

Transilvania University of Brasov, Romania

Study program: Mathematics and Computer Science

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
Algebra	ALG1	5	2	2	-	-

Course description (Syllabus): Matrices and Determinants: definition, properties, R. Laplace, rank, inverse, software products; Linear Systems: T. Rouche, numerical methods, software; Vector spaces: definition, examples, subspaces; Linear independence, basis and dimension, change of base substitution lemma; Euclidean and unitary spaces: definition, time distance, ortogaonalitate, orthogonal projections; Morphisms of vector spaces: definition, kernel, image properties, linear isomorphisms; Vectors and eigenvalues, their subspaces. Software products; Jordan and diagonal forms of a square matrix; p-linear forms, tensor calculus; Quadratic forms: definition, canonical expression, Sylvester theorem. Hermitian quadratic forms.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Real Analysis	AMR1	7	3	3	-	-

Course description (Syllabus): The real number system; topological notions; Sequences and series of real numbers; Limits and continuity; properties of continuous functions; Differential calculus of functions of one variable; Taylor's Theorem; Integral calculus of functions of one variable; improper integrals; Euler's functions; Sequences and series of functions; Power series. Structure of the space R^n ; euclidian norm and distance; Real-valued and vector-valued functions of several variables; Limits and continuity of functions of several variables, linear functions; Partial derivatives, differentiability of functions; The implicit function theorem, the inverse function theorem; Relative extrema of differentiable functions, conditional relative extrema.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Synthetic Geometry	GES1	5	2	2	-	-

Course description (Syllabus): Axiomatic Theories: deductive systems, Hilbert axiomatic system, Erlagen program; Absolut and euclidian geometric problems; Geometric transformations in euclidian plane: isometric transformations, homotheties and inversions, analytical expresions; Transformations groups: Klein spaces, projective plane, projective geometry, affine plane, affine plane geometry.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Algorithmic and Programming	IAP1	5	2	1	2	-

Course description (Syllabus): Fundamental algorithms; Basic data structures: stacks, queues; Sorting: mergesort, quicksort, heap sort; Algorithm analysis; Greedy; Divide et Impera; Backtracking; Dynamic Programming; Trees and binary trees

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Data Structures	SD1	4	2		1	-

Course description (Syllabus): Learning mechanisms, structuring and data processing with complex structure; The study of principles used in the elaboration of algorithms as an essential phase in the development of software applications; Criteria for designing effective programs; Case studies and methods for performance evaluation of algorithms; Solving problems which include elements of data structures and algorithms.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
English Language (1)	LE1		1	1		

Course description (Syllabus): Verb Tenses 1, Verb Tenses 2, The Passive Voice, Modal Verbs 1, Modal Verbs 2, Relative Clauses, Pronouns and Determiners.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Mathematical Analysis	AMA1	7	3	3	-	-

Course description (Syllabus): Stieltjes integral; Functions defined by integrals; Fourier series; Line integrals; Jordan measure; Riemann multiple integral; Surface integrals; Green, Stokes and Gauss-Ostrogradsky formulas.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Analytical Geometry	GEA2	6	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); Cuadrices, Classification, Reduced at canonical form; Generating surfaces, cylindrical, conic

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Algebraic Structures	ALG2	5	2	2	-	-

Course description (Syllabus): Sets, Functions, Relations; Laws of composition. Monoid, Group. Outstanding examples of groups. Subgroup. Normal subgroup. Subgroup generated by a set. Cayley theorem. Congruence modulo a subgroup. Lagrange theorem. Factor group. Fundamental isomorphism theorem. Cyclic groups. Euler's theorem. Fermat's little theorem; Rings and fields. Subrings, subfields, ideal. Operations ideal. Morphisms of rings and fields; Factor ring. Isomorphism theorems. Characteristic of a field. Outstanding examples of fields. Invertible elements in $A[X]$, The roots of polynomials; Formal derivative of a polynomial. Polynomials with coefficients in R, Q, Z . Division theorem t in $K[X]$, Polynomials in several undetermined. Symmetric polynomials. Newton sums.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Computer Networks	RC1	5	2	-	2	-

Course description (Syllabus): The course introduces main concepts of networking; application areas; classification; reference models; transmission environment; technologies; routing algorithms; IP, UDP and TCP protocols; reliable data transferring methods; application protocols; network security; management systems; perspectives of communication networks

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Object Oriented Programming	IP03	5	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
English Language (2)	LE02	2	1	1	-	-

Course description (Syllabus): Flomes 1, Our Land is Your Land 1, Never lost for Words 1, Celebrity 1, Newspeak 1, The Body Beautiful 1, The Medial

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Physical Education and Sport 1	EF02	2	-	2	-	-

Course description (Syllabus): Education / develop basic motor skills and specific of branches / sports events ; Formation of a system of motion skills and general (basic and specific application or utility samples / sports branches) ; Appropriation of means and structures for learning exercises , strengthening and improving the technical elements specific sports games ; To acquire notions on the drives methodical approach in the learning , strengthening and improving sports gaming elements

2st Year

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Differential equations	ED1	6	2	2	-	-

Course description (Syllabus): Ordinary Differential Equations, Differential Equations of superior order with variable coefficients; Differential Equations of superior order with constant coefficients; Symmetric Systems of Differential Equations; Linear and cvasi-Linear Equations with partial derivatives of order I; Non-Linear Equations with partial derivatives of order I; A qualitative theory of Dynamical Systems, Stability of solutions for dynamical systems; Linear and nonlinear Integral Equations of Volterra type; Integral Equations of Fredholm type; Fredholm alternatives.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Differential geometry	GED3	6	2	2	-	-

Course description (Syllabus): Curves in a Euclidean space (arc, parametric and implicate representation, particular cases: plane and space curves); Plane curves (contact and applications, hull of curves, evolute and evolvents, frame and Frenet formulas, existence theorem, global properties); Space curves (contact and applications, frame and Frenet formulas, curvature and torsion, existence theorem, remarkable curves, approximative representation); Surfaces (curves on a surface, metric of a surface, isometries and conformal transformations, second fundamental form, Gauss curvature, mean curvature, curvature and asymptotic lines, geodesics, Gauss-Bonnet Theorem, constant curvature surfaces); Generaliztions and applications.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Complex Analysis	ANC3	6	2	2	-	-

Course description (Syllabus): Complex Numbers, The field of complex numbers, Elements of topology in C, The extended complex plane and its spherical representation; Flolomorphic functions, Examples of holomorphic functions; Complex integral, Paths in the complex plane, Complex integral, Cauchy's theorem. Cauchy's formula; Maximum modulus principle ;Schwarz's lemma; Series of functions. Residue theorem, Taylor series. Taylor series expansions, Laurent series. Laurent series expansions, Singularities, Residue theorem; Conformal mappings.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Logic and set theory	LOG3	6	2	2	-	-

Course description (Syllabus): Stieltjes integral; Functions defined by integrals; Fourier series; Line integrals; Jordan measure; Riemann multiple integral; Surface integrals; Green, Stokes and Gauss-Ostrogradsky formulas.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Java Programming	IPJ6	5	2	-	2	-

Course description (Syllabus): Understanding the contents and the importance of the object oriented programming, as a method to realize quality software systems; The presentation of the concepts and principles of the object oriented programming considering the perspective of the Java programming language; The exemplification of the manner through which important statements of the object oriented programming can be used; Gathering the state-of-the-art knowledge from the field of object oriented programming; The formation of the skills that are required to use the Java language in order to realize object oriented software systems.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Physical Education and Sport 2	EF2	2	-	2	-	-

Course description (Syllabus): Education / develop basic motor skills and specific of branches / sports events; Formation of a system of motion skills and general (basic and specific application or utility samples / sports branches); Appropriation of means and structures for learning exercises, strengthening and improving the technical elements specific sports games; To acquire notions on the drives methodical approach in the learning, strengthening and improving sports gaming elements and specific procedures; Capacity building for the implementation of the bilateral learn in the game

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Partial differential equations	ECP2	5	2	2	-	-

Course description (Syllabus): Mathematical methods and models that exists mainly in Mathematical Physics; The second-order quasilinear partial differential equations are classified and for each type, the most important equations from an applicative point of view are studied (e.g. Mechanics, Electrical engineering, etc.); The fundamental solutions of these equations are deduced and the problems generated by these equations are studied: initial value problems, boundary value problems, initial boundary value problems.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Measure theory	AMM5	6	2	2	-	-

Course description (Syllabus): Algebras and eAlgebras, Measure; Outer measure, Lebesgue outer measure in $\mathbb{R}^n$, Caratheodory's theorem; Measure extension, Lebesgue outer measure in $\mathbb{R}^n$; General properties of measurable functions, General properties of measurable step functions, Types of convergence for sequences of measurable functions; Lebesgue integral for non-negative measurable step functions, Lebesgue integral for non-negative measurable functions, Lebesgue integral for measurable functions, Riemann integral and Lebesgue integral; p-integrable functions, Holder and Minkowski inequalities, L^p space-Banach space, L^∞ space- Banach space.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Numerical analysis	AMN4	5	2	1	1	-

Course description (Syllabus): The formation of habits of use of an information product specific; Numerical methods in

linear algebra (Factorization LU, Gauss-Jordan Method, Householder Transform, Decomposition and factorization QR, Interactive methods for solving algebraic linear equations systems .); Elements of interpolation theory (Lagrange, Lagrange -Hermite interpolation); Finite differences and divided differences; Numerical integration formulas (Formulas of Newton-Cotes type, orthogonal polynomials, Gauss type formulas); Numerical derivation, Richardson extrapolation; The method of least squares; Cubic spline functions.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Data Bases	IBD5	5	2	-	2	-

Course description (Syllabus): Using systems projects of methodology of systems with data bases by specific methods; Using Entities-Relations diagramme, using normalizations, physics projections in Access and Appex- Oracle.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Financial Mathematics	MFIN	5	2	2	-	-

Course description (Syllabus): Equivalent operation in simple interest regime . Compound interest; Percentage and risk placement. Devaluation; . Discount operations. Simple discount; Compound discount. Equivalent operations in discount regime; Deferred payments. Annuities, Perpetuities; Special annuities; Repayment . Tables for reimbursement; Amortization of loans . The real interest rate; Elements of theory of insurance; Life annuities, Life insurance.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Actuarial Mathematics	Mact	5	2	2	-	-

Course description (Syllabus): Life probabilities; Tables of mortality; Life annuities, Life insurance. Data and basics of modeling; Theory of interest rates; Equation of value and its applications; Single decrement models; Multiple decrement and multiple life models; Pricing and reserving.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
English Language (4)	MIE4ITR	2	1	1	-	-
German Language (4)	MIG2ITR					

Course description (Syllabus): Science and Technology 1; The Cutting Edge 1; Let's talk! 1; Computer Architecture 1; Operating Systems 1; Software 1; The Internet and Hackers 2.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Physical Education and Sport 4	EF04	1	-	1	-	-

Course description (Syllabus): Education / develop basic motor skills and specific of branches / sports events; Formation of a system of motion skills and general (basic and specific application or utility samples / sports branches); Appropriation of means and structures for learning exercises, strengthening and improving the technical elements specific sports games; To acquire notions on the drives methodical approach in the learning , strengthening and improving sports gaming elements and specific procedures; Capacity building for the implementation of the bilateral learn in the game.

3st Year

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Theoretical Mechanics	EMT3	6	2	2	-	-

Course description (Syllabus): Applications of vector calculus - Momentum theory ; The study of the point motion in different coordinate systems; Solid kinematics, Euler's angles; Dynamics of material point; Theory of universal attraction; Mechanical analytic, Lagrange's equations; The canonical system of Hamilton. Prime integrals of the canonical system; The stability theory; Analysis of discrete dynamical systems, Introduction in method of finite element.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Probabilities	AMP6	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 law of large numbers, the central limit theorem; Stochastic processes: Markov processes, Poisson processes

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Functional Analysis	AMF7	5	2	2	-	-

Course description (Syllabus): Topological vector spaces; Locally convex topological vector spaces; Normed linear spaces; Linear operators and linear functionals; Basic principles: Hahn-Banach theorem, uniform boundedness principle, the open mapping and closed graph theorems; Duality and weak topologies. The bidual and reflexivity; Hilbert spaces.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Optimization Technics	ALG47	5	2	1	1	-

Course description (Syllabus): 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 domain and decide over the optimal solution; Knowing and understanding the domain specific concepts, theories and basic methods; Recognizing the appropriate classes and types of problems to be solved with Operations Research methods ; Mathematical modelling the quantity and quality characteristics of a given situation; Using the appropriate mathematical models for specific real problems solving; 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
Mathematical Software	MMA	5	2		1	-

Course description (Syllabus): Linear Programming. Integer Programming. Mixed Integer Programming. Fuzzy sets. Transportation. Assignment. Networks. Networks-Shortest Route. Networks-Minimum Spanning Tree. Project Management. Decision Analysis. Forecasting. Markov Analysis.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Abstract Algebra	ALG5	5	2	2	-	-

Course description (Syllabus): Maximal ideal. Prime ideal. Arithmetic properties of the ring. Principal rings, Euclidean and factorial rings. Arithmetic in the ring of integers; Polynomial rings. Irreducible elements. Arithmetic in the ring of polynomials: irreducible polynomials, irreducibility criteria; Extension of a field. Finite extension, algebraic extension.

Algebraic element. Decomposition field of a polynomial. Galois group of an extension; . Modules. Submodules. Morphisms of modules. Factor module. Exact sequences of modules and morphisms of modules. Direct product of modules. Straightforward modules. Module. Free module generated by a lot. Tensor product of modules. Finitely generated modules over principal rings.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Practice	PRAC	5	-	-	-	8

Course description (Syllabus): 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.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Complements of Mathematical Analysis	AP10	5	2	2	-	-

Course description (Syllabus): Systematic deepening of fundamental results of real analysis; Illustration of some techniques of addressing of problems in real analysis; Preparation of mandatory exams for teachers; Establish the nature of sequences and series. The study of the rate of convergence; Using the Taylor developments; Using the notions of continuity and differentiability of real functions; Study the extremes of real functions, establishing inequalities arising from convexity; Study classes of functions that have primitive; Calculation of Riemann integrals. Convergence of integrals sequences; Systematic approach of problems proposed in recent exams for teachers.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Differentiable Manifolds	GED4	5	2	2	-	-

Course description (Syllabus): Smooth manifolds and maps. Immersions. Submersions; Tangent and cotangent spaces. Tangent and cotangent maps; Vector bundles. Tangent and cotangent bundles. Operations with vector bundles; Differential forms and calculus on manifolds; Connections in vector bundles; Curvature and torsion. Covariant derivatives; Integration on manifolds.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Mathematical statistics	AMS8	5	2	1	1	-

Course description (Syllabus): Essentials in probability theory; Samples and sampling distributions; Estimators; Finite sample properties of estimators; Asymptotic properties of estimators; General methods to prepare estimators; Interval estimation; Hypothesis testing.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Mathematical models to Machine Learning	MMML	5	2	1	2	-

Course description (Syllabus): Supervised learning (generative/discriminative learning, parametric/nonparametric learning, neural networks, and support vector machines);Unsupervised learning (clustering, dimensionality reduction, kernel methods); Learning theory (bias/variance tradeoffs; VC theory; large margins);Reinforcement learning and adaptive control.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Practical Coordination for Bachelor Thesis	ELLC	6	-	-	-	4

Course description (Syllabus): 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.