# Transilvania University of Braşov, Romania
# Study program: Informatics

Faculty: Mathematics and Computer Science
Study period: 3 years (bachelor)

### 1st Year

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Mathematical Analysis | AP01 | 6 | 3 | 2 | | |

**Course description (Syllabus):** Relations (properties of a relation, equivalence relations, order relations, function as an example of a relation); Using axiomatic properties of the set of real number; Sequences and series (sequences and series of real numbers, sequences and series of functions);Determining the radius of convergence and interval of convergence of power series; Using the Taylor series expansions of function; First order and higher order partial derivatives of real-valued functions of several variables, the Schwarz theorem, the first order differential and the partial derivatives of a composite real function; Study extremes of the real differentiable functions of several variable; Constrained extrema, the method of Lagrange multiplier; Establish the nature and calculation of improper integrals; Calculation of integrals depending on a parameter; Calculation of line integral; Calculation of multiple integrals.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Basic algebra for computer science | AG13 | 5 | 2 | 2 | | |

**Course description (Syllabus):** Functions and relations, Binary operations, Free semigroups, Groups, Permutations, Rings and fields, Tropical geometry, Matrices, Vector spaces, Linear codes.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Basic algorithms | IT11 | 6 | 2 | 1 | 2 | |

**Course description (Syllabus)** Introductory elements. Components of an algorithm. Pseudocode and conventions. Variables; Constants. Instructions. Visibility of variables in an algorithm, global / local variables. Subprograms. Recursion; Analysis of Algorithm Efficiency. Computing complexity on various issues; Algorithms of Elementary Data Structures (List, Stack. Queue - Implementations and Complexity); Search and sort algorithms; Divide et Impera algorithms; Greedy algorithms; Dynamic programming algorithms; Text Processing algorithms; Comparative analysis of implementations and programming methods; Intelligent Algorithms with discussion of the basic notions of Artificial Intelligence - research / case study on several chosen issues. In the seminar: solving different types of problems. In the laboratory: implementation of the discussed algorithms.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Basic Programming | IT12 | 6 | 2 | | 2 | |

**Course description (Syllabus):** Getting familiar with the C language; Generic programming using macros; Understanding procedural programming; Pointers. Memory allocation and management; Developing function-oriented C applications.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Mathematical computational Logic | IT13 | 5 | 2 | 1 | | |

**Course description (Syllabus):** Binary, decimal, octal, hexadecimal number systems; Conversions among bases; Addition, subtraction, multiplication and division of base $b$ numbers, Representation of integer numbers (Sign and magnitude, One's complement, Two's complement); Addition, subtraction and multiplication of two's complement numbers; Fixed point numbers; Floating Point Numbers. The IEEE 754 Floating Point Standard (Formats and Rounding), Properties of Boolean Algebra; Truth Table; Boolean Functions. The disjunctive normal form and conjunctive normal form; Minimization of Boolean functions: Veitch-Karnaugh Maps, Quine McCluskey's method; Combinatorial circuits; The Algebra of GF(2). The operational and function domains; Reed-Müller expansions; Generalized Reed-Müller expansions.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| English Language (1) | MIE1 | 2 | 1 | 1 | | |
| French Language (1) | | | | | | |
| Spanish Language (1) | | | | | | |
| German Language (1) | | | | | | |

**Course description (Syllabus):** The English/French/Spanish/German language course attempts at revising, consolidating and improving grammar points at advanced level. It also provides opportunities for students to practice grammar structures and express themselves during the seminars. To this end, each lecture presents a theoretical issue which synthesizes essential information from outstanding books in English/French/Spanish/German morphology, followed by a wide range of exercises which will be approached during the following seminar. The exercises are designed in such a way so that students can solve them both individually and in pairs, during the seminars. The aim of this course is to provide students with comprehensive grammar structures linked to the following issues: problem verbs, modal verbs, passive voice, determiners and pronouns and relative clauses.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Linear Algebra, Analytical and Differential Geometry | AG03 | 5 | 2 | 2 | | |

**Course description (Syllabus):** Basic notions of linear algebra (vectors, calculus with vectors, dependence and independence linearity, bases, dimensions, linear applications, bilinear forms, and quadratic forms, scalar products and other products); Matrix representation from linear algebra (of vectors, linear applications, bilinear forms and quadratic forms, of vectors products); Basic notions of analytical geometry (point, line, conic, plane, quadric and its equations, frame, relative positions, angles, distances); To apply techniques from linear algebra in analytical geometry, the knowledge of basic elements from differential geometry of curves and surfaces; Explain the necessity for use specific techniques of linear algebra and analytical geometry in mathematics, physics, technique and informatics; Explain the use of specific techniques of linear algebra and analytical geometry (in particular and in details); Matrix interpreting the abstract definitions from linear algebra; Mathematics significations interpreting of some calculated elements; Use theoretical knowledge for problem solving; Interpreting algebraic and geometric some notions related to informatics.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Arhitecture of computer systems | IT21 | 5 | 2 | 1 | 1 | |

**Course description (Syllabus):** The Computer Architecture content attempts at using theoretical computer science fundamentals for describing the modern computers' structure and organization, in order to efficient value the hardware characteristics in the software programming solutions; introducing the main concepts in computer architecture; understanding the basic concepts in modern computer architecture; identifying and distinguishing between the hardware and software components of a given computer system; understanding the inner-workings of modern computer systems, their evolution and the present aspects about the hardware-software interface; enabling students to design and recognize the structure of a basic computer system, including the design of the I/O subsystem,

the memory system and the processor data path and control; presenting how a personal computer system operates. Appropriate working with the specific concepts of the computer architecture are focused and specific set of basic assembly language programs for the specific model of processor in use are developed.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Object Oriented Programming 1 | IT22 | 6 | 2 | | 2 | |

**Course description (Syllabus):** Getting familiar with the C++ language; Understanding OOP concepts; Developing OOP applications in C++.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Data Structures | IT23 | 6 | 2 | | 2 | |

**Course description (Syllabus):** Data structures used for efficiently storing and manipulating data in computer programs: linear structures like stacks, queues, linked lists; hash tables; binary search trees, balanced trees, heaps; advanced data structures: quadtrees, point-region trees, kd-trees, persitent trees. The data structures are described in the context of their applicability, together with the main operations and their complexity. Description of some data structures from the STL C++ library. In the laboratory: implementation of the data structures, using the data structures for solving problems.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Operating Systems | IA21 | 6 | 2 | | 2 | |

**Course description (Syllabus):** Assimilating the basic concepts of operating systems; Knowledge of theoretical concepts of operating systems Windows and Linux; Knowledge of interface elements of operating systems; Developing the skills to use resources provided by operating systems in applications development; To use MSDOS, Windows and Linux Interfaces; To write command files / scripts under MSDOS / Linux; To develop applications in C that use the resources offered by operating systems; To use specific algorithms of operating system.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| English Language (2) | MIE2 | 2 | | 2 | | |
| French Language (2) | | | | | | |
| Spanish  Language (2) | | | | | | |
| German Language (2) | | | | | | |

**Course description (Syllabus):** The main objective of English/French/Spanish/German language seminars from the second semester is that of consolidating and improving the English/French /Spanish/German language knowledge acquired by students up to that point. This time the focus is no longer grammar but students' ability to express themselves as fluently and as accurately as possible by means of using a wide range of vocabulary items. To this end special material providing them with texts and exercises covering various artistic, cultural, political and social issues will be used. Apart from the emphasis placed on developing students speaking skills, the seminars will also focus on students' ability to communicate in writing. They will be taught to develop and organize their ideas logically and coherently, while at the same time using the language correctly.

## 2<sup>nd</sup> Year

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Scientific and professional communication | AG14 | 5 | 2 | 2 | | |

**Course description (Syllabus): ):** Principles of academic writing, Approaches for academic and scientific writing, Types of scientific papers: essay, review, bachelor, dissertation, thesis, Citation rules, Write a scientific article - practical approach, Presentation of scientific papers, Publication of scientific papers.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Graph algorithms | IT31 | 6 | 2 | 1 | 1 | |

**Course description (Syllabus):** The students must learn how to use the basic knowledge about graph algorithms that are necessary for studying other disciplines and practical applying after graduation; Modelling practical problems using graph algorithms. Basic notion, Graph searches, Minimum spanning trees, Shortest paths, Maximum flows.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Formal Languages and Compilers | IT32 | 6 | 2 | 1 | 1 | |

**Course description (Syllabus):** Main concepts in formal languages: grammars, Chomsky hierarchy, deterministic finite automata, nondeterministic finite automata, pumping lemma, Myhill-Nerode theorem, regular languages, regular expressions, finite automata with lambda-transitions, context-free grammars and languages, push-down automata. Main concepts in compiler theory: stages of a compiler, lexical analysis, syntactic analysis, semantic analysis, LEX and YACC. In the seminary: solving problems. In the laboratory: implementing automata, grammars and using LEX and YACC for compiler construction.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Programming tools environments | IA31 | 6 | 2 | | 2 | |

**Course description (Syllabus):** Introductory concepts; Fundamental laws. Parallel computing; Introduction to cloud computing, typologies; Amazon Web Services. Google Compute Engine. HP Cloud Compute; IBM Smart Cloud Enterprise. Amazon S3. Google Cloud Storage. Host Europe Cloud Storage; Google App Engine. AWS Elastic Beanstalk; Private Cloud Infrastructure Services. Private platform services; Cluster computing; Grid computing; Peer to peer and Cloud Computing; MapReduce/Hadoop; Service Oriented Architectures. Web services.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Databases | IT33 | 5 | 2 | | 2 | |

**Course description (Syllabus):** Differences between logical and physical views of data, Data Modelling, Logical Database Design, ANSI / X3 / SPARC model, Entity Relationship Model, Design Rules for Data Modelling, Main steps in the logical program design, Modes of operation and their symbolic presentation, Case Study: Manage Owners Association, SQL commands, Database implementation Examples: Library management, restaurant management, employee management, management of a medical cabinet, management of a CD collection, resource management of a computer network, etc.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| English Language (3) | MIE3 | 2 | 1 | 1 | | |
| French Language (3) | | | | | | |
| German Language (3) | | | | | | |
| Spanish Language (3) | | | | | | |

**Course description (Syllabus):** The English/French/German/Spanish language course attempts at revising, consolidating and improving grammar points at advanced level. It also provides opportunities for students to practice grammar structures and express themselves during the seminars. To this end, each lecture presents a theoretical issue which synthesizes essential information from outstanding books in English morphology, followed by a wide range of exercises which will be approached during the following seminar. The exercises are designed in such a way so that students can solve them both individually and in pairs, during the seminars. The aim of this course is to provide students with comprehensive grammar structures linked to the following issues: subjunctives and conditional, reported speech, adjectives and adverbs, nouns and articles, non-finite moods, linking clauses and emphasis.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Automaton, calculability, complexity | IT41 | 6 | 2 | 1 | 1 | |

**Course description (Syllabus):** Types of automatons and formal languages (4 Hours): Deterministic / non deterministic finite automata and regular expressions / languages, Pushdown Automata and context free languages
Theory of computability (12 Hours)Turing machines and variants, Algorithms and some Hilbert's problems, Decidability problems in formal languages, The Halting problem, Non-decidability problems in formal languages
Theory of Complexity (12 Hours);Measures of complexity using the big-O and small-o notations, P and NP problems, Theoretical elements for the NP complexity class

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Distributed databases | IT42 | 6 | 2 | | 2 | |

**Course description (Syllabus):** Introduction to distributed databases, DDBMS architectures, Designing Distributed Databases, Vertical and horizontal fragmentation of relations and fairness requirements, Tree representation of the fragmentation of relations, Transparent Distributed Databases, Two-phase commit protocol, Deadlock, Replicated data synchronization, Production and use phases of the data warehouse (Data Warehouse), Events and processing rules based on data

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Visual programming environments | IA43 | 6 | 2 | | 2 | |

**Course description (Syllabus)** .NET Framework and .NET Core – overview; Data types, arrays, strings; Statements, classes, namespaces; Object oriented programming in C#; Delegates, events, structs; Collections, generic classes, generic collections; Exception handling, attributes; ADO.NET; LINQ to Objects; Threads; Streams.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Computer networks | IA44 | 5 | 2 | | 2 | |

**Course description (Syllabus):** Assimilating the basic concepts on which the computer networks; Learning some basic notions on current network technologies; Acquisition of necessary knowledge for distributed programming; Formation of required skills for computers network administration; Using Windows commands to manage computer networks; IP and MAC addresses; Using and programming various algorithms for computer networks; To establish a local network and an inter-network.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| English Language (4) | MIE4 | 2 | | 2 | | |
| French Language (4) | | | | | | |
| German Language (4) | | | | | | |
| Spanish Language (4) | | | | | | |

**Course description (Syllabus):** The main objective of English/French/German/Spanish language seminars from the second semester is that of consolidating and improving the English language knowledge acquired by students up to that point. This time the focus is no longer grammar but students' ability to express themselves as fluently and as accurately as possible by means of using a wide range of vocabulary items especially from the field of computer science. To this end special material providing them with texts and exercises covering various issues of interest from their future professional activity will be used. Topics such as operating systems, computer programming, viruses, modern gadgets, etc will be approached.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Optional (1) | IA42 | 5 | 2 | | 2 | |

**Course description (Syllabus):** Various courses are proposed by members from the Department; after an election process, the most popular choice is taught.

3rd Year

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Operations Research | IT51 | 5 | 2 | 1 | 1 | |

**Course description (Syllabus):** The Operations Research course attempts at understanding the concept of mathematical model for handling the basic economic problems in terms of an adequate math modelling language in order to solve the problems, analyze their solutions and decide over the optimal solution. At the end of this module, the students will know and better understand the domain specific concepts, theories and basic methods, they will recognize the appropriate classes and types of problems to be solved with Operations Research method, identify the opportunities for (a) solving and (b) studying the solutions of real decisional problems using specific software tools. Mathematical modelling the quantity and quality characteristics of a given situation and using the appropriate mathematical models for specific real problems solving are considered for developing the software modules for specific Operations Research algorithms and providing the corresponding documentation.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Distributed programming | IT52 | 5 | 2 | | 2 | |

**Course description (Syllabus):** Acquiring specific theoretical aspects of programming in a distributed environment; Developing skills of using specific instruments of distributed programming.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Software Engineering | IA51 | 5 | 2 | | 2 | |

**Course description (Syllabus):** Elements regarding the general theory of the system; Information systems. Information flows; Information systems with automated component; The notion of methodologies. The UML modeling language; Tools that assist the UML development of a problem's solution; The presentation of the tool Visual Paradigm for UML.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Web Technologies | IA57 | 5 | 2 | | 2 | |

**Course description (Syllabus):** Web-design principles, MVC principle, Design and animation with Photoshop, HTML5, CSS rules, JavaScript language, VRML1 and VRML2, Canvas in HTML5

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Practical Placements | IT53 | 5 | | | | 4 |

**Course description (Syllabus):** Improvement of the didactic activities and the students' vocational training by placing students in real situations of software development and by practicing the basic competences regarding human relations within working conditions; Placing students in real situations of software development; Qualified company personal attendance to student's practical training; Practicing the competences regarding human relations within working conditions; Increasing students' motivation regarding their theoretical and practical preparation by offering them a better knowledge about their future profession; Preparing young graduates for the work market, by acquiring practical experience during the period of university studies; Supervising and validation of the students activity both by the university mentor and the person appointed by the company; Providing detailed and reliable information regarding the future students profession.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Probabilities and Statistics | AP07 | 5 | 2 | 1 | 1 | |

**Course description (Syllabus)**: Events, probability space, properties of probability; Counting methods (probability schemes); Conditional probability, independent events; Random variables, distribution functions; Discrete and continuous distributions, mean and variance, Chebyshev's inequality; The weak low of large numbers, the central limit theorem; Descriptive statistics; Estimators, properties

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Artificial Intelligence | IA56 | 5 | 2 | | 2 | |

**Course description (Syllabus):** Introduction, topics, foundations, candidate definitions for AI; Solving problems by searching: uninformed and informed search; Heuristic methods for searching; Constraint satisfaction problems; Logical agents, propositional logic; First order logic

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| IT Project Management | IA62 | 5 | 2 | | 2 | |

**Course description (Syllabus):** Elements regarding the general theory of the management; The management of the IT projects. Planning the IT projects; The management of the IT projects. Resource management; The management of the IT projects. Quality management; The management of the IT projects. Risk management; The management of the IT projects. The management of changes; The usage of the supporting tools for the projects management. Case study: Microsoft Project 2010.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Practical Placements | IT61 | 5 | | | | 4 |

**Course description (Syllabus):** Improvement of the didactic activities and the students' vocational training by placing students in real situations of software development and by practicing the basic competences regarding human

relations within working conditions; Placing students in real situations of software development; Qualified company personal attendance to student's practical training; Practicing the competences regarding human relations within working conditions; Increasing students' motivation regarding their theoretical and practical preparation by offering them a better knowledge about their future profession; Preparing young graduates for the work market, by acquiring practical experience during the period of university studies; Supervising and validation of the students activity both by the university mentor and the person appointed by the company; Providing detailed and reliable information regarding the future students profession

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Optional (2) | IAO2 | 5 | 2 | | 2 | |

**Course description (Syllabus):** Various courses are proposed by members from the Department; after an election process, the most popular choice is taught.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Optional (3) | IA61 | 5 | 2 | | 2 | |

**Course description (Syllabus):** Various courses are proposed by members from the Department; after an election process, the most popular choice is taught.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Optional (4) | IAO4 | 5 | 2 | | 2 | |

**Course description (Syllabus):** Various courses are proposed by members from the Department; after an election process, the most popular choice is taught.