

Transilvania University of Braşov, Romania

Study program: Biomaterials Engineering

Faculty: Materials Science and Engineering Faculty

Study period: 4 years (bachelor)

1st Year

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Mathematical Analysis	SMAMA1	4	3	1		

Course description (Syllabus): Field theory. Scalar and vector fields. Differential operation. Theory of complex variable functions. Cauchy integrals. Taylor and Laurent series. Partial differential equations of first order. Trigonometric series. Fourier series. Bessel functions. Vibrant, heat equation, Laplace equation.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Computer Programming and Programming Languages	SMPRG1	6	3		2	

Course description (Syllabus): HTML programming language; PHP programming language; JavaScript programming language; Java programming language.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Descriptive Geometry	SMGDE1	4	2	1		

Course description (Syllabus): Importance of standards in technical drawing. Classification of technical drawings. Representations used in industrial design. Sections. Representation and dimensioning of machine elements. Overall design and installation.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Materials Science	SMSMM	5	2	1	1	

Course description (Syllabus): The discipline of materials science involves investigating the relationships that exist between the structures and properties of materials. Metallic Crystal Structures, Fundamental Concepts, Unit Cells, Crystal Systems; Crystallographic directions and planes. Phase transformations in metals, Polymorphism and Allotropy, Crystallization, etc. Equilibrium phase diagrams: Solubility Limit, Phases, Microstructure, Interpretation of Phase Diagrams, Development of Microstructure in Isomorphous Alloys. Binary Eutectic Systems, Development of Microstructure in Eutectic, Intermediate Phases or Compounds, Eutectoid and Peritectic Reactions, Congruent Phase Transformations. Ternary Phase Diagrams. Ferrous Alloys, The Iron-carbon system, The Iron-Iron Carbide (Fe-Fe₃C) Phase Diagram, Development of Microstructures in Iron-Carbon Alloys. Nonferrous Alloys. Heat Treatments, Mechanism of Hardening.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
General Chemistry	SMCGB1	5	2	1	2	

Course description (Syllabus): General notions of chemistry (Atom, molecule, mol equivalent gram). The relationship between structure and properties of substances. Chemical bonds. Water. Water hardness. Water softening and demineralization. Metals. Preparation. Properties. Corrosion. Corrosion protection methods and techniques. Fuels.

Economic importance and practical applications of materials (lubricants, abrasives, glass). Electrochemical energy conversion. Cells. Macromolecular compounds. Composites.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Mechanics	SMMEC	4	2	1		

Course description (Syllabus): Systems of forces; Center of mass; Rigid solid balance; Balance material systems; Mechanical inertia; Kinematics point; Kinematics of rigid objects; Introductory dynamics; Fundamental theorems of dynamics; Dynamic stiffness.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Materials physics	SMFIZ1	4	2	1	1	

Course description (Syllabus): Mechanics and acoustics; Thermodynamics and Statistical Physics; Electromagnetism; Maxwell's equations; Potential field; Transition equations for the electromagnetic field components; Field energy in inductors and capacitors electromagnetic; Electrostatics.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Linear Algebra, Analytical Geometry and Differential Equations	SMALG1	5	2	1		

Course description (Syllabus): Vector spaces; Euclidean spaces; Space; Linear transformations; Values and eigenvectors; Bilinear and quadratic forms; Conic; Sphere; Quadra on reduced equations; Generated surfaces.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Technical Drawing	SMDEST	3	1		2	

Course description (Syllabus): General presentation: software, interfaces, configuration, screen, menus, opening, closing, maneuvers, etc. Fundamentals of technical drawing (initiation, ordering, managing screen graphics, design prototype, coordinates and units) Basic 2D drawing techniques. Layer concept. Graphic aids (basic object creation, types of lines, properties). Editing commands and extract information from drawings. Selecting entities (set of selection, editing techniques, attachment points, grips, delete, move, zoom, scale, copy, etc.). Advanced editing techniques (changing object characteristics, beveling, connections, extensions, and so on). The concept of block. Symbols and attributes. External references.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Numerical Methods	SMMEN1	4	2		1	

Course description (Syllabus): Numerical errors; Numerical solution of algebraic equations; Solving systems of equations; Numerical methods for calculating eigenvectors; Approximation of functions; Numerical derivation; Numerical integration; Numerical solution of first order differential equations.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Introduction in Bioengineering	SMIBI	4	2	1		

Course description (Syllabus): Introduction in bioengineering. Fundamentals. Principles. Ethical issues; Fundamentals of biomechanics; Bio-system modeling; Biocompatible materials; Types and material properties; Bioinstrumentation; Sensors for medical applications; Medical optics; Medical image acquisition and processing.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Management in engineering	SMASE1	4	1	2		

Course description (Syllabus): General aspects on economic systems; Company structure; SWOT analysis applied in economic systems; General aspects on company's financial management (outgoings cost, resources, accountability, values, financial situations); Expenses analysis of economic systems; General aspects on marketing operations inside of economic systems; General aspects on project management inside of economic systems. General aspects on Quality management inside of economic systems.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Techniques of communication and intellectual property (optional)	SMTCPi	4	2	1		

Course description (Syllabus): Science communication and communication principles; classification of communication. Written communication: letter, essay, report, request, official and personal letters, E-mail, web pages, CV and cover letter. Mood control in communication. The conflict in the managerial team, communication types during conflicts, dialogue theory. Brainstorming and Delphi techniques. Notable discoveries and inventions. Romanian and foreign famous inventors. Industrial intellectual creations. Distinctive signs. Copyright and rights related to copyright. Patenting inventions in Romania and abroad. The economic value of the patent.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Elements of biology (optional)	SMEBI	4	2	1		

Course description (Syllabus): Cell - Morphofunctional unit of living organisms; Cell organelles; Metabolism. General; Mass transfer through cell membranes; The genetic code and protein biosynthesis; The genetic mutation.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Foreign Language: English	LE01/LE02	2/2	1/1	1/1		

Course description (Syllabus): The Verb. Indicative Mood. Present (simple & continuous, perfect simple & continuous); Practice; The Verb. Indicative Mood. Past (simple & continuous, perfect simple & continuous); Practice; The Verb. Indicative Mood. Future (simple & continuous, perfect simple & continuous). Future-in-the-Past (simple & continuous, perfect simple & continuous). Other ways of expressing the future (Present simple & continuous, be going to, be to, be about to), Practice. The Verb. Subjunctive Mood. Synthetic (Present/Past/Past perfect) & Analytic (modal + inf.), Practice. The Noun. Classification, gender, number, case, Practice. The Adjective. Classification, comparison, special constructions, position, Practice. The Adverb. Classification, types, comparison, position.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Physical Training	EF01/EF02	1/1		1/1		

Course description (Syllabus): Sports, athletics, basketball, football;

2nd Year

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Special Mathematics	SMMSP	3	2	1		

Course description (Syllabus): Systems of differential equations; Elements of field theory; Complex functions; Fourier series; Partial differential equations of second order; Laplace transform.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Strength of Materials	SMRM	4	2	1	1	

Course description (Syllabus): Strength of materials problems; Static moments of inertia; Sectional efforts to straight beams, curved, flat and spatial structures; Elements of the Theory of Elasticity; Extent-compression; Shear of relatively small sections, calculating joints; Torsion bars; Bending of straight beams.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Physical Chemistry	SMCHFZ	5	2	1	1	

Course description (Syllabus): Thermodynamics: basic concepts, thermodynamic laws and applications; Thermodynamic potentials and spontaneity criteria, applications; Phase equilibria in pure fluids and binary systems; Kinetics: reaction rate, simple reactions (formal kinetics); complex reactions; catalysis; Electrochemistry: electrolyte solutions and transport phenomena; energy conversion (electrodes and galvanic cells, electrolysis); Corrosion and anticorrosion protection.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Fluid Mechanics	SMMF	3	2	1		

Course description (Syllabus): Introduction. Physical properties of fluids; Basics on static of fluids; Kinematics, basic definitions; Basic equations of fluid Dynamics. Dynamics of inviscid fluids: Euler equation, Bernoulli law, law of momentum; Dynamics of viscous fluids: laminar regime and turbulent regime; Some topics in the dynamics of inviscid compressible fluids: water hammer; Measurement of various parameters of flowing fluids: velocity and flow rate; Hydraulic machines: introduction, classification, working parameters; Turbomachines: characteristic curves, efficiency definitions, similarity laws and factors for turbomachines, the ensemble pump-network, operating point, suction head of a pump, cavitation, pump regulation; Volume machines. Hydrostatic pumps and motors. Hydraulic and pneumatic drives. Characteristics of pneumatic drives.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Applied Informatics	SMINFA	4	1	2		

Course description (Syllabus): Database; MySQL language; Interaction between PHP and MySQL; Economic and engineering applications; Creating a virtual store; Server-side ASP.NET language, C# language; Applications in Visual Web Developer express 2008.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Material properties	SMPMMT	5	2	1	1	

Course description (Syllabus): Crystalline structure – perfection. Crystal defects and noncrystalline structure-imperfection (the solid solution-chemical imperfection, point defects, linear defects, planar defects, three dimensional imperfections). Mechanical behavior - the theoretical aspects, influences, determination methods, choosing materials based on these characteristics. Thermal behavior (heat capacity, thermal expansion, thermal conductivity, thermal shock) - the theoretical aspects, influences, determination methods, choosing materials based on these characteristics. Electrical behavior - the theoretical aspects, influences, determination methods, choosing materials based on these characteristics. Magnetic characteristics - the theoretical aspects, influences, determination methods, choosing materials based on these characteristics (magnetism, ferromagnetism, ferrimagnetism, metallic magnets, ceramic magnets). Technological properties of materials - the theoretical aspects, influences, determination methods, choosing materials based on these characteristics. Materials in engineering design (environmental degradation, materials selection).

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Probability Theory and Mathematical Statistics	SMTPSM	4	1	2		

Course description (Syllabus): Field-probability events; Classical probability distributions; Random variable systems; Law of large numbers; Selection and estimation theory; Confidence intervals; Hypothesis testing.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Biocompatible materials	SMBIO	8	4		3	

Course description (Syllabus): Biomaterials - Definition, characterization; Metallic materials used for implants; Polymeric materials used for implants; Ceramic materials used for implants; Composite systems and perspectives.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Biomolecules and biopolymers	SMBB	5	2	1	2	

Course description (Syllabus): The intramolecular interactions in biostructure; The structure of biopolymers; Specificity; Biostructure level interaction sites; Bioreceiver; Biomembrane; Enzymatic microreactors and nanoreactors.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Electrotechnics	SMETH	4	2		1	

Course description (Syllabus): Electrostatic. Primitive and derived sizes. Units. Electrification phenomena. Electric charge, electric charge density. Electric field in the vacuum electrical current, Coulomb's formula, induction electric vacuum voltage vacuum. Laws of electrostatics. Applications. Electro kinetic. Electro kinetic status, power and electric current density. Electric fields printed. Cells and batteries. Solving linear DC network. Applications. Electrodynamics.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Microscopy and Image Analysis	SMMAI	5	2	1	1	

Course description (Syllabus): Microscopic analysis; Quantitative metallographic analysis; Automatic methods of analysis in quantitative metallography; Electronic microscopy.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Marketing	SMMK	4	2	1		

Course description (Syllabus): Commercial transactions (subject, payment, participants). Trade policies (tariff protection tools, non-tariff protection tools, incentives and export promotion). The General Agreement on Tariffs and Trade (GATT) and World Trade Organization (WTO). European Union trade policy. International commercial negotiation and contracting. Combined commercial transactions (re-exporting, loan, switch).

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Practical Activity I (90 hours)	SMPRS2	2				

Course description (Syllabus): Analysis on the types of materials and biomaterials (metal, ceramics, composites, polymers). Materials synthesis processes. Technologies and equipment for processing biomaterials.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Foreign Language: English	LE03	2	1	1		
	LE04	2	1	1		

Course description (Syllabus): The Verb. Indicative Mood. Present (simple & continuous, perfect simple & continuous); Practice; The Verb. Indicative Mood. Past (simple & continuous, perfect simple & continuous); Practice; The Verb. Indicative Mood. Future (simple & continuous, perfect simple & continuous). Future-in-the-Past (simple & continuous, perfect simple & continuous). Other ways of expressing the future (Present simple & continuous, be going to, be to, be about to), Practice; The Verb. Subjunctive Mood. Synthetic (Present/Past/Past perfect) & Analytic (modal

+ inf.), Practice; The Noun. Classification, gender, number, case, Practice; The Adjective. Classification, comparison, special constructions, position, Practice; The Adverb. Classification, types, comparison, position.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Physical Training	EF03/ EF04	1/1		1/1		

Course description (Syllabus): Sports, athletics, basketball, football;

3rd Year

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Medical Imaging	SMIMG	7	2	1	2	

Course description (Syllabus): X-rays – General; Basic physical and technical characteristics of ultrasound, computer tomography, nuclear magnetic resonance, Image Formation CT, MRN- general concepts; Methods of investigation of the respiratory system; Methods of investigation mediastinum, diaphragm; The heart - diagnostic imaging methods; Radiological examination of the digestive tract, radiological semiotics; Imaging diagnosis of liver disease, biliary tract, spleen, and pancreas. The appearance of the kidneys and urinary tract imaging; Osteo-articular system, investigation methods; Diagnostic imaging in disorders of the nervous system.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Prostheses	SMPROT	6	2		1	2

Course description (Syllabus): Types of prostheses; Computer aided design fundamentals: 2D and 3D representations. 3D CAD software; Wireframe, surface and solid models in AutoCAD; Solid primitives. Creating complex solids parts through Boolean operations; Material properties assignation to solid models; Sketches transformation into drawings by geometric constraints; Solid modeling based on features in SolidWorks. Assembling parts; Obtaining views and sections from 3D models; Design applications for prostheses.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Heat Treatment	SMTT	5	2		2	

Course description (Syllabus): Basic principles of the heat treatment operations; Primary heat treatment; Hardening of steels; Annealing of steels; Heat treatments of alloyed steels; Heat treatments of cast irons; Heat treatments of non-ferrous alloys.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Elaboration and Casting alloys	SMELAB	8	4	1	2	

Course description (Syllabus): Structure formation mechanism of ferrous alloys. Types of structures. Melting of irons and steels. Features of technologies. Control of cast iron melting (in the cupola and induction furnace) and steel melting (in electric arc furnace). Cast iron and iron casting. Casting properties. Technological features. Alloys Phase Diagrams, Structure and Properties of Engineering Nonferrous Alloy: based on Cu, Ni, Zn, Pb, Sn, Al, Mg and Ti. Fusion and alloying of nonferrous metals. Phenomena and processes during the elaboration of nonferrous alloys. Refining of metallic melts.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Biocompatibility	SMBIC	5	3	1	1	

Course description (Syllabus): Metals and alloys used in implants. Trends in their evolution. The surface quality of the materials used in implants, ways of amending them. Surface modification of materials for implants by chemical

procedures. Surface characterization of materials for implants. Physical characterization of protein adsorption. Modeling and simulation of protein adsorption on nanostructured metallic surfaces. Biological characterization of biological tissue-material interface contact.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Computer aided design	SMPAC	5	2		1	2

Course description (Syllabus): Computer aided design fundamentals. 2D and 3D representations. 3D CAD software. 3D wireframe and surface models in AutoCAD. Solid models in AutoCAD. Solid primitives. Creating complex parts through Boolean operations with solids. Material properties assignment to solid models. Sketches transformation into drawings by geometric constraints. Solid modeling based on features in SolidWorks. Obtaining views and sections from 3D models. Design applications for molds and dies.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Cutting processing	SMPAB	6	2		2	1

Course description (Syllabus): Basic concepts about Machining technologies: measurement bases, constructive-technological and non-technological forms of machined parts, installation guide and fixing parts on machine tools for machining. General and particular elements about design of machining technologies. Presentation of main technologies: manufacturing technology of shafts, flywheels, bearings. Parts reconditioning technology. Maintenance and repair of technological equipment.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Cardiovascular implants	SMIC	5	2		2	

Course description (Syllabus): The interventional treatment of coronary heart disease; coronary stents; Interventional treatment in peripheral vascular damage; carotid, renal and peripheral stents; Interventional treatment of aortic stenosis (valve prosthesis percutaneous) and mitral regurgitation; Interventional treatment of fistulas (pulmonary, coronary, brain); Bradyarrhythmias treatment: temporary and permanent pacing; Prevention of sudden death - implantable defibrillator; Long monitoring and remote device; Ventricular assist devices; Ablative therapy; energy sources; pulmonary veins isolation devices; Surgical valvular prosthesis.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Materials for biosensors	SMBIOS	3	2		2	

Course description (Syllabus): physiological sensors that provide biochemical information transfer in the electric field; afferent sensors that replace human organs and human senses; Physiological sensors; Biosensors metabolism; Immunosensors; Bio tactile sensors; Acoustic biosensors; Bio visual sensors; Bio Sensors for smell and taste.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Techniques of advanced analysis of biomaterials (optional)	SMTAAB	4	2		2	

Course description (Syllabus): Introduction of metrology: history, standardization strategies, quantitative and qualitative analysis, statistical processing. Determining the chemical composition: chemical composition analysis for coarse materials; microanalysis on nanomaterials. Determining the type of structure / morphology: crystalline and amorphous structure analysis; network fault analysis and impurities; texture and distribution of phases. Determination of thermal properties: thermal conductivity, specific heat; expansion; thermomechanical analysis; Determination of electrical properties: electrically conductive metallic materials; determining the dielectric characteristics; semiconductors. Determination of magnetic and optical properties. Determination of the functional

properties: corrosion resistance, wear resistance. Determination of functional properties: biological response; biocompatibility; impact on the environment.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Dental implants (optional)	SMID	4	2		2	

Course description (Syllabus): Notions of anatomy and physiology of the maxillary; Classification of biomaterials; Physical and chemical characteristics of biomaterials; Bio integration of dental implants; indications of prosthetic biomaterials; Indications, contraindications and complications of biomaterials; Prophylaxis of dento-maxillary diseases;

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Project Management (optional)	SMMPRO	4	2	2		

Course description (Syllabus): Definition and position in the technical sciences; Concept – idea, general plan, detailed plan, feasibility and decision; Realization – WP, Objectives, Deliverables; Indicators – scaling; Planification – CPM, PERT, PDM; Resource allocation.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Value Analysis (optional)	SMAV	4	2	2		

Course description (Syllabus): Basic concepts about Management and Value Analysis elements; General and particular elements about design of Value Analysis Method; Function Analysis System technique (FAST); Functional Analysis; Concepts and Approaches of Value Analysis and Engineering; Case study: equipment, technologies; Practical applications: technology and Value Analysis products.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Practical Activity II	SMPRS3	2		90 hours/sem		

Course description (Syllabus): Industrial case studies: The process design analysis of methods for the synthesis and processing of advanced materials; Computer aided design processing technologies; Industrial management and management design.

4th Year

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Quality Management	SMMCAL	4	2		1	

Course description (Syllabus): Fundamentals of Quality Management; The main precursors of the Quality Management; Standardization. Vocabulary and terminology in quality. ISO 9000; The concept of Quality Management (QM). Quality Control (QC). Quality Assurance (QA); Quality Management System (QMS); The main documents of the QMS; Principles of Quality Management according to ISO 9000; Total Quality Management (TQM). TQM principles; Assessment and certification QMS. Strategic planning quality. Quality Awards;

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Biotribology	SMBTRI	6	2	1	2	

Course description (Syllabus): Getting started on biotribology: materials for prosthetics; types of friction couples, wear and friction types. Metal – metal joints: geometry, materials used and methods of production; quantification of wear; influence of metal particles detached from the prosthesis components on the surrounding tissue. Biotribology of titanium alloys: history; properties of titanium alloys, titanium alloys surface modification and characteristics. Metal

/ polymer joints; ceramic / polymer joints: the influence of temperature on the tribological behavior of friction couplings made from polymers; the deformation and wear mechanisms of polymers. Dental biotribology: wear mechanisms; tribological behavior of materials used for repairs (resins, metallic alloys, ceramics); wear at the interface of implant / bone.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Processing by plastic deformation	SMBTDPL	6	2		1	2

Course description (Syllabus): General and specific elements regarding the processing of materials in solid state. Classification of plastic deformation processes (open die forging - closed die forging, cold and hot plastic deformation). Processing technologies by plastic deformation – design. Plastic deformation using hammers – design. Plastic deformation using presses – design. Rolling technology- design. The effect of plastic deformation process on the microstructure, residual stresses and typical defects. Severe Plastic Deformation. Super-plasticity and Superplastic Forming.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Nanomaterials and nanotechnologies	SMNANO	6	3			2

Course description (Syllabus): Introduction to nanomaterials and nanotechnologies. Evolution of nanomaterials. Size influence on the behavior and properties of materials. Characterization methods for nanomaterials. Nanometrology. The structure, shape and properties of different types of nanomaterials. Carbon nanotube-structure, properties, areas of use. Manufacturing technologies of carbon nanotubes. Manufacturing technologies of nanopowders, structures, properties, areas of use. Nanobiotechnologies.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Surface Engineering	SMIS	5	4		2	2

Course description (Syllabus): Surface engineering: the key to optimized performance; General aspects on coatings structure and characterization; Use of plasmas in deposition technologies; Ion implantation and ion-assisted coatings and thin-films; Evaporation and Sputter deposition; Plasma-assisted physical vapors deposition; Thermally activated chemical vapors deposition; Plasma-assisted chemical vapors deposition; Thermal spraying; Laser surface treatment; Characterization of coatings and interfaces.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Corrosion and protection of bio-materials	SMCORZ	5	2	1	2	

Course description (Syllabus): Corrosion mechanisms, prediction and control; Chemical corrosion (theoretical bases, corrosion rate, forms of corrosion); The oxidation of materials (direct atmospheric attack, oxidation at high temperature, mechanism and kinetics, corrosion rate, forms of corrosion); Electrochemical corrosion (electrochemical aspects, environmental aspects, metallurgical aspects, forms of corrosion, corrosion testing, methods of corrosion prevention, corrosion rate measurement); Monitoring corrosion through electrochemical methods; Corrosion in biological environments and synthetic environments; The passivation theory, Flade potential, Pourbaix diagrams; Methods of corrosion prevention (surface treatments, corrosion protection by design).

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Biomimetic materials	SMBMI	5	2		2	

Course description (Syllabus): Structures and mechanical layouts with mimetic properties; Biomimetic materials – from multifunctional to integrate system type materials; Locomotion systems – morphology and adaptive design; Biomechanics of adapted media locomotion systems – haptic devices; Similarities with extreme environment withstanding materials.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Modelling and optimization of the technological processes	SMMOP	5	2	2		

Course description (Syllabus): Introduction to Modeling and optimization of industrial processes. Technological parameters of modeling. Types of models. Applications of mathematical statistics to the processing and interpretation of experimental data. Calculation of statistical parameters. Correlation analysis. Correlation and simple linear regression. Statistical analysis of the regression equation. Optimization techniques used in industry. Optimization without restriction. Gradient method. Regular simplexes method. Constrained optimization by linear programming. Simplex algorithm. Dynamic optimization. Optimization in industrial conditions.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Powder Processing for biomaterials (optional)	SMPP	4	3		2	

Course description (Syllabus): Overview and classification of metallic and ceramic powders for biomaterials. Manufacturing technologies of powders: mechanical methods, reduction, electrolysis, atomization processes and special methods. The properties of powders: physical properties – particle size and shape determination, technological properties – apparent density, flow rate etc. and chemical properties. Getting parts from powders: compaction and sintering; die compaction and other consolidation techniques, sintering, sintering with liquid phase. The properties of sintered powders for biomaterials.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Intelligent biomaterials (optional)	SMMINT	4	3		2	

Course description (Syllabus): Overview and classification of smart materials; Shape memory materials; Martensite crystallography of packed beds; Shape memory nickel-titanium based alloys; γ type martensitic transformation in alloys with shape memory; The link between the martensitic transformation and shape memory phenomena; The mechanism of mechanical memory; Ceramic materials with shape memory.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Ecotechnology (optional)	SMECOL	4	2	2		

Course description (Syllabus): Fundamentals of environmental protection. Avoiding environmental pollution. Ecological reconstruction of the environment. Management of resources. Monitoring key environmental factors. Eco technologies which are developing environmental-friendly materials and bio-inspired materials. Eco technologies which are developing metallic biomaterials: ferrous and nonferrous metals and alloys.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Virtual instrumentation for biomaterials (optional)	SMINVR	4	2	2		

Course description (Syllabus): LabVIEW virtual instrumentation.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Bases of Experimental Research (optional)	SMBCE	4	2	2		

Course description (Syllabus): Introduction to research management and research organization activities; Innovation and intellectual property protection; Research strategies and policies; Human resources management and project management in research; Research, development and innovation at the European Union level; The national system of research, development and innovation; Business incubators. Science and technology parks; Research financing.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Entrepreneurship (optional)	SMANTR	4	2	2		

Course description (Syllabus): Short history. Introduction to terminology. Management functions. Prediction function, the function of coordination, motivation function, organizing function, the evaluation function. Company and entrepreneur. Analysis skills of an entrepreneur. Business plan development. The feasibility study of a business. Entrepreneurial management and its forms. Entrepreneurial Communication Strategy. Entrepreneurial Distribution Strategy. Building Customer Relationships

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Practical Activity III (60 hours)	SMPRS4	2				

Course description (Syllabus): Scientific research projects conducted in the Department. The students will work in mixed teams with PhD and research grant coordinators. The considered topics are: Innovative technologies for synthesis and processing of biomaterials; Development of innovative biomaterials; Technologies for biomaterials synthesis and processing and environmental impact analysis.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Research for the Diploma Project (104 hours)	SMPPD4	4				

Course description (Syllabus): Scientific research projects conducted in the Department. The students will work in mixed teams with PhD and research grant coordinators. The considered topics are: Innovative technologies for synthesis and processing of biomaterials; Development of innovative biomaterials; Technologies for biomaterials synthesis and processing and environmental impact analysis.