectures. 2. Define the ISO/OSI reference model. Define the TCP/IP protocol group and compare to the OSI model. 3. Explain the work of the TCP/IP protocol group on the application layer. 4. Explain the work of TCP and UDP protocol on the transport layer. 5. Explain the work of IP protocols, IP addressing and routing. 7. Define LAN protocols and their work on the data link and physical layer. 8. Define WAN protocols and their work on the data link and physical layer. 9. Define addressing on the physical, data link and transport layer. 10. Define basics in computer network security.
Skills	This course provides basic concepts of computer networks which are the core of computing science.

2.33 Personal Computer Architecture

VSITE144

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	0
Laboratory exercises	30
Seminars	0
Individual work	90

Contents	Introduction. Basics of 80x86 architecture. Interrupts and DMA mechanism. 2. Bus. PC bus development: PC, ISA, EISA, MCA, VLB, PCI. 3. Processor. CISC and RISC processor. Development from Intel 8086 to Pentium IV. Using cache. Basic instruction set and MMX instruction set. Comparison with AMD processors. AMD 3D. 4. Memory systems. Organizing working memory. Static and dynamic memory. Data flow. Memory development: FP, EDO, SDRAM, DDR, RDRAM. 5. Mother board. BIOS, CMOS and RTC. Chipset. North and south bridge. Plug and Play technology. PC power supply. AT and ATX form. 6. Image presentation system. Image generating. Pixel and resolution. Video processor, video memory, DAC. Video standard development: MGA, CGA, EGA, VGA, SuperVGA. AGP bus. Monitors. Working principle: cathode ray tube, pixel resolution, horizontal and vertical frequency. Trinitron, LCD. 7. Data storage. Hard disks. Magnetizing materials. Data organization on hard disk. CHS. Data transfer. External buses: IDE and SCSI. Optical media. CD-ROM. ATAPI. CD-RW. Removable media. 8. I/O communication. Serial and parallel interface, devices and transfer. Modems, ISDN. USB bus. Local network connection. 9. Input devices. Keyboard, Mouse, PS2. Joystick. 10. Sound. Generating sound, analog and digital technique. Modulation, wave tables, PCM. Midi standard. 11. Printers. Paper printing techniques. Printer types: matrix, laser, ink. Connecting printer with computer. Communication languages: PostScript, PCL, ESCP2.
Learning objectives	General. Recognizing working mode of key components of PC and data flow through it. Specific: Deep insight into each of the key PC components. Understanding and defining importance of each component in overall hardware definition.
Learning outcomes	It is expected that after obligations defined by the curriculum are fulfilled, student will be able to: 1. Define key modules of PC processor architecture. 2. Define tasks and functioning of a memory system. 3. Define tasks of PC bus system. 4. Define role and tasks of PC chipset. 5. Define video system tasks. 6. Define role of PC peripherals. 7. Define computer configuration regarding user needs and 8. Recognize key problems in PC work.
Skills	This course provides specialized knowledge in the field of computer systems and networks which represents an upgrade to the computing science core and it enables the attendant for designing, assembly and maintenance of PCs.

2.34 Computer Networks Design and Management

VSITE145

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	0
Laboratory exercises	30
Seminars	0
Individual work	90

Contents	Computer network elements: computers, nodes, channels. Local area networks, Ethernet. Local networks topology development. Cabling development. Structured cabling. Campus cabling, building (vertical distribution) and floor cabling (horizontal distribution). Installation elements: cables, connectors, patch panels. Characteristics and categories of copper (UTP, STP) and optical cables. Standardization: ISO/IEC 11801, EIA/TIA 569. Creating project documentation: contents, organization, labeling system. Standardization: IEC 750, IEC 1082. Setting up installations. Identifying and testing lines. Labeling lines and connectors. Measurements. Documenting measurements. Network delivery. Identifying user requirements. Workgroups. Choosing and setup of active gear. Integration of computer network subsystems. Installing and adjusting modem connections. Installing and adjusting local network ports. Network architecture of TCP/IP (Internet). Addressing and domain names. Installing and adjusting TCP/IP programs. Non-connected and hidden networks (intranet). Reserved addresses. Installing and adjusting intranet networks. Basics of computer and data security. Traffic filtering. Firewall.
Learning objectives	General: The course enables students to gain knowledge in the field of design, construction, management and usage of computer networks as the central element of the information system infrastructure. Specific: Insight into the computer network design, construction and maintenance issues. Definition of parameters for the active and passive communications equipment, needed for a successful computer network construction. Defining and configuration of basic network services needed for the computer network operation.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Define basic parts of a computer network project. 2. Carry out a computer network project according to investors' requirements. 3. According to the project, install and test structured cabling for computer networks. 4. According to the project, define, install, configure and maintain passive/active network equipment. 5. According to the project, configure and maintain basic network services. 6. Manage a computer network. 7. Successfully identify and solve computer network problems.
Skills	This course provides specialized knowledge from the field of computer systems and networks which represents an upgrade to computing science core and it enables the candidate for designing, building and measuring structured cabling systems, and setting, initiating and maintaining active network gear.

2.35 Server Computer Architecture

VSITE151

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	0
Laboratory exercises	30
Seminars	0
Individual work	90

Contents	Introduction. 1. Server computers. Purpose and development. Mainframe computer, distributed systems, client-server concept. 2. Server systematization by function. File and print servers. Communication, RAS, gateway, DHCP, WINS, DNS, Web, FTP and Mail servers. Database servers. Fax servers. Back-up servers. Firewalls. 3. Server hardware. Server processors. Multi-processor platforms. Scalability. Symmetrical multi-processing SMP. Clustering. Memory system. Parity, ECC memory. Bus organization, I/O structure. 4. Data storage system. RAID technology. Physical and logical capacity. Fibre channel. SAN-Storage Area Network. 5. Networking. Data flow requirements and network port selection. Two-Three-Four tier model. Computer cluster. 6. Creating safety copies-Backup. Tape systems. Magneto -optical devices. Planning backup strategy. Device selection. 7. Operational security. Physical level security. Data security. Anti-virus protection and firewall. User level security. Supervision. Operating system administration. 8. Power source. UPS- Uninterruptible power source. Shut down control. 9. Server installation. Desktop and rack housing. Environmental parameters Hot-Plug technology. Cables. KVM switch. Operating system compatibility testing. Server operating system installation. 10. Solving problems in server environment. Order of server boot up. Disc recognition problems. Network problem diagnostics. Maintenance and upgrade.
Learning objectives	General: Explaining working principles of server components. Tracking control and data flow through server systems and components. Specific: Detailed development of key server systems and components. Detailed development of hardware and software of essential parts of server systems.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Define the architecture, functions and working mode of individual elements of server computer processors. 2. Define tasks and operation of memory systems. 3. Define working principles and tasks of bus systems of server computers. 4. Define chipset role and tasks in server computers. 5. Define working principles, types and system functions for data storage. 6. Define redundant, uninterruptible AC, DC and hybrid systems of powering server computers. 7. Define working principles, types and functions of monitoring system for server computers and 8. Recognizing key problems in server computer operations.
Skills	This course provides specialized knowledge from the field of computer systems which is an upgrade to the computing science core and it enables a student to design, implement and maintain server computers and operating systems.

2.36 Server Management

VSITE152

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	0
Laboratory exercises	30
Seminars	0
Individual work	90

Contents	Server computer preparation. Load optimization. Selecting operating systems. Selecting server hardware. RAID. Operating system installation. Disc system initialization. UPS installation. Interactive or automatized installation. Detecting and tuning server interfaces. Documenting installation. Network access configuration. Protocol selection. Address setup. Workgroup, domain. Creating user accounts and groups. System login. Kerberos. User profiles. Roaming profile. Active directory. Resource balancing. DNS hierarchy. File server. Directory and file sharing. Accessibility setup. File server installation. Printing server. Printer installation. Sharing a printer. Printer traffic optimization. FAX server. Network services. DHCP, DNS, WINS. Remote server access. Setting up RAS. Routing services. VPN Server. Remote server operations. Terminal Server. Remote Desktop Connection. Web server. Application server. IIS server. Tuning. Web area definition. Access security. Mail server. Exchange server. User login. Distribution groups. POP3 server. Public directories. Database server. Microsoft SQL server. Installation. Database, tables and users creation. Query Analyzer. Backup. Replication. DTS service. Creating safety copies. Selecting tactics and devices. Monitoring. Monitoring tools. SNMP Reporting Services. Event Viewer. Performance Services. Windows Update. Setting up security. Anti-virus protection. Firewall. ISA server.
Learning objectives	General: Explaining basic principles of managing individual and networked server computers. Application support for supervision of computer server systems. Specific: Detailed development of hardware and software support for database systems, RAID and VRAID sets, primary and secondary data storage, support using virtualization techniques of the client, server and data storage techniques, and of firewall and security technology implementation in server computer systems.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Define basic principles and functions of database systems and OS of computer servers. 2. Define the operational principles of RAID and VRAID systems of data storage. 3. Define primary, secondary, internal and external data storage systems. 4. Define and describe the functions of AD, WINS, DNS and DHCP services of Windows OS of server computers. 5. Define the working principles, types and functions of data storage security. 6. Define the term virtualization and develop the principles and implementation of client, server and virtual storage system. 7. Define the working principles, types and functions of data security, and also the working principles of security systems and firewalls. 8. Define the principles and methods of software and hardware support for monitoring and managing computer server systems.
Skills	This course provides specialized knowledge from the field of computer systems as an upgrade to the core of computing science, and it enables the student to install and set up server operating systems and services.

2.37 Computer and Data Security

VSITE153

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	0
Laboratory exercises	30
Seminars	0
Individual work	90

Contents	Information system security and protection goals. Development of Internet and the role of intranet and extranet. Management level controls: data control, data administration, security control, management control. Software controls: Access control: cryptography, personal identification numbers, digital signature, security and card operations. Input data controls, communication control, data processing control, database control, output file control. Legal aspects of information system protection. Planning information system security: managing of the information system protection, reconstructing information system plan, ISO/IEC 17799: 2000. Information security standard. Security organizations. Network security threats: eavesdropping, scanning, denial of service, Web hacking, data manipulation, masquerade, session replay, session hijacking, rerouting, viruses, Trojan horses, worms. Defining security policies. Network and operating system protection. DNS, NIS, Proxy, e-mail, WWW, ftp, NFS, protection. Firewalls, NAT. Security services and procedures: one-time password, token cards/soft tokens, TACACS+, RADIUS, KERBEROS, VPN, IKE/IPSec. Safety data storage. Monitoring system operation. Systems for intrusion detection. Network system recovery.
Learning objectives	General: The course offers basic knowledge in the field of computer and data security. Specific: Familiarizing with network security technologies, network threats and defense through study of different types of attacks. Familiarizing with network security on small, medium and large network level. Familiarizing with computer data security, the encryption and protection.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Recognize and define security on the level of managing information systems and legal aspects, ergonomics, RAID systems, NAT, VPN, IP spoofing, DOS attacks and other types of attacks 2. Recognize and define security on the software support management level 3. Define and explain the architecture of network security.
Skills	This course provides students with professional knowledge from the field of computer system security as an upgrade to the computing science and it trains a student for technical and organizational protection of computers and data.

2.38 Multimedia Networks and Systems

VSITE154

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	0
Laboratory exercises	30
Seminars	0
Individual work	90

Contents	Multimedia. Videoconference and video telephony. Multimedia presentations. Characteristics of audio and video signals. Coding audio/video information. Integration of traffic and services in communication networks. Digital networks of integrated services (ISDN). Broadband ISDN-ATM. ATM networks' architecture. ATM networks' services: CBR, VBR, ABR and UBR. Models of service quality on Internet. Intserv, Diffserv. Protocols for multimedia flow. Multimedia network services. Radio and TV program transmission. Music and video clips' transmission and reproduction. Video and music on demand. Voice transmission. VoIP. Multimedia presentation system. PC multimedia elements. Sound reproduction. TV and HDTV signal reproduction. Integrated receiver. Signal reproduction from CD and DVD media. Installing and setting up computer multimedia equipment.
Learning objectives	General: The course offers familiarization with multimedia services and with their transmission through various networks. Specific: Familiarizing with codecs for video and voice communication transmission and their application in systems, the protocols used for the mentioned and the working principle of VoIP and video streaming through service provider networks.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Identify and define basic types of codecs for the audio and video signal transmission. 2. Recognize the principle of audio and video signal transmission through an IP network and the protocols used for it. 3. Configure basic parameters of a VoIP telephone and central switch office, and also of a video streaming system. 4. Recognize the system and infrastructure of a service provider and the separation procedure of different services inside a system.
Skills	This course provides students with professional knowledge from the field of computer systems as an upgrade to the core of computer science and it trains a student to design and maintain a system for processing and transferring multimedia information.

2.39 Databases

VSITE161

ECTS	6
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3.5

Lectures	30
Auditorium exercises	15
Laboratory exercises	30
Seminars	0
Individual work	105

Contents	Database concepts. DBMS-Database management system. Hierarchical model. Entities and attributes. Relationships and cardinality. Relationship types. E-R model. Relational model. Relational algebra – operators, keys. Database integrity, referential integrity. Indexing. Normalization, normal forms. SQL. Transaction: processing requirements, blocking access, checkpoints, recovery from errors. Modeling events – triggers. Multi-user access control. Security and access privileges. Database design. Distributed databases. Client-server systems. Databases: Access, SQL server, ORACLE, fundamentals of use, access and processing data – forms, reports.
Learning objectives	General: This course provides knowledge about modeling and using relational databases as the central element of an information system. Special: Modelling database using the E-R model and relational data model. Eliminating anomalies through normalization. Introduction to indexing. Using SQL language for creating tables and working with data. Recognizing problems during multi-user work in database. Using MS Access system for managing database.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Design entity-relationship diagrams. 2. Transform E-R model into relational data model. 3. Set up rules of integrity in database. 4. Master operations of relation algebra. 5. Apply normalization of database. 6. Apply SQL commands for definition of elements in database. 7. Efficiently apply SQL commands for inserting, updating, deleting and searching database. 8. Learn about fundamentals of multi-user work.
Skills	This course provides basic knowledge from the field of databases as the fundament of the computer science core and it trains the attendants to design and to create databases in MS Access application.

2.40 Database Design

VSITE162

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	0
Laboratory exercises	30
Seminars	0
Individual work	90

Contents	Identifying user requests. Creating formal system specification. . Data modeling. Designing database structure. Transact SQL commands and functions. Database procedures. SQL query optimization. Creating base prototype. Selecting user interface. Selecting programming tools. Designing forms for entry and correcting data. Report criteria selection. Designing reports. Data security. Limitation of database access and authorization. Database backup copies. Database server systems. Data availability and protection. Database performance optimization. Multi-user access. Database networking.
Learning objectives	General: This course provides basic knowledge about database server systems functioning. Students learn basic administration and programming skills within the database servers .Mastering Transact-SQL language as well as Microsoft SQL Server Management Studio tools. Development and execution of stored procedures and triggers inside the database. Setting permissions and denying of access to data. Managing locking to optimize multi-user concurrency on the database server. Learn how to backup data, and restore in case of system crash.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled, the student will be able to: 1. Explain basic types and structures of databases. 2. Understand syntax and general rules of Transact-SQL language for database development. 3. Create stored procedures and triggers inside Microsoft SQL database. 4. Understand and apply error handling, performing various scripts within database. 5. Understand the basic elements of transactions and database locking mechanism. 6. Protect data from unauthorized use. 7. Apply basic procedures of data restoration in case of database crash. 8. Apply basic principles of optimization SQL queries.
Skills	This course provides specialized knowledge from the computing science area of database design and development systems. It enables the attendant to design, create and maintain databases in MS SQL Server.

2.41 Network Services and Programming

VSITE163

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	0
Laboratory exercises	30
Seminars	0
Individual work	90

Content	Network services: E-mail, Telnet, FTP, Web. Ways of publishing data. Web servers and clients. Selection of technologies and web tools. Preparation of web-pages. HTML language. Basic structure of HTML document, list, table, form. Programming in JavaScript, DOM. XML basics and syntax. Connecting HTML and XML. XSL elements, transformations from JavaScript. Web applications on client side, without server side script, like ASP, Cgi-bin, Perl, JSP support.
Learning objectives	General: Knowledge about web protocols. Using and setting up e-mail and FTP clients. Connecting and working on a remote computer with the use of SSH protocol. Understand the structure of HTML pages. Reading and writing XML. Recognizing poorly written (outdated) HTML pages and transforming them to XHTML standard. Using CSS in an efficient manner. Writing Javascript for improving accessibility of Web-pages. Comparing XML and JSON technologies and transforming one format into another.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Know and use basic network protocols: SMTP, POP, IMAP, Telnet, SSH, FTP. 2. Create a valid XHTML page. 3. Program in JavaScript for different browsers. 4. Style a page with the use of CSS. 5. Know the rules of XML and JSON.
Skills	This course provides knowledge for client side web programming, including creation of static and dynamic web pages, optimized for different browsers.

2.42 Internet Programming

VSITE164

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	0
Laboratory exercises	30
Seminars	0
Individual work	90

Contents	Developing dynamic web-applications. Creating data models for Internet applications. Server oriented script languages. Programming in ASP and ASP.NET, ADO and ADO.NET. Three-layer architecture of Internet applications. Data security and crypto-security with the use of XML on the client side. Creating web applications from data model to web front-end using MS SQL Server, HTML, JavaScript, ASP, XML technologies. Supporting various web-browsers.
Learning objectives	General: Understanding the entire path of generating web-page- from the point of the user's entering a URL address into browser to HTTP server, database and back to resulting page in client's browser. Specific: Mechanism of developing web applications: HTML, POST, GET, Cookies, Session, Application, ViewState. Programming on the server side. Working with MS SQL Server database.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Configure and start IIS and Apache servers. 2. Understand HTTP protocol. 3. Create ASP.NET web application which contains: a) user authentication, b) connect to database and display data upon user request c) changing data in the database, according to user's requests (adding, changing, deleting), 4. Understand security problems on the Internet.
Skills	This course provides knowledge of programming web sites, and it enables the attendant to create dynamic web pages with server side scripts.

2.43 Web Design

VSITE165

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	0
Laboratory exercises	30
Seminars	0
Individual work	90

Contents	Purpose of a Website. Design strategies. Interface design. Information access, navigation, connections. Page formatting, grid design, basic tables. Page length. Different environment (platform) problems. Comparative display of web-browser possibilities. Graphics, GIF, JPEG, maps. Multimedia and animation on the Web, AVI, MP3, MPEG, SWF. Using MS FrontPage, basics of using PaintShopPro. Macromedia DreamWeaver
Learning objectives	General: Optimum use of multimedia formats to keep all the information while taking up as little space as possible. Specific: Advanced use of CSS for positioning elements on a Webpage. Using AJAX technique. Using jQuery libraries. Using HTML5 in practice.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Create an entire web application with server and client side, which looks and functions well. 2. Know multimedia formats and their use in web applications. 3. To adjust a webpage that works just as good in various browsers and resolutions. 4. To use existing applications (e.g. Joomla or Wordpress) for building more complex systems.
Skills	This course provides specialized knowledge from the field of programming web pages as an upgrade to the core of computing science, and it enables the user to use advanced tools for creating and formatting Web pages.

2.44 Information Systems

VSITE171

ECTS	6
ECTS lectures	1.5
ECTS auditorium exercises	0
ECTS laboratory exercises	0
ECTS seminars	0.5
ECTS individual work	4

Lectures	45
Auditorium exercises	0
Laboratory exercises	0
Seminars	15
Individual work	120

Contents	Definition of a system, business system and its information system. Organization of business information system. Nolan's division of phases of company information development, IS life cycle phases, information engineering, elements of IS integrity. Planning IS development. Strategic analysis of business of an organizational system, business processes reengineering, determining fundamental IS architecture, determining priorities of developing information subsystems. Decomposition of goals, functions and processes, process model, data model, resource model. Process to data (CRUD) matrix, diagonalization of matrix and formatting subsystem, internal consistency and external relation of subsystem, defining basic architecture of IS. Process affinity analysis. Business subsystem analysis, diagram of document (data) flow, work diagram (work flow), requirements specification. Data administration. Cipher systems. IS implementation. Using CASE tools. Information system's quality and protection against violation. ISO standards.
Learning objectives	General: This class provides basic knowledge from the field of information systems as the fundamental core of computing science. Special: Communicating with all the participants in planning and development of information systems, analysis of a minor business system and creating process model and data model, defining subsystem development priority, planning and conducting testing, implementing and maintaining information systems.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to:1. Recognize sorts, types and models of information system organization. 2. Connect organizational maturity and planning development of information system. 3. Analyze a minor business system. 4. Draw diagrams of decomposition, document and data flow, work diagrams. 5. Create a requirement specification and matrix of business technology. 6. Connect tasks of data administration, data modeling and managing cipher systems. 7. Formulate criteria of information system quality. 8. Conceive testing, implementing and maintaining information systems.
Skills	This class provides basic knowledge from the information system field which is the fundament of the computing science core.

2.45 Information Systems Design

VSITE172

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	0
Laboratory exercises	30
Seminars	0
Individual work	90

Contents	Defining user requirements, defining information subsystem boundaries. The role of a user in information system development. Business processes reengineering. Modeling processes, program design. Data modeling, logical modeling of database. Modeling resources. Examining requirement validity with the help of a prototype. Data flow diagram: concepts of data flow diagram, process decomposition, context diagram, lower level data flow diagram, recommendations and limitations with drawing DFD. Program design: describing internal logic of a process, action diagrams, decision trees and decision tables, navigation diagrams. Examining requirement validity with the help of a prototype: system development with the prototype method, testing, implementation and maintenance of information systems. CASE tools. Reporting. Documenting.
Learning objectives	General: This course enables students to gain advanced knowledge in information system development and also to apply modern techniques for designing information systems. Special: Selecting the work method for the development of an information system. Understanding the role of a user. Creating process model and data model. Introduction to prototype method. Designing with the use of CASE tools. Knowledge of working with MS Visio.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to:1. Distinguish models of life cycle of an information system. 2. Define user requirements and set up sources of information in the development of information systems. 3. Create process models with the use of decomposition diagrams and data flow diagrams. 4. Model data with the entity-relationship model and map it into relational data model. 5. Create a description of entities and attributes, and the catalogue of input masks and reports. 6. Recognize the importance of making a prototype.
Skills	This course provides specialized knowledge from the field of information systems as an upgrade to the core of computing science and it enables the attendant to design information systems by modeling user requirements.

2.46 Informatization of Management

VSITE173

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	0
Laboratory exercises	30
Seminars	0
Individual work	90

Contents	System definition, information system and informatization of business. Conducting office business: office system development, office business supported by computer, standard programme aids for conducting office business, organization and informatization of an office. Managing documents. Enterprise informatization: IPS reports about the market, marketing IPS, IPS sales, i.e. communication with costumers, production IPS, supply IPS, financial business IPS, accounting IPS, planning and analyzing business IPS, internal control and revision IPS, managing human resources IPS, managing information resources IPS, research and development IPS. Internet, intranet and extranet: development and use of the Internet, personal identification number, digital signature, electronic business conduct, virtual organization. Integration of technologies in business: call centres enterprise systems, multimedia systems. Ergonomics of work places with computers. Safety and protection of IT system.
Learning objectives	General. Knowledge of terms and requests used for describing enterprise information systems. Specific. Deep insight into issues during informatization of enterprise and customer business systems. Understanding and defining needed requests for successful implementation of more and more demanding IT systems which are used in business enterprises systems.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Define system, office business system, business communication and the office organization. Know programme aids for office business conduct. Understand terms such as: personal identification number, general card payment over the Internet, digital signature, etc. 2. Efficiently manage, process and store various types of documents. 3. Recognize to which group of enterprise informatization an individual application solution belongs to. 4. Recognize the upcoming trends in informatization of business, such as virtual organization, virtual reality, virtual scene, virtual networking, virtual people, integrational technology such as call centres from multimedia systems, etc. 5. Define required ergonomical preconditions for quality business conduct in an information environment. 6. Define needed requirements for safety and protection of an information system.
Skills	This course provides specialized knowledge from the field of information systems as an upgrade to the core of computing science and it enables the attendant for creating and maintaining business information systems.

2.47 E-Business

VSITE174

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	0
Laboratory exercises	30
Seminars	0
Individual work	90

Contents	What is Internet and how was it created. Architecture and the way that Internet works. Internet services - e-mail, discussion groups, distribution lists, WWW, remote data transfer, using distant computers, browsers. Digital libraries. Publishing on the Internet. Access to Internet business applications over mobile devices. What is electronic business conduct and how was it created. Legal predispositions for electronic business. Types of electronic business. Security issues in electronic business systems. Electronic data exchange. Electronic marketing. Electronic markets, business models. Selling goods and services such as software, hardware and services. Trade from a distance: basic presumptions, some models of trade web places. Electronic auctions and electronic classifieds. Electronic capital trade (online investing). Trade between firms: basic presumptions, trading models. Conducting financial transactions- electronic payment and charging, digital (electronic) money and so-called smart cards, security problems with conducting financial transactions on the Internet.
Learning objectives	General. Ability to define conditions and requirements needed for successful implementation of an e-business system. Special: Detailed knowledge of all steps required for establishing system of electronic conducting business. Knowledge of technology, processes, laws and environments through which a quality and successfully formed electronic business will be achieved.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Understand the sense of terms appearing in electronic business, such as: WWW, URI, HTTP, XML, EDI, SOAP, SOA, WSDL, UDDI, ebXML, electronic agents, etc. 2. Know how to propose required architecture according to OSI layers dependent on gathered requests for desired electronic business system. 3. Know how to propose protection required for individual Internet layer for desired electronic business system. 4. Rough knowledge of laws and norms related to electronic business. 5. Know how cryptography functions, which algorithms exist and what is needed for successful implementation. 6. Recognize biometric signature and what it means, and define its level and weight parameters. 7. Recognize to which group of electronic business application belongs. 8. Know what is required for electronic trade. It is expected that a student is able to recognize and propose the use of a credit card, debit card, electronic money, electronic cheque, electronic wallet, etc., depending on set requirements. 9. Know how a trade with the use of mobile device works. 10. Being able to choose electronic business conduct model. 11. Recognize requirements when introducing electronic public administration. Apply such terms to achieve eDemocracy. 12. Each student will, in the end, be able to compose a short document in which all the requirements will be listed and also the solution by which a certain model of electronic business conduct will be presented.
Skills	This course provides specialized knowledge from the field of information systems as an upgrade to the core of computing science and it trains the attendant for organizing and maintaining information systems for conducting business through the Internet.

2.48 Public Information Systems

VSITE175

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	0
Laboratory exercises	30
Seminars	0
Individual work	90

Contents	The design and life cycle of information systems. The relationship of business information system and social information systems. Laws and Regulations of the Republic of Croatia, the Official Gazette. Administrative bodies of the Republic of Croatia. Territorial organization structure of the government administration and self-government, county, city, municipality. Labeling territorial units and the relation to the business information systems. Citizens' records: citizenship, registry, national identification number (OIB) and logical control of unique identification number, ISO 7064 (MOD 11, 10). Fixed property records: cadastre, land registers. Geographic information systems (GIS). Chattel records. Car and vessel registration. Central Bureau of Statistics. Registry and classification of economical subjects, OIB, identification and tax number, logical control of a unique citizen number. Payment system. Croatian National Bank. Registry of business subjects' accounts. Structure and way of labeling, leading bank number and business subjects' accounts. Financial agency and banks. Tax system. Registry of the tax for added value, for income and gain. Court system in Croatia. Court jurisdiction. Registries in judiciary system. Trading courts. Court registrar of legal persons. Pension insurance, first, second and third pillar. Insured persons' registry (REGOS) and Croatian Agency for monitoring financial institutions. Health insurance, mandatory and voluntary insurance, insurance against injury at work and occupational diseases. Croatian Chamber of Economy. Databases of Croatian companies. Commission for Securities of the Republic of Croatia, Central depository agency, capital and money market. Role and meaning of Internet in social information systems. Social information systems and the relationship of Croatia with the world. ISO standards, GSI , RFID and other standards. Ciphers and state symbols, currencies, EAN code, customs administration of the Republic of Croatia, unique customs declaration, ways of labeling. EU projects: Semantic Interoperability Centre Europe (SEMIC), Open Source Observatory and Repository for European public administration.
Learning objectives	General: Student is introduced to the relation of the information system with the environment, laws, regulations, standards, and interaction of information systems especially in relation to social information systems in the widest sense. Special: This course provides specialized knowledge in the field of information systems as an upgrade to the computing science core and it trains users to design and maintain information systems according to administration laws and regulations, and international and other standards with the goal of achieving maximum interoperability between information systems.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Evaluate the relation of his/her information system with the surrounding information systems. 2. Discover possible sources (laws, regulations, standards, etc.) which internally affect information systems and also possible ways of their use. 3. Maintain development of information system according to the requirements and standards from the surrounding and to achieve maximum operability and interoperability through that. 5. Recommend further development of internal and external standards.
Skills	This course provides specialized knowledge of information system science as an upgrade to the core of computing science and it trains users to design and maintain information systems according to the regulations of the administration.

2.49 Informatization of Production

VSITE176

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0
ECTS laboratory exercises	1
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	0
Laboratory exercises	30
Seminars	0
Individual work	90

Contents	Definition of management iterative, project and hybrid type production; ERP philosophy- Enterprise resource planning; Stock management- including EOQ (Economic Order Quantity) model and ROP (Reorder Point) model, Statistical stock model; (MRP) Material requirements planning - The role of forecasting in manufacturing company, Needs and forecasting. Problems concerning different kinds of requirements. The major production plan- Theory of the major plan, Major plan management. Logical use of the main plan- creating main plan for the warehouse. The use of the major plan in logistics Procurement planning, Planning by order, The use of the major plan in logics concerning the basic product buyer; Rough capacity planning; Operation management - work centers, Plan technology, Order component, Order technology, Fine termination. Operation performance monitoring; Supply management; Sale management; Manufacturing costs management- (Direct Costing), (Activity Based Costing); Just-in-time philosophy, Kanban philosophy, OPT philosophy, CONWIP philosophy, project manufacturing monitoring - Gant diagrams, Perth diagrams. Resources. Costs.
Learning objectives	General. Recognizing terms and requests when defining and creating ERP information projects. Specific. Introduction to the issue of ERP philosophy. Understanding the importance of creating needs analysis of a company before entering software purchase. Recognizing optimum methods for software selection. Understanding the importance of a project team for informatization of production. Understanding the business process reengineering before ERP implementation. Recognizing appropriate software type of production informatization, regarding the production type.
Learning outcomes	It is expected that after the obligations defined by the curriculum are fulfilled the student will be able to: 1. Define basic terms of managing production of repetitive, project and hybrid type. 2. Define basic terms which are precondition of compatible preparation of master data of production firms. 3. Recognize the importance of ERP concept as the dominant philosophy of production informatization. 4. Recognize the importance of the appropriate software selection. 5. Recognize the importance of compatible implementing form of production firms. 6. Recognize the key success factors of ERP solution implementation in production firms.
Skills	This course provides students with professional knowledge of information systems as an upgrade to the IT core and trains students to design and maintain information systems of production organizations.

3 Professional Graduate Study in Information Technology – Study Program

Autumn courses -1st, 3rd semester
Summer courses – 2nd, 4th semester

Elective courses – 1st Semester				
Course title	**Code**	**English***	**Teaching hrs.**	**ECTS**
Elective Courses - Core				
Statistics (STAT)	VSITE201		45+30	6
Discrete Mathematics (DMAT)	VSITE202		45+30	6
Elective Courses - Social				
Accounting Basics (ORAC)	VSITE211		30+15	4
Sociology of the Information Society (SOCID)	VSITE212		30+15	4
Elective Courses - Embedded and Mobile Computers				
Embedded and Mobile Systems (UPS)	VSITE241		30+30	5
Basics of Robotics (ROB)	VSITE242		30+30	5
Elective Courses - Software Engineering and Information Systems				
Advanced Algorithms and Data Structures (NASP)	VSITE251		30+30	5
Principles of the Object Oriented Design (POOD)	VSITE252		30+30	5
Database Programming (PBAP)	VSITE271		30+30	5
PHP Programming (PHP)	VSITE272		30+30	5
Artificial intelligence (UINT)	VSITE258		30+30	5
Elective Courses – Computer Systems				
Computer Security Management (URAS)	VSITE261		30+30	5
Information System Reliability (POIS)	VSITE262		30+30	5

Elective Courses – 2nd Semester				
Course title		**English***	**Teaching hrs.**	**ECTS**
Elective Courses - Core				
Numeric Modelling (NUMOD)	VSITE203		45+30	6
Automata and Languages (AJEZ)	VSITE204		45+30	6
Elective Courses - Social				
Marketing Basics (OMAR)	VSITE213	I	30+15	4
Introduction to Research (UIR)	VSITE214		30+15	4
Elective Courses - Embedded and Mobile Computers				
Digital Signal Processing (DOSI)	VSITE243		30+30	5
Digital Instrumentation (DINS)	VSITE244		30+30	5
Elective Courses - Software Engineering and Information Systems				
Software Engineering (PRIN)	VSITE253		30+30	5
Advanced Java Programming (NAJP)	VSITE254		30+30	5
Reliable Software Design (RPP)	VSITE257	I	30+30	5
Service Oriented Computing (USL)	VSITE273		30+30	5
Advanced .NET Programming (DOTN)	VSITE274		30+30	5
Elective Courses – Computer Systems				
Computer Networks Security (SRM)	VSITE263		30+30	5
Server Computer Tuning (PPR)	VSITE264		30+30	5

Elective Courses – 3rd Semester				
Course title	**Code**	**English***	**Teaching hrs.**	**ECTS**
Elective Courses - Core				
Operational Research (OIST)	VSITE205		45+30	6
Mathematical Logic in Computer Science (MLOG)	VSITE206		45+30	6
Elective Courses - Social				
Ecology and Sustainable Development (EKOR)	VSITE215		30+15	4
Consulting Skills (SAVV)	VSITE216	I	30+15	4
Elective Courses - Embedded and Mobile Computers				
Digital System Design (PDS)	VSITE245		30+30	5
Mobile Applications (MAP)	VSITE246	I	30+30	5
Java and Mobile Platforms (JAMP)	VSITE247		30+30	5
Elective Courses - Software Engineering and Information Systems				
Computer Graphics (GRAF)	VSITE255		30+30	5
Dynamic Programming (DPR)	VSITE256		30+30	5
Content Management Systems (SUS)	VSITE275	I	30+30	5
Business Intelligence (PINT)	VSITE276		30+30	5
Information Systems Integration (INIS)	VSITE277	I	30+30	5
Elective Courses – Computer Systems				
Computer Forensics (RFOR)	VSITE265		30+30	5
Server Computer Virtualization (VPR)	VSITE266		30+30	5

4th Semester				
Course title	**Code**	**English***	**Teaching hrs.**	**ECTS**
Diploma Thesis (DIPL)	VSITE291		0+360	30
Total:			**0+360**	**30**

*** Explanation of English language levels:**
Level I: the course is given in Croatian, but the course literature is provided in English and individual consultations are provided in English
Level II: level I + lectures are given in Croatian but bilingual presentations during lectures contain English translation
Level III: the course is given in English

DESCRIPTION OF INDIVIDUAL COURSES

3.1 Statistics

VSITE201

ECTS	6
ECTS lectures	1.5
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3.5

Lectures	45
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	105

Contents	Probabilistic models. Random variables. Descriptive statistics. Inferential statistics. Interval estimation of parameters. Hypothesis testing. Two-sample inferential statistics. Correlation and regression. Analysis of variance. Nonparametric statistics. Statistical Process Control.
Learning objectives	To prepare the student for the application of statistical methods.
Learning outcomes	1. List probabilistic models, explain random variables 2. apply random variables, descriptive and inferential statistics, correlation and regression and statistical process control 3. test the hypothesis 4. analyse the variance.
Skills	The course provides fundamental knowledge of statistics with emphasis on application.

3.2 Discrete Mathematics

VSITE202

ECTS	6
ECTS lectures	1.5
ECTS auditorium exercises	1
ECTS laboratory exercises	0
ECTS seminars	0
ECTS individual work	3.5

Lectures	45
Auditorium exercises	30
Laboratory exercises	0
Seminars	0
Individual work	105

Contents	MATHEMATICAL MODELING. Mathematical structures. Language and formal procedures. Discrete and continuous. MATHEMATICAL LANGUAGE. Symbolization and the use of variables. The elements of mathematical language. Defining and proving. LOGIC. Propositional logic. Introduction to predicate logic. Introduction to Logic Programming and Prolog. The problem of program correctness. SETS. Algebra of sets. The partitive set and the partition of a set. The ordered pair and the Cartesian product. RELATIONS. Relations between devices. Topological sorting. Equivalence relations. The application of the relational databases. FUNCTIONS. Introduction to functional programming and Lisp. STRUCTURES. Structures, isomorphism, specification and implementation. Algebra modulo *n* and symmetric cryptography. Data Structures. INDUCTION AND RECURSION. The structure of natural numbers. The principle of proof by induction. The principle of definition by recursion. Sums. Recursive modelling. COMBINATORICS. The addition principle and the principle of inclusion and exclusion. The multiplicative principle and selection trees. Permutations and selections. ALGORITHM COMPLEXITY. The comparison of asymptotic behavior. Asymptotic complexity assessment. The complexity of recursive algorithms. Practical non-computability and public key cryptography. P, NP and NP complete problems. CHARTS. The Chinese postman problem. The traveling salesman problem. The connectivity problem. The shortest path problem. The minimum spanning tree problem. The flow problem.
Learning objectives	To prepare the student for understanding discrete models.
Learning outcomes	1. Explain the principles of mathematical modelling, the principles of propositional logic and the principles of functional programming, 2. apply the elements of mathematical language, functions, relations and sets, induction and recursion, the operations on sets and 3. distinguish between algebraic structures and to assess the complexity of the algorithms.
Skills	The course provides expanded knowledge of discrete mathematics as the basis of core computing.

3.3 Numerical Modeling

VSITE203

ECTS	6
ECTS lectures	1.5
ECTS auditorium exercises	1
ECTS laboratory exercises	0
ECTS seminars	0
ECTS individual work	3.5

Lectures	45
Auditorium exercises	30
Laboratory exercises	0
Seminars	0
Individual work	105

Contents	Numerical solution of ordinary differential equations – radioactive decay. Modeling realistic motion of projectiles (including air resistance). Oscillatory motion and chaos. Solar System – Kepler's laws. Electric potential and the electric field – solving the Laplace equation. Wave motion. Monte Carlo simulation – random walker and diffusion. Neural networks.
Learning objectives	To prepare the student for the development, analysis and numerical solving of mathematical models.
Learning outcomes	1. Apply the process of mathematical modeling to problems from various branches of science and technology 2. numerically solve differential and difference equations and 3. develop Monte Carlo simulation
Skills	The course provides: (i) Fundamental knowledge of numerical methods with emphasis on their application in the analysis of physical, mathematical and biological models, (ii) Through modeling real problems student learns the: to identify critical degrees of freedom in the observed problem, why and how to simplify the models, to analyze the results of numerical simulations.

3.4 Automata and Languages

VSITE204

ECTS	6
ECTS lectures	1.5
ECTS auditorium exercises	1
ECTS laboratory exercises	0
ECTS seminars	0
ECTS individual work	3.5

Lectures	45
Auditorium exercises	30
Laboratory exercises	0
Seminars	0
Individual work	105

Contents	Language processors. Lexical, syntactic and semantic analysis. Generating bytecode. The formal definition of the alphabet, a string and of language. Operations between languages. The classification of programming languages: imperative, object-oriented, functional and logic languages. Simple one-pass compilers and interpreters. Lexical analysis of programming languages. Regular Languages: Finite automata, Regular expressions. Formal grammar. Regular grammar. Context-independent languages: context-independent grammar. Pushdown automaton. Lexical generator - Lex. Syntactic analysis. Top-down parsers. Parser generator for LL (k) grammar. Bottom-up LR parsers and pushdown automata. Parser generator - Yacc. Syntax-directed translation. Attributed grammar. The abstract syntax tree and symbol table. Checking data types. Generating bytecode and the source code for CISC processors and virtual stack processors. Optimizing code. An example of designing a compiler. An example of designing an interpreter for functional language. Recursively countable languages: The Turing machine. Unrestricted grammar production. Context-sensitive languages: Context-dependent grammar. Linear bounded automaton. Classification of languages, automata and grammar: Structural complexity of a language. The complexity of accepting the language.
Learning objectives	The course prepares the student for understanding a language and translation.
Learning outcomes	1. Explain the lexical, syntactic and semantic analysis, the alphabet, the string, language and operations between languages, the Turing machine and unrestricted grammar productions, 2. list the classes of language, automata and grammars, program translators, classify programming languages 3. apply disassemblers and 4. design an interpreter for functional language.
Skills	The course provides basic theoretical knowledge of automata, grammar and language as the basis for core computing.

3.5 Operational Research

VSITE205

ECTS	6
ECTS lectures	1.5
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3.5

Lectures	45
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	105

Contents	Linear optimization. Optimization on graphs. Process management. Dynamic modeling. Integer programming. Non-linear optimization. Game theory. Games with complete and incomplete information. Decision Theory. Markov chains. Queuing theory. The Theory of Storage. The Prediction theory.
Learning objectives	The course prepares students for the application of optimization methods.
Learning outcomes	**1.** Explain process management and dynamic modeling, nonlinear optimization, Game theory and Queueing theory and **2.** apply linear optimization, Integer programming, Decision theory, Prediciton theory and Markov chain models.
Skills	The course provides fundamental knowledge of a set of practical mathematical models, methods and optimization algorithms.

3.6 Mathematical Logic in Computer Science

VSITE206

ECTS	6
ECTS lectures	1.5
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3.5

Lectures	45
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	105

Contents	First-order languages. Natural deduction and its application in verifying the correctness of programs and hardware. Logic programming and Prolog. Sets, relations and SQL. Functions, functional programming and Haskell.
Learning objectives	The course prepares students to understand logical decision-making.
Learning outcomes	1. Explain First-order languages, the principle of logic programming, sets and relations, the principles of functional programming 2. prove the correctness of the program and the hardware and 3. apply Prolog, SQL relational databases, Haskell.
Skills	Using logical language to specify a problem. Logically verifying the correctness of the solution of the correctness of the solution. Acquiring the basic skills of logic programming, database programming and functional programming. The application of mathematical structures in coding and encryption.

3.7 Accounting Basics

VSITE211

ECTS	4
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0
ECTS seminars	0
ECTS individual work	2.5

Lectures	30
Auditorium exercises	15
Laboratory exercises	0
Seminars	0
Individual work	75

Contents	Accounting principles, standards and policies. Basic models of balance. Basic changes in the balance sheet. The impact of economic activities of the company on its balance sheet. The basic models of the profit and loss account. The elements of the profit and loss account. The basic model of cash flow reports. Subledger accounts and the rules of double-entry bookkeeping. Basics of entering business changes to accounts. Chart of Accounts. Business records. Posting entries of tangible and intangible assets. Depreciation as an expense and the amount of the adjusted value of fixed assets. Payment transactions through transfer accounts and accounting models. Interim account. Cash desk operations.
Learning objectives	To prepare students for understanding the principles of bookkeeping.
Learning outcomes	1. List the accounting principles, standards and policies, the basic balance models, explain the effects on the balance sheet, the basic models of the profit and loss account, chart of accounts, 2. apply the elements of the profit and loss account, the rules of double entry bookkeeping, basic techniques of entering business events and 3. keep records of assets and depreciation and apply rates, manage payments.
Skills	The student is qualified to keep record of the entrepreneur's business events by applying bookkeeping models.

3.8 Sociology of the Information Society

VSITE212

ECTS	4
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0
ECTS seminars	0
ECTS individual work	2.5

Lectures	30
Auditorium exercises	15
Laboratory exercises	0
Seminars	0
Individual work	75

Contents	The history of information technology, the transition from an industrial to an information society, information society theory, the theory of the network society . Information society and cyber culture, collective intelligence and planetary man. Social life and ICT, dichotomy of real / virtual, information availability, professionalism and amateurism, new educational and communication practices. Phenomenology of risk in the global information society, the global risk management. Cyber-crime: identity theft, gray trade, child pornography. Cyber extremism, racism and xenophobia. E-government. Models of interaction G2C, G2B, G2G. Availability and digital equality, civic participation and identification, security. Online markets, new jobs, changes in the structure of work. Non-market forms of action, sharing economy, open source. Networks, social networks and online social networks. Virtual communities. Cyber space and collective action. Online identities, multiple identities, perception and identification. Networked individualism.
Learning objectives	To prepare students for understanding social relations.
Learning outcomes	1. Explain the development and the theory of the information society, the impact of culture and collective intelligence, the relationship between the virtual and the real, the risks of the information society, electronic public administration, social networks and 2. Specify the new communication and educational practices, list the models of interaction.
Skills	Students acquire knowledge of the sociology of modern society based on information technology.

3.9 Marketing Basics

VSITE213

ECTS	4
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0
ECTS seminars	0
ECTS individual work	2.5

Lectures	30
Auditorium exercises	15
Laboratory exercises	0
Seminars	0
Individual work	75

Contents	Marketing and its role in achieving business results by using available capital. The impact of the external environment, consumer needs, and the principles of marketing: product, pricing, sales and distribution and promotion. The process of marketing planning and marketing audit; Basic elements of a marketing plan. Market Research. Segmentation and selection of target markets, differentiation and market positioning. Identifying internal strengths and weaknesses of the business system and its market opportunities and threats. Analysis of consumers and competition. Setting goals and selection of marketing strategies. Developing a sustainable competitive advantage. Application and control of marketing activities. Ethics in business marketing.
Learning objectives	To prepare students for applying marketing methods.
Learning outcomes	1. Explain marketing, marketing planning process and audit, marketing plan, market research, list the principles of marketing 2. analyse consumers and competition, set marketing objectives and strategies and 3. apply and control marketing activities.
Skills	Students are trained for the immediate application of marketing in business systems in order to achieve profitable operations, competitive advantage, growth and development.

3.10 Introduction to Research

VSITE214

ECTS	4
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0
ECTS seminars	0
ECTS individual work	2.5

Lectures	30
Auditorium exercises	15
Laboratory exercises	0
Seminars	0
Individual work	75

Contents	Introduction to science. Research in technical and natural sciences. Types of scientific papers. Elements of scientific research. Phases of scientific research. How to conduct scientific research and write a scientific paper. Publishing the paper. Public presentation of scientific and technical projects.
Learning objectives	To prepare students for applying methods of research.
Learning outcomes	1. Distinguish between types of scientific papers 2. list the elements of scientific research and the phases of scientific research, 3. create the paper, 4. publish the paper and 5. present the paper.
Skills	The course provides insight into the methods of research that are necessary for understanding the process of scientific research.

3.11 Ecology and Sustainable Development

VSITE215

ECTS	4
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0
ECTS seminars	0
ECTS individual work	2.5

Lectures	30
Auditorium exercises	15
Laboratory exercises	0
Seminars	0
Individual work	75

Contents	Industry and society. The development of industry and the impact on the climate and the environment. The life cycle of industrial products, raw materials, processing, useful life of the product, disposal of waste, energy balance. Maintaining a balance between industrial development and natural ecosystems. The Industrial society and climate change, the purification of waste air and water. Disposal of waste and hazardous waste. Handling unforeseen environmental pollution. Renewable sources of energy.
Learning objectives	To prepare students for applying ecological standards.
Learning outcomes	• List the effects of industry on the environment, classify renewable sources of energy, • plan the life cycle of industrial products, purification of waste air and water, plan waste management, • make an energy balance and • analyse the balance of the ecosystem.
Skills	The course provides knowledge about the man-made disorders in nature and the measures necessary to make business processes run with the lowest possible environmental impact.

3.12 Consulting Skills

VSITE216

ECTS	4
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0
ECTS seminars	0
ECTS individual work	2.5

Lectures	30
Auditorium exercises	15
Laboratory exercises	0
Seminars	0
Individual work	75

Contents	The role of information technology in the implementation of the strategy; IT engineering and IT consulting, IT specialists in the role of expert and/or consultant; The specialties of the ideal consultant: knowledge of specific activities, functional expertise and relationship management; The main qualities of a good consultant; The process and the roles of consulting; Functional expertise: Software quality and information services management; relationship management - facilitation, communication and negotiation; Sales of consulting services: ways of promotion, assessment of user needs, defining sales and negotiation strategies, preparation and presentation of bids; Code of Conduct and Ethics for consultants, Effective presentations; The tools required to perform consulting services: the tools for overcoming complex problems, troubleshooting tools, and decision-making tools - when and how to apply them; Interviewing as a means of collecting data and a research tool; How to increase the efficiency of teams and the role of the consultant; Change Management; The successful execution of consulting assignments; Time management techniques.
Learning objectives	To prepare the student for applying consulting skills.
Learning outcomes	1. List the qualities of a consultant, the elements of functional expertise 2. explain the role of the IT specialist as an expert and consultant, explain the consultation process, the code and ethics of the consultant, the time management techniques, 3. apply the consulting tools and 4. conduct interviews.
Skills	Students are trained for the immediate application of consulting skills needed to perform consulting services in the field of computer science, in the preparation and implementation of developmental and business projects and in communication with customers.

3.13 Embedded and Mobile Systems

VSITE241

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	Computer Architecture and the specificity of running in real time. Portable computers. Embedded computers. Microcontrollers. ARM Architecture. Computers in systems for process measurement and management. Adjust the computer to the process and the process to the computer. Connecting the computer and the environment. The instrumentation chain, gauges. Measurement signals. Operating systems and programming languages designed for embedded computers. Realization of the measurement and control algorithms in the assembler and in high-level programming languages. Distributed control systems. The architecture of portable computers. Energy balance. Interaction with humans. Operating systems and programming languages designed for portable computers.
Learning objectives	To prepare the student for applying embedded microprocessors.
Learning outcomes	1. Explain the operation of the computer in real-time, the portable and embedded computer, the architecture of ARM processors, distributed systems, 2. apply computers in monitoring systems, create an energy balance of the portable computer, set the operating system of portable computers, 3. design a system of interaction with humans and 4. connect the computer with the environment, program gauges.
Skills	The course provides knowledge of the structure of microprocessors and enables the student to independently design and program microprocessors as an embedded and portable system.

3.14 Basics of Robotics

VSITE242

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	Basic concepts about robots and robotics, Asimov's laws of robotics, classification and application of robots. Positions and degrees of the robot's freedom of movement. Conversion from Joint to the Cartesian coordinate system, and vice versa. Direct and inverse robotics problems. Kinematic analysis of robots according to the Denavit-Hartenberg analytical approach. Dynamic analysis of a robot based on Newton-Euler and Lagrange methods. Robot control. The purpose of robot vision. The model and calibration of the camera. Edge and corner points detection. Hugh's transformation. Recognition of two-dimensional and three-dimensional objects. Stereo vision. The positioning of the camera. Three-dimensional reconstruction of the scene. The inaccuracy of measurement using computer vision. Constructing workspace maps based on the results obtained with robotic vision. Programming in robotics. Exercises will be carried out using robots Scorbot ER-4U and the robotic program Scorbase.
Learning objectives	To prepare the student for understanding robotic systems.
Learning outcomes	1. List the basic concepts and laws of robotics, explain the degrees of freedom, robotic vision, edge detection and object recognition, 2. analyse the kinematics of the robot, 3. calibrate the camera, determine the position of the camera and reconstruct the scene and 4. program the robots.
Skills	The course provides the fundamental knowledge of building kinematic and dynamic models of industrial robots and controlling industrial robots. Fundamental knowledge in the application of sensor systems in controlling the robot. Fundamental knowledge of mobile robotics. Introduction to computer vision and its application in robotics.

3.15 Digital Signal Processing

VSITE243

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	Statistical properties of signals and information capacity. Size display. Sampling, quantization and coding. Elementary signals: impulse, step, ramp and exponential. Complex values. The properties of Linear time-invariant systems (LTI). The basic structure of LTI systems. The basic time domain algorithms. Impulse response of the LTI system. Implicit and explicit convolution. Filters with finite (FIR) and infinite (IIR) response. The basic frequency domain algorithms. The Fourier series and the transformation of non-periodic signals. Z transformation. Discrete and Fast Fourier transform (DFT and FFT). The elements of signal processing systems. A/D and D/A converters. The properties of the converter. Filters for avoiding overlaps and reconstruction filters. Filters with overlapping capacity. Integer arithmetic. Fixed and floating point arithmetic. Multiplication and accumulation. The architecture of signal processing systems. Parallel processing. Harvard architecture. Program and working memory. Connecting the DSP. Algorithms and indirect logic systems.
Learning objectives	To prepare the student for applying methods of digital signal processing.
Learning outcomes	1. Define information capacity, sampling, quantification and coding. List the elementary signals, define LTI systems and the structure of LTI systems, impulse response, elements and architecture of signal processing systems, 2. apply the algorithms of time and frequencies domains and FFT, 3. synthesize FIR and IIR filters and 4. program and connect the DSP.
Skills	The course provides specialist knowledge of the architecture and application of digital signal processing systems.

3.16 Digital Instrumentation

VSITE244

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	Complex management systems. Control center and a network of intelligent devices. Programmable Logic Controller (PLC) and its connections. PLC Operating Systems, programming and configuration. Dedicated and standard networking technologies and public networks. Construction of fiber-optic networks, construction of wireless networks. Collecting data in distributed management systems. SCADA systems.
Learning objectives	The course prepares students for constructing distributed management systems.
Learning outcomes	1. Explain complex management systems, the control center and the device network, the structure and role of PLC, SCADA systems 2. determine data collection, 3. program and configure the PLC and 4. design dedicated networks.
Skills	The course provides fundamental knowledge of connecting intelligent components into distributed management systems.

3.17 Designing Digital Systems

VSITE245

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	Digital systems. Software approach to defining hardware. Parallel processing and object oriented approach. Basic VHDL syntax. VHDL modeling, structural, procedural and flow modeling. Behavior modeling. The use of memory elements and synchronization. Finite automaton model. Automaton specifications, the difference in response between Mealy and Moore models. Parallel structures. Complex systems, procedures and components. Libraries. Top-down and bottom-up approach. The structure of complex programmable logic devices (CPLD). Connections and delays. Optimization of delay. The structure of field programmable gate arrays (FPGA). Basics of verification through simulation.
Learning objectives	The course prepares students for designing silicon digital systems.
Learning outcomes	1. Explain digital systems and software definition of hardware, VHDL modeling, synchronization, CPLD and FPGA architecture, 2. apply VHDL syntax, the function libraries 3. specify a finite automaton and 4. verify functionality through simulation.
Skills	The course provides advanced knowledge of the synthesis of digital circuits using VHDL description language.

3.18 Mobile Applications

VSITE246

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	Operating systems for mobile devices. Development tools for mobile applications. Specific features and differences compared to desktop solutions. The requirements of mobile applications. The architecture of mobile solutions. The basic components of mobile applications. Communication and connection to networks, Bluetooth, Wifi. Working with databases on mobile devices. Managing device features. SMS and voice calls. Managing the camera and multimedia. Security of mobile devices. Geolocation services. Mobile device emulators. Testing mobile solutions. Bringing mobile solutions into operation.
Learning objectives	To prepare the student for designing and developing mobile applications.
Learning outcomes	1. Explain the specific features and requirements of mobile applications, explain the architecture of mobile solutions, list the mobile application components, 2. manage operating systems and mobile device development tools, databases, GSM services, the camera and multimedia, the geolocation system 3. use emulators, and test mobile applications 4. determine safety measures, connect to the network and bring mobile applications into operation.
Skills	The course provides fundamental knowledge of mobile computer platforms, as well as the basics of developing software solutions for those platforms, along with practical knowledge about mobile application development.

3.19 Java and Mobile Platforms

VSITE247

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	Technology Overview; Overview of mobile platforms; Tools for developing mobile applications; The basic elements of an application: Activities, Intents, Services, Content Providers, and Broadcast Receivers; Designing the user interface; Working with background processes; AIDL and NDL basics. Java on other platforms; Java ME; Smart card programming using Java Card.
Learning objectives	To prepare students for applying the programming language Java on mobile platforms.
Learning outcomes	1. List the mobile technologies and platforms, and the basic elements of the application, 2. use tools for Java programming on mobile platforms, AIDL and NDL languages, 3. organize background processes, 4. design the user interface and 5. apply Java to other platforms - Java ME and Java Card.
Skills	The course provides fundamental knowledge of developing mobile, micro and Android applications in Java.

3.20 Advanced Algorithms and Data Structures

VSITE251

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	Search. Skip Lists. Balanced search trees (AVL trees, red-black tree). B-trees. Multiple trees. Prefix trees. Spatial indexing and search. Quad- and octal- trees. R-trees. Selected graph algorithms. Random numbers. The Greedy method. Dynamic programming. Backtracking. The traveling salesman problem. Task scheduling.
Learning objectives	To prepare the student for applying advanced algorithms and data structures.
Learning outcomes	1. List and explain the graph algorithms, the greedy method, the principle of dynamic programming, 2. apply searching skip lists 3. use a balanced tree, spatial indexing and search, 4. generate random numbers and 5. schedule tasks.
Skills	The course provides advanced knowledge of computer algorithms and data structures.

3.21 The Principles of Object- Oriented Design

VSITE252

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	The basics of object-oriented models: classes and objects. Principles of inheritance, encapsulation, polymorphism. Relationships between objects, the difference between inheritance (“is-a” relationship), containment and use. The difference between inheriting implementation and inheriting interface. Design Methodology: the difference between the "waterfall" and the iterative-incremental approach. Test-driven development. The basic rules for designing classes: defining interfaces, the definition of methods, data protection, designing virtual methods, inheritance. Applying the “open-closed” principle (open for extension, closed for modification). The principle of design by contract. The basics of design patterns – purpose, overview and the analysis of the most commonly used patterns.
Learning objectives	To prepare the student for applying object-oriented methods of design.
Learning outcomes	1. List and explain the classes and objects, the principles of inheritance, encapsulation and polymorphism, relationships between objects, interface inheritance and implementation 2. apply the methodologies of design, test driven development, the rules of design by contract, design patterns, and 3. use the rules of interface design, methods, data protection and virtual methods.
Skills	The course provides advanced knowledge of object design, and trains the student to design object application structures independently.

3.22 Software Engineering

VSITE253

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	A system for automatically controlling translation and creating projects or programs. Task file for describing the process of creating a project or program. Scheduled automatic task control. Task files, writing rules and manner of execution. Tasks, the conditions for the execution of tasks and actions that are performed. Built-in rules. Grouping rules by dependencies and tasks. Conditional execution of tasks. Exercises with make/gmake tools. The system for managing changes in files and the project (Revision Control System). Records of all changes to files and the project, purpose and significance. Marking certain current versions of the project. Branching a project. Managing project branches, creating and merging branches. Common types of project branches, announcements, bug fixes, adding new functionality. Functionality and use from the standpoint of developers and administrators. Examples and exercises using GIT tools.
Learning objectives	To prepare students for applying methods of managing programming projects.
Learning outcomes	1. List and explain the systems for managing projects, the purpose and significance of records, 2. specify and write the task file, 3. manage tasks, incorporate rules 4. manage changes in the project, use the make/gmake tools 5. use branching and merging, indicate current versions, use the GIT system.
Skills	The course provides the fundamental knowledge needed for managing project design and the project version control system.

3.23 Advanced Java Programming

VSITE254

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	Technology Overview; The presentation level: servlets, JavaServer Faces and Facelets; Web Services (JAX-WS and JAX-RS); Business logic - Enterprise Java Beans, Security and transactions management; Connecting to databases using the Java Persistence API; Connecting to other and legacy systems - SOA, RMI, CORBA; Transaction and transport services - JTS and JMS; Comparing J2EE and. NET environments; Java EE development tools.
Learning objectives	To prepare the student for applying advanced Java programming.
Learning outcomes	1. List the features of Java technology, 2. use the presentation level techniques and business level tools, 3. connect the database, connect the service systems, 4. use transaction and transport services and 5. use Java EE development tools
Skills	The course provides advanced knowledge for the development of multi-layered corporate applications in the Java EE set of technologies.

3.24 Computer Graphics

VSITE255

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	Applications and basic concepts of computer graphics. Computer graphics in engineering applications. Hardware equipment for computer graphics. Graphics software packages and graphics systems. Interactive computer graphics. The graphics terminal and the graphics processor. The mathematical foundations of computer graphics. Algorithms of 2D graphics and 3D modeling. Raster and vector graphics systems. Graphic transformation. Projections. Basic raster graphics algorithms. Displaying lines, curves, surfaces and bodies. Animation. Colour in computer graphics. Libraries of graphics functions. Digital image processing and analysis. Image enhancement.
Learning objectives	To prepare students for applying computer graphics.
Learning outcomes	1. List the applications and concepts of computer graphics, explain the hardware of computer graphics, graphics systems and packages, interactive graphics, the graphics terminal and graphics processor, define raster and vector systems, animation, colour, 2. apply mathematical foundations of computer graphics and algorithms of 2D and 3D modeling, 3. apply graphics transformations, raster graphics algorithms, 4. apply libraries of graphics functions and 5. enhance an image.
Skills	The course provides fundamental knowledge of computer generating 2D and 3D views, and image processing.

3.25 Dynamic Programming

VSITE256

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	Dynamism in programming. Features of dynamic languages. The basics of the programming language Python. The functions and modules. Object-oriented programming. Customizing the behavior of objects. Executable objects. Object attributes. Iteration. Regular expressions. Standard modules. Python/C interface.
Learning objectives	To prepare the student for applying methods of dynamic programming.
Learning outcomes	1. Explain dynamic programming, list the features of dynamic languages, functions and models, 2. use the Python programming language and standard modules 3. determine the attributes of objects, customize the behavior of objects and 4. create executable objects.
Skills	The course provides the basics of dynamic programming and scripting languages by learning the programming language Python.

3.26 Reliable Software Design

VSITE257

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	The life cycle of software support. The development cycle. Basic testing procedures. Access to testing, testing levels. Defining errors. Functional testing. Manageability and measurability of the process. Testing the system. Strategy, acceptability, regression. Modeling software, graphs and diagrams. Software testing tools.
Learning objectives	To prepare the student for applying methods for developing reliable software support.
Learning outcomes	1. Explain and apply the development and life cycle of the software, 2. use methods for modeling the functionality of the software, 3. determine quality criteria of the software product 4. create a quality and reliable software product.
Skills	The course provides fundamental knowledge of methods for developing software support from the standpoint of software quality assurance.

3.27 Artificial intelligence

VSITE258

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	Artificial intelligence algorithms, model training and model predictions. Concepts of setting up training models and training strategies. Fully connected models and convolution models. Supervised by machine learning, unattended machine learning and reinforcement learning. Applications to image element recognition and natural language recognition..
Learning objectives	Prepare the student to optimize the neural network and machine learning models.
Learning outcomes	After completion and curriculum of projected commitments, the student is expected to be able to: 1. Optimize the neural network model 2. Prepare data to train a deep neural network 3. Optimize machine learning parameters 4. Apply supervised machine learning 5. Apply artificial intelligence to image parts recognition and natural speech
Skills	The course provides advanced specialist knowledge in the field of artificial intelligence and machine learning and trains students to independently create and apply artificial intelligence models.

3.28 Computer Security Management

VSITE261

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	Computer security from a technical, administrative and management perspective. The basics of cryptography, access control, general vulnerability of software support and computer networks, digital rights management, data classification, computer security policies and legislation, privacy, the impact of human factors and computer security management. Effective management of organizational solutions for computer and network security, the impact of security technology on the risk management of computer security. Information Security Management System (ISMS) using the international standard ISO/IEC 27001, selection of security measures in accordance with ISO/IEC 27002 as well as all activities related to the PDCA (Plan-Do-Check-Act) life cycle of ISMS. Comparative analysis of risk management tools. Criteria for selecting methodological support for risk assessment. Preventing attacks. Incident handling, preparation and incident control. Types of the incident response teams, availability of teams and resources. International organization for handling incidents, CERT, planning and execution of handling incidents.
Learning objectives	To prepare the student for managing computer security.
Learning outcomes	1. Explain the role of computer security, show the basics of cryptography and access control, explain data classification 2. create a computer security policy, define the criteria for risk assessment, 3. implement ISO27001, 4. compare tools for risk management and 5. handle incidents, create an incident response team, coordinate CERT activities.
Skills	Students will acquire basic understanding of the procedures for including computer security into information systems through the perspective of security engineering and business management.

3.29 Reliability of Information Systems

VSITE262

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	Definitions of information system reliability, availability, safety, efficiency and effectiveness. Failure, fault, error, system collapse. Density function and hazard rate, mean time to failure. Redundancy spares and repairs. Serial, parallel, r of n and voting structures. Stand-by systems. Repairable and Fault-Tolerant Systems. Reliability analysis methodology (a priori and a posteriori). Dependent failures. Redundant structures availability, Markov chain models of reliability and availability. Software reliability: software development life cycle, software error models, software reliability models, software redundancy, software testing methods, rollback and recovery. Computer networks reliability: definition of network reliability, s-t reliability, k-reliability, topology parameters of network reliability. Optimization methods of information system - parallel and stand-by redundancy, algorithmic methods and techniques.
Learning objectives	The course prepares students for information system reliability control.
Learning outcomes	1. Explain the information system reliability components, failure, fault, error and system collapse, redundancy, stand-by systems and fault-tolerant computing systems. 2. compute density function and reliability of complex structure 3. apply serial, parallel and r of n structures 4. apply Markov models of reliability and 5. analyse software and networks reliability.
Skills	The course provides fundamental knowledge of the reliability of electronic systems, software and computer networks.

3.30 Computer Network Security

VSITE263

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	Security threats to networked computers. Basic defense techniques. Local network defense. The concept of firewall. Filtering levels. Support for private and dynamic addresses . Demilitarized Zone. Intrusion detection, systems and network systems for intrusion detection. Network traffic analysis, tools and methods, etherreal, tcpdump, snort. Maintaining and customizing rules and alert levels, results analysis, system integration, application rules, possible errors. Attack prevention. Connecting to a central control system. Incident handling, preparation and incident control. Types of incident response teams, availability of teams and resources. The International Organization for handling incidents, CERT, planning and implementation of programs for handling incidents. The infrastructure for handling incidents, incident control alerts. Cooperation with other organizations in resolving incidents. Tools and methods for enhancing system security, tcp wrappers, service control, system imprint. Enhancing application security. The relationship between security and the reliability of the system security policy.
Learning objectives	To prepare students for ensuring computer network security.
Learning outcomes	1. Explain security threats, explain defense techniques, 2. apply the firewall concept and determine the level of filtering, 3. determine the support for private and dynamic addresses, 4. design a demilitarized zone, an intrusion detection system, alert rules, and 5. analyse network traffic, connect to the central system, handle incidents.
Skills	The course provides specialist knowledge of computer networks protection using firewall techniques and intrusion detection, and of incident handling.

3.31 Server Computer Tuning

VSITE264

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	Installing servers, server maintenance, upgrade and backup. User Administration. Common network services. Tools for server management and administration. Basic user services. Other Software and Services: LAMP, CRMS, LCMS, CMS, ERP, SCM, Wiki HELP DESK, media streaming.
Learning objectives	To prepare the student for setting up server computers.
Learning outcomes	1. Install the Linux server computer, upgrade software, 2. programme security backup, 3. manage users, 4. set up network services and 5. use management tools.
Skills	The course provides fundamental knowledge of installation, administration and maintenance of Linux/UNIX servers and setting up systems services, control and user-oriented services and applications.

3.32 Computer Forensics

VSITE265

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	Computer forensics as a branch of forensic science. Collecting, searching, protection and analysis of evidence in digital form, and presenting it as material evidence. Measures for conducting forensic investigations to obtain evidence admissible in court. Branches of forensics: firewalls, networks, databases and mobile devices. Steps of forensic procedures: collecting, search, analysis and presentation. The electronic device as a means or object of criminal activity. Copying data using forensic tools, keeping the original data. Searching and analysing files, the contents of unused disc space, log files. Compiling the report.
Learning objectives	To prepare the student for applying computer forensics methods.
Learning outcomes	1. Explain the role of computer forensics, identify different computer forensics branches 2. handle digital evidence, present evidence, 3. apply forensic investigation measures, steps in forensic procedures, 4. retrieve contents of the disk, analyze the data and 5. compile a forensic report.
Skills	The course provides knowledge of computer forensics procedures, and trains students to analyse computer systems and programs, and computer incident control.

3.33 Server Computer Virtualization

VSITE266

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	The problem of high availability servers. Individual servers and server clusters. Motivation for server virtualization. Virtualization techniques. Hardware virtualization, operating system virtualization, application virtualization, storage system virtualization. Virtualization drivers. Virtual managing programs. Evaluating and operating virtual servers. High availability servers. Virtualization of computer clusters and network storage systems.
Learning objectives	To prepare the student for server computer virtualization.
Learning outcomes	1. Explain the high availability system, virtualization techniques, 2. implement individual servers and server clusters, 3. implement virtualization of hardware, operating systems, storage systems and applications, 4. virtualize server clusters and storage systems, connect the virtual machines and 5. operate virtual servers.
Skills	The course provides the knowledge of implementing high availability virtual server systems over individual servers and server clusters.

3.34 Database Programming

VSITE271

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	Advanced SQL on Oracle databases. Overview of the language basics (keywords, basic commands, join, grouping). Oracle SQL functions, processing time and date in the Oracle database, the operators IN, LIKE, EXISTS. Commands composed of several basic queries. Set operations with queries. Translate, decode, case. Hierarchical queries. Analytic functions. The merge command. Transactions. Creating tables, partitions, indices. Optimization. No-SQL databases. The concept of key-value.
Learning objectives	To prepare the student for programming complex databases.
Learning outcomes	Apply SQL to the Oracle database, create tables and indices apply basic commands and functions, use complex commands, set operations, edit date and time, create hierarchical queries, use analytic functions, define transactions and optimize alternative bases, implement the concept of key-value.
Skills	Students are trained for advanced database usage.

3.35 PHP Programming

VSITE272

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	Introduction to PHP programming. The concept of Web applications. The structure of an HTML document. Apache web server and PHP interpreter in operation. Basics of PHP syntax. Variables and data types in PHP. Operators. The structure of decisions and repetition. Working with arrays. Processing strings. User-defined functions. Functions for working with time. Working with files. Forms. Object-oriented programming in PHP. Classes and objects. The basic operations of the MySQL server. Connecting PHP with the MySQL database. Dynamically generating HTML documents based on data from a relational database. Integration with other technologies (JavaScript, AJAX).
Learning objectives	To prepare the student for PHP language programming.
Learning outcomes	1. Explain the concept of WEB applications, to show the structure of an HTML document, explain how an Apache/PHP server works, the variables and data types, 2. apply basic PHP syntax, use operators and branching structures, and the PHP object-oriented concept, 3. create and process arrays and data fields, define user functions, 4. connect to the MySQL database, dynamically generate HTML documents and 5. integrate JavaScript and AJAX.
Skills	The course provides fundamental knowledge of the PHP programming language and trains the student to create dynamic web pages in PHP.

3.36 Service- Oriented Computing

VSITE273

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	Distributed systems architecture. Service-oriented distributed computing. Basic standards, principles and technologies. SOA - Service Oriented Architecture. Service description and bindings, discovering and engaging services. Services management. Interoperation, composition, collaboration, orchestration and choreography of services. Service-oriented computing. Applications in entrepreneurship and business. The architecture of distributed systems, SOA - Service Oriented Architecture, Communication protocols, XML documents, XSD, Web level, business logic level, Web components, business logic components, Web services, security of distributed systems, multithread systems, Web Portals, Business Process Management.
Learning objectives	To prepare the student for the development and configuration of service-oriented systems.
Learning outcomes	1. Explain the concept of service-oriented distributed computing, basic standards and principles of SOA, 2. create SOA system architecture: specify, compose, find and engage services, verify security, 3. manage services, negotiate and contract services, design communication interface, 4. develop service-oriented applications, and 5. use XML and XSD documents.
Skills	Students acquire advanced knowledge of the implementation of complex information systems based on web technologies.

3.37 Advanced .NET Programming

VSITE274

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	Windows forms and their elements. Objects and classes. The delegates, interfaces, events and their processing. Creating .NET components and their use in developing applications. Working with databases. ADO.NET, LINQ technologies and connecting with relational and XML sources. Windows processes. Multithreading and applications with multiple "threads". Web services and the Windows Communication Foundation (WCF). Creating user interface with the Windows Presentation Foundation and XAML. Business processes and workflow applications. The MVC concept. The Windows Workflow Foundation.
Learning objectives	To prepare the student for advanced .NET programming.
Learning outcomes	1. Explain delegates, interfaces and events, 2. implement Windows Forms, 3. create .NET components, 4. use WCF, WPF and WWF, as well as ADO.NET and LINQ technologies, and 5. create multithreaded applications, create workflow applications.
Skills	The course provides fundamental knowledge of developing advanced software solutions for the .NET platform, with practical knowledge of programming in the C# programming language.

3.38 Content Management Systems

VSITE275

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	Definition of content management systems. Types of systems according to the type of data. Functions of CMS. The advantages of using a CMS. Available general solutions and their selection. System requirements. Installing, localizing and customizing the system. System components and their adjustment. Developing own components. Creating content. Life cycle management of content. Multimedia content. Defining user groups and granting authorizations. CMS security. Organization of content. Interaction with visitors of the portal. Website management.
Learning objectives	To prepare the student for implementing website content management systems.
Learning outcomes	1. Specify the content management system and its functions, system requirements, present the available general solutions, 2. install and configure the system, customize the system components, 3. develop own components, 4. define users, groups and roles, define the interaction with users and 5. create content, manage the life cycle of content, manage the portal.
Skills	Students are trained to select, install and customize content management systems, and to create websites with dynamic web pages.

3.39 Business Intelligence

VSITE276

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	The need for business intelligence. Business intelligence life cycle. Data quality. The value of business information. Analytical application of business intelligence. Data Warehouses. Structured and unstructured types of data sources. Analysis, metadata and granularity. Extraction, transformation and data load (ETL). Data stage. Preparation and structuring of dimension and fact tables. Return on investment in business intelligence. Information-assisted management. OLAP , reporting, data mining and corporate portals.
Learning objectives	To prepare the student for applying business intelligence methods.
Learning outcomes	1. Explain the need for business intelligence, explain return on investment, 2. specify data quality and the value of business information, 3. use structured and unstructured data sources, 4. specify data warehouses, metadata, dimensional and historical tables, 5. implement ETL procedures 6. apply OLAP.
Skills	Students learn to implement and use data warehouses, integration and analytical systems, and business reporting.

3.40 Integrating Information Systems

VSITE277

ECTS	5
ECTS lectures	1
ECTS auditorium exercises	0.5
ECTS laboratory exercises	0.5
ECTS seminars	0
ECTS individual work	3

Lectures	30
Auditorium exercises	15
Laboratory exercises	15
Seminars	0
Individual work	90

Contents	Introduction to integrating information systems. Business system that works in real time. Role-based organization. Process implementation from the beginning to the end. Business Process Management. Information systems integration development. The methodological framework of integrating information systems. Levels of interoperability. Integrating information systems and business processes. Service Oriented Architecture. Events-driven architecture.
Learning objectives	To prepare the student for integrating information systems.
Learning outcomes	1. Explain the need for integrating information systems, the level of interoperability, 2. specify system operation in real time, the execution of the process, 3. apply integration methodology, role-based organization, 4. specify business process support, service delivery architecture and event driven architecture, and 5. manage processes.
Skills	The course provides fundamental knowledge of information systems integration, and knowledge about its role and impact on business processes.

3.41 Diploma Thesis

VSITE291

ECTS	30
ECTS lectures	0
ECTS auditorium exercises	0
ECTS laboratory exercises	0
ECTS seminars	0
ECTS individual work	30

Lectures	0
Auditorium exercises	0
Laboratory exercises	0
Seminars	0
Individual work	900

Contents	Based on the assignment, study in detail the state of technology, suggest the optimal solution and experimentally verify it. Develop a thesis of approximately 60 pages.
Learning objectives	To prepare the student to independently create complex projects.
Learning outcomes	1. Independently study a given topic, quote the literature, 2. periodically present the achievements to date, 3. elaborate dedicated issue, 4. perform experimental verification and 5. draw conclusions.
Skills	Trains the student to independently research literature, design solutions, perform experimental verification and present the problem.