Transilvania University of Braşov, Romania
Study program: Materials Science
Syllabus for ERASMUS + students

Faculty: Materials Science and Engineering
Study period: 4 years

1st Year (suspended for 2023-2024)

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Mathematical Analysis	5	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. Vibrant, heat equation, Laplace equation.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Software and computer programming	6	3		2	

Course description (Syllabus): Microsoft Office, OriginLab, SigmaPlot, HTML programming language; PHP programming language; JavaScript programming language; Java programming language.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Descriptive Geometry	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	No. of credits	Number of hours per week			
		course	seminar	laboratory	Project
General Chemistry	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; Macromolecular compounds. Composites.

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

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

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	Project
Materials Science and Engineering I	4	2		1	

Course description (Syllabus): Structure and properties of metallic materials; Definitions of metal, alloy, crystal structure, types of networks; Influence of the network type on the properties. Allotropic metallic materials. Crystallization of metallic materials.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	Project
Linear algebra, Analytical Geometry and Differential Equations	4	2	2		

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

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Probability and statistics	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	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Physics	4	5	1	1	

Course description (Syllabus): Mechanic and acoustic; 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	No. of credits	Number of hours per week			
		course	seminar	laboratory	Project
Technical drawing and infographics	3	1		2	

Course description (Syllabus): General (presentation software, interfaces, configuration, screen, menus, opening, closing, maneuvers, etc.). Fundamentals for 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	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Numerical Methods	4	2		1	

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

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Materials Science and Engineering II	4	2	1		

Course description (Syllabus): Homogeneous and inhomogeneous crystallization; Defects. Methods of prevention; Plastic deformation and recrystallization; Plastic deformation of crystals; Plastic deformation of polycrystalline aggregates; Hot plastic deformation.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Communication and academic writting	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. Academic writing.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
English language 1/2	3/3	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	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Physical training 1/2	1/1		1/1		

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

2nd Year (suspended for 2023-2024)

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Special Mathematics	4	2	1		

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

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Strength of Materials	5	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	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Physical Chemistry	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	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Fluid mechanics.	4	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. Hydrostatic pumps and motors. Hydraulic and pneumatic drives. The operating principle. Characteristics of pneumatic drives.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Electrotechnics	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. Cells and batteries. Electrically conductive materials. Solving linear DC network. Applications. Electrodynamics.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Thermotechnics	3	2		1	

Course description (Syllabus): Introduction. General terms of thermotechnics; The first principle of thermodynamics; Perfect gas; The second principle of heat transfer; Heat conduction; Internal combustion engine with reciprocating piston; Compressors; Gas turbine.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Applied Informatics	3	1	2		

Course description (Syllabus): Tabular calculation using the EXCEL program from Microsoft Office. Design elements using Autocad software.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Materials Properties	4	2		2	

Course description (Syllabus): Materials in engineering design (environmental degradation, materials selection. Crystalline structure - Perfection. Defects, planar defects, three dimensional imperfections. Mechanical properties of materials-the theoretical aspects, influences, methods of determination, choice of materials based on these characteristics. Thermal properties of materials (heat capacity, thermal expansion, thermal conductivity, thermal shock) - the theoretical aspects, influences, methods of determination, choice of materials based on these characteristics. Electrical properties of materials-the theoretical aspects, influences, methods of determination, choice of materials based on these characteristics. Magnetic properties of materials-the theoretical aspects, influences, methods of determination, choice of materials based on these characteristics (magnetism, ferromagnetism, metallic magnets, ceramic magnets).

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

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

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Materials Technology	4	2		2	

Course description (Syllabus): The relationships between structures and properties. Manufacturing, processing and fabrication of materials. Mechanical properties of materials and measurement of mechanical properties: elastic and plastic deformation. Properties and applications of the major metal alloys. Principles for rational and knowledge based selection of materials. Environmental aspects of the production and use of different materials.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Machine parts and mechanisms	3	2			1

Course description (Syllabus): Introduction. Objective and importance of the subject. History. Course contents. Bolted joints and screw-nut transmissions.Assemblies with pins and bolts. Longitudinal assemblies feathers. Grooved assembly. Polygonal wheels on.Tightening assemblies own. Assembly by clamping onto the cone. Assemblies with tapered rings. Couplings. Gears.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Technological Processes in Materials Engineering - Additive Manufacturing	5	2		1	1

Course description (Syllabus): Additive manufacturing processes, the advantages and limitations of these processes, and the approaches to be used in considering the material properties and design for additive manufacturing. Design of 3D models in a systematic way for various engineering application by learning the software and hardware of the additive manufacturing implementation.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Basics of Management [O1]	3	2	1		

Course description (Syllabus): The course creates an overview and understanding of traditional management, its philosophy and role in society, knowledge of models for analysis and control of the management function in a company or other organisation. The course covers basic concepts, often illustrated by examples from established, large companies.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Practical activity II (90h)	4				

Course description (Syllabus): Organizational and functional aspects of commercial companies. Primary technologies in materials processing. Machining of materials. Heat treatment technologies. Finishing and super finishing technologies. Industrial equipment working efficiency estimation. Company's primary accounting. Quality management in a manufacturing company. Logistics activities in a manufacturing company.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
English language 3/4	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	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Physical training 3/4	1/1		1/1		

Course description (Syllabus): Sports, athletics, basketball, football; School walking, running and sports march; School-jumping; School-throwing; Passing strengthening the place of displacement; Strengthening the place and throw away; Repeating structures and finishing the game with 2-3 players; Long jump with 1 ½ steps in flight; Throwing small

3rd Year

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Quality Engineering	5	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	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Technological Processes in Materials Engineering - theoretical and technological bases of alloys melting	5	2		1	1

Course description (Syllabus): Basic concepts about history, construction, operation of Processing of Materials in Liquid State. General and particular elements about design of Processing of Materials in Liquid State. Main laws and theorems that explain the phenomena that occur at Processing of Materials in Liquid State: Calculating of pouring cup, sprue, gating system, runner. Presentation of main Processing of Materials in Liquid State Technology: Classic and modern equipment for transport, modification, maintenance and pouring liquid alloys.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Technological Processes in Materials Engineering - theoretical basis of metal casting	4	2		2	

Course description (Syllabus): General information on obtaining cast parts; Alloys properties (structure states of aggregation); Melting alloys. Assimilated heat in process; Liquid alloys properties (surface tension, viscosity); Flow of liquid alloys. Flow laws; Solidification of cast alloys; Principles of modeling heat exchange during solidification of casting alloys; Casting defects. Prevention methods.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Technological Processes in Materials Engineering - theoretical basis of plastic deformation	4	2		2	

Course description (Syllabus): State of stress (components of stresses, maximum and octahedral shear stresses, differential equations of equilibrium); The mechanisms of plastic deformation (elementary dislocation theory, deformation by twinning); Laws of plastic deformations; Deformation of metallic crystals; The deformation of aggregates; The influence of friction on material flow during plastic deformation; Annealing of deformed metals; Anisotropy in polycrystalline metals.

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

Course description (Syllabus): Structure formation mechanism of metallic alloys. Influences. Types of structures. Melting of irons and steels. Features of technologies. Control of cast iron melting (in the cupola and induction furnace). Control of steel melting (in electric arc furnace). Cast iron casting. Casting properties. Technological features. Iron casting. Casting properties. Technological features.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Project management [O2]	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; Planning – CPM, PERT, PDM; Resource allocation.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Basics of Experimental Research [O2]	4	2			2

Course description (Syllabus): Various types of Research Design. Various sampling techniques, statistical analysis and interpretating of the results.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Environmental Protection in Industry	4	2		1	

Course description (Syllabus): Fundamentals of environment. Environment. Avoid environmental pollution. Ecological reconstruction of the environment. Management of resources. Monitoring key environmental factors. Conceptual framework and Legislative Environmental Management System. ISO 14001: 2007 - Environmental Management Systems. Requirements and user's guide. Vocabulary and terminology in the field of Environment Management System. The concept of Environmental Management. The main documents of the EMS. Environmental Policy. EMS implementation and certification.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Technological Processes in Materials Engineering - the theoretical basis of heat treatment	4	2		2	

Course description (Syllabus): Introduction to solid state phase transformations. Thermodynamics of phase transformation (equilibrium of thermodynamic systems, mono-component systems, binary systems, equilibrium in heterogeneous systems). Qualitative and quantitative interpretation of phase equilibrium diagrams (including Gibbs law and iron-carbon diagram). Diffusion processes in metals and alloys (mechanism, diffusion types, Fick laws). Phase transformation in metals and alloys. Time-temperature transformation (TTT) diagrams, continuous cooling transformation (CCT) diagrams.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Materials Analysis and Characterization Techniques	3	2		1	

Course description (Syllabus): This course aims to impart knowledge on various techniques of material characterization. Knowledge in microstructure evaluation, crystal structure analysis, electron microscopy, Chemical Thermal Analysis, static and dynamic mechanical testing methods.

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

Course description (Syllabus): 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. Presentation of the principal melting aggregates offers the possibility to compare their technical and economical performances. Phenomena and processes during the elaboration of nonferrous alloys. The physico-chemical processes are presented, thermodinamics, mechanism and kinetics of interaction processes of metals with gases and the refractory lining of melting and casting aggregates. Refining of metallic melts: degassing and deoxidation. Grain refining; Modification of nonferrous alloys. Presents the principles of solidification of the metallic melts; the principal theories and methods of grain refinement and the theories of modification of eutectic alloys.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Ceramic and Polymeric Materials	4	2		2	

Course description (Syllabus): Definition, classification and scope of ceramics and refractory materials. Conventional ceramics: Refractories, cement, etc. - elementary ideas of their manufacture and applications. Characteristics and specifications of ceramic materials. Chemistry and Classification of Polymers. Properties of Thermo plastics. Properties of Thermosetting Plastics.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Materials Engineering Equipment [O3]	3	2		1	

Course description (Syllabus): Basic concepts about history, construction, operation of industrial equipment. General and particular elements about design of industrial equipment. Main laws and theorems that explains the functioning of the industrial equipment. Presentation of main casting equipment: Modern molding machines. Classic and modern machines for cores execution. Mechanized and automated formation-casting lines. Classic and modern equipment for transport, modification, maintenance and pouring liquid alloys. Equipment for casting metal shapes. Centrifugal casting.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Thermal Equipment and Installations [O3]	3	2		1	

Course description (Syllabus): History, basic processes of heating in a furnace; Determination of the heat quantity; Calculation of the burning speed, stability of burning; Heating balances – types, calculation; Part heating – nomogram method and calculation method; Recovery of the heat in heat exchangers; Refractory materials; Furnace as automation device.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Basics of Computer Aided Design [O4]	4	2		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 assignation to solid models. Sketches transformation into drawings by geometric constraints. Solid modeling based on features in SolidWorks. Obtaining views and sections from 3D models.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Electronics and Automation [O4]	4	2		2	

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.

Fundamental terms: principle of actions with fluid things, general principles of hydrostatics and pneumatic. Hydrostatic and pneumatic generators. Hydrostatic and pneumatic engine. Hydrostatic and pneumatic equipments: distributors, adjusting, clack, assembly blocks. Dynamic fluidic elements. Combined operating circuits. Automatic and combinational operating circuits and systems.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Production management [O5]	4	2			2

Course description (Syllabus): Production process in an industrial enterprise. General overview. Organizing production systems, types of production. Methods and techniques to study and analyze the production process. Calculating elements for a production line flow. VSM (Value Stream Mapping) diagrams. Production efficiency, elements of Lean Manufacturing, Just in Time production. Production capacity. Production cycle, production system indicators.5S system.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Manufacturing Engineering [O5]	4	2			2

Course description (Syllabus): Manufacturing technology and management, together with an understanding of the full range of activities involved from market analysis through product design and production, to sales and distribution, all set firmly within a financial and business context.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Practical activity (90h)	4				

Course description (Syllabus): Analysis of the design methods for synthesis and processing of advanced materials; Computer aided design for materials processing technologies; Industrial management and project management.

4th Year (suspended for 2023-2024)

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Nanomaterials and Nanotechnologies	4	3			1

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. Technologies for obtaining carbon nanotubes. Technologies for obtaining nanopowders, structures, properties, areas of use. Nanobiotechnologies.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Heat and Thermochemical Treatments 1	6	3		2	1

Course description (Syllabus): Introduction to solid state phase transformations; Thermodynamics of phase transformation (equilibrium of thermodynamic systems, mono-component systems, binary systems, equilibrium in heterogeneous systems). Qualitative and quantitative interpretation of phase equilibrium diagrams (including Gibbs law and iron-carbon diagram). Diffusion processes in metals and alloys (mechanism, diffusion types, Fick laws). Phase transformation in metals and alloys. Time-temperature transformation (TTT) diagrams, continuous cooling transformation (CCT) diagrams.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Surface Corrosion	5	2		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 (anodic protection, cathodic protection, inhibitors, surface treatments, corrosion protection by design).

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Advanced Materials and Technologies	5	2		1	1

Course description (Syllabus): Modern Metallic Materials: Dual Steels, Micro alloyed, High Strength Low alloy (HSLA) Steel, Transformation induced plasticity (TRIP) Steel, Maraging Steel, Inter metallics, Ni and Ti Aluminides. High strength Aluminium and Magnesium alloys, Nickel and Cobalt based Superalloys, Titanium alloys, their structures, structure-property relationships, heat treatment. Directional solidification and single crystal turbine blades.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Amorphous and Monocrystalline Materials [O6]	5	2		2	

Course description (Syllabus): General information about structure states of aggregation; Structure states of amorphous materials; Thermodynamics of amorphous materials; Structure stability and heat treatments applied to amorphous materials; Technologies for fabrication of amorphous materials; Properties and utilization of amorphous materials; Thermodynamics of crystal germination; Techniques for crystal's obtaining.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Smart Materials [O6]	5	2		2	

Course description (Syllabus): Shape memory materials; Martensitic transformation in carbon steels; Martensitic transformation in β type alloys with shape memory; Martensitic transformation in γ type alloys with shape memory. Non-metallic materials with shape memory; Ceramic materials with shape memory; Polymers with shape memory; Electrostrictive shape memory materials; Electrorheologic materials; Composite materials with shape memory; General characterization of shape memory materials.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Controlled Media in Materials Engineering [O7]	5	2		2	

Course description (Syllabus): The purpose of the course is to provide students with the necessary knowledge regarding the controlled environments used in materials engineering.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Surface engineering [O7]	5	2		2	

Course description (Syllabus): Principles of coating deposition methods. Fundamentals of tribology and related contact mechanics. Fundamental coating properties and their relationship.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Sintered Materials and Products	4	2		1	1

Course description (Syllabus): Manufacturing and treatment of powders; consolidating and shaping by cold, warm hot pressing; uniaxial vs. isostatic compaction; fundamentals of sinering with solid and liquid phase; industrial sintering, furnaces, atmospheres Special consolidation techniques (powder injection moulding, rapid prototyping; extrusion, powder rolling) Secondary operations exclusively for PM (siting, repressing, infiltation) and adapted for PM (heat treatment, surface hardening, machining, joining). Relationships microstructure - properties Applications for PM materials and products.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Modelling and Simulation in Materials Science	3	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; Constrained optimization by linear programming. Simplex algorithm; Dynamic optimization. Optimization in industrial conditions; Simulation of industrial processes.

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

Course description (Syllabus): Basic definitions, various types of composites, classification based on the matrix material. Role and selection or reinforcement materials, types of fibers, glass fibers, carbon fibers, aramid fibers, Metal fibers, alumina fibers, etc. Functions of a matrix, desired properties of a matrix, polymer matrix (thermosets and thermoplastics), metal matrix, ceramic matrix. Fibers reinforcement composite materials. Linear elastic stress-strain characteristics of composites. Processing of composite materials.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Materials with special applications	3	2		2	

Course description (Syllabus): Describe the advantages and performance of using various material forms in specific application.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Selection and use of Materials	3	2		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 - 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. 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	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Heat and Thermochemical Treatments 2	4	2		1	1

Course description (Syllabus): The theoretical basis of thermochemical treatment processes. Carburizing (theoretical basis and technological parameters, calculation of thermochemical parameters, carburizing environments, structure and layer properties, heat treatments after carburizing). Nitriding (theoretical basis, technological parameters, specific equipment, environments). Plasma nitriding/ion nitriding, structure and properties of the nitrided layers). Carbonitriding and nitrocarburizing (fields of use, technological parameters, equipment, structure and layer properties). Aluminizing process (theoretical basis, usage, technology parameters, structure and properties of aluminized layer, specific equipment). Chromizing (theoretical basis, usage, technological parameters, chromizing layer structure). Boriding (theoretical basis, usage, technology parameters, plasma boriding, structure and properties). Sherardizing (theoretical basis, usage, technological parameters, structure and properties).

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Computer Aided Design and Manufacturing	3	2			1

Course description (Syllabus): Create and modify detailed part drawings to meet industry standards. Create 2D and Solid Model (3D) assemblies and design layouts with regard to product function, quality and manufacturing techniques including bill of material structure. Complete a design project.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Practical activity (60h)	2				

Course description (Syllabus): Experimental development in scientific research projects conducted in the Department. BA students will work in mixed teams with PhD and coordinators. research grants. The topics considered are: Innovative technologies for synthesis and processing of materials. Development of innovative materials. Technologies for materials synthesis and processing. Economic efficiency and environmental impact analysis.