Transilvania University of Braşov, Romania
Study program: Materials Science

Faculty: Materials Science and Engineering
Study period: 4 years

1st Year

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Mathematical Analysis	SMAMA1	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	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 Engineering	SMINM1	5	2		2	

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; 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	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Software and Computer Programming	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
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; Macromolecular compounds. Composites.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Mechanics	SMMEC1	3	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	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Physics	SMFIZ1	5	2	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	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Linear algebra, Analytical Geometry and Differential Equations	SMALG1	4	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.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Algorithms and Data Structures	SMAST1	4	2	1		

Course description (Syllabus): The course Algorithms and Data Structures aims to introduce the students to the main algorithms and data structures used in solving problems with the computer. The course starts with an introduction to pseudo-code and linear structures like vectors and matrices. Some sorting algorithms are described. Further on, the notion of recursivity is introduced together with the Divide and Conquer algorithm. Other techniques, like the Greedy algorithm and Backtracking are discussed. All the algorithms are to be presented together with numerous examples and discussion about complexity. Data structures like stacks, queues and binary trees are also subject of the course.

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 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	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 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	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Economic Systems Analysis	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
Communication techniques and intellectual property [O1]	SMTCPI	4	2	1		

Course description (Syllabus): Science communication and communication principles; classification of communication. Written communication: letter, essay, request, official and personal letter, e-mail, web pages, CV and cover letters. 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
History of technical sciences	SMIST1	3	2	1		

Course description (Syllabus): Human civilization aspects; Metals history; Engineering: between art and science; The engineering profession and the first engineers; World's first universities; Materials science and engineering trends; Remarkable moments in humanity's technical progress; Technical wonders of the ancient/new world.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
English language	SMLE01/ SMLE02	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 1/2	SMEF01/ SMEF02	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	SMMSP1	3	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	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Strength of Materials	SMRM01	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
Fluid mechanics.	SMMEFL	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. Hydrostatic pumps and motors. Hydraulic and pneumatic drives. The operating principle. 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
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
Metallic Materials Science	SMSMM1	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, melting definitions and basic concepts. 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, Mechanisms of Hardening.

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
Electrotechnics	SMETH1	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	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Thermotechnics	SMTERM	4	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	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Theory of Metallurgic Processes	SMTPME	5	2	1	2	

Course description (Syllabus): Thermodynamic and Kinetic Process of Carbonates and Oxides. Forming and Dissociation: presents the theoretical fundaments of compounds dissociation processes, taking into consideration problems like oxide dissociation of of solutions and chemical combinations. Physico-Chemical Bases of Oxide Reducing Processes: presents from the thermodynamical point of view the direct and indirect reduction processes of oxides in simple and complex systems, a special attention being paid to metalothermal processes of metal obtaining. The thermodynamical study is completed by approaching the mechanism and kinetics of reduction processes. Physical Chemical and Structural Bases of metal and oxidic melts: this chapter deals with the main problems connected with the structure and physico-chemical and thermodynamical properties of cast metals and slags. A series of properties are presented, such as: viscosity, superficial tension, density. A special attention is paid to the equilibrium between metallic and oxidic melts. Evaporation and Distillation Process Theory: deals with the problems raised by thermodynamic and kinetic evaporation and distillation processes: steam pressure of a mechanic mixture, of a complete miscibility component system and of systems with limit of miscibility. Theory of Refining Processes of Metallurgical Products (cast-iron, steels, non-ferrous metals: presents the refining physico-chemical bases, the process mechanism, the slag-metal bath interaction.

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

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

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Machine Components	SMOM01	4	2		1	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; Grooved assembly; Polygonal wheels; Tightening assemblies; Assembly by clamping onto the cone; Assemblies with tapered rings; Couplings; Gears.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Value Analysis	SMAVAL	4	2	1		

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 (90h)	SMPRS2	2				

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	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
English language 3/4	SMLE03/ SMLE04	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 3/4	SMEF03/ SMEF04	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
Structural Theory of Material Properties	SMTSPM	6	2	1	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). Technological properties of materials- the theoretical aspects, influences, methods of determination, choice of materials based on these characteristics.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Basic of the Heating Processes_	SMBPIN	5	2	1		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	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Ferrous Alloys Smelting; Fundamentals	SMBEAF	6	3		2	1

Course description (Syllabus): Structure formation mechanism of ferrous 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	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Theoretical Bases of Casting	SMBTET	4	2	1	1	

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	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Computer Aided Design	SMPCAL	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	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Theoretical Fundamentals of Heat Treatment Processes	SMBPTT	5	2	1	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	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Nonferrous Alloys Melting. Fundamentals	SMBEAN	5	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	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Plastic Deformation. Fundamentals	SMBTDP	5	2	2	1	

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	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Drives and Automation	SMACTA	4	2		2	

Course description (Syllabus): 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 equipment: distributors, assembly blocks; Dynamic fluidic elements; Combined operating circuits; Automatic and combinational operating circuits and systems; Automatic control and operating systems of warm architecture equipment.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Industrial Process Equipment	SMEPPI	3	2		1	

Course description (Syllabus): Equipment for core and structure mixing. Automatic systems for mixing. Machines for core and structures based on classical and unconventional procedures. Formation lines – casting: mechanized and automatic. Specific equipment for special procedures in building up and casting. Hydraulic presses. Mechanical presses. Equipment for the purification of molten and wrought pieces. Industrial robot deployment in technological procedures from warm sectors.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Data Acquisition Systems [O2]	SMSAD1	4	2	1		

Course description (Syllabus): Measurement systems architecture; LabVIEW language; Applications of signal processing.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Computer Aided Engineering [O2]	SMIASC	4	2	1		

Course description (Syllabus): CAD/CAE programs; Methods used in virtual testing; Transfer formats between CAD / CAM / CAE environments; Cooling and solidification simulation; Forging process simulation; Simulation of structural transformation depending on process parameters.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Manufacturing Systems Engineering [O3]	SMISP1	4	2			1

Course description (Syllabus): Fundamentals of manufacturing systems; Identify the components and characteristics of manufacturing systems; Identify appropriate performance metrics of different manufacturing systems; Develop mathematical models to describe manufacturing systems; Analyze performance of manufacturing systems; System performance and influencing factors analysis.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Identification and Control of Industrial Processes [O3]	SMICPI	4	2			1

Course description (Syllabus): Analogous control systems; Numerical control systems; Basics of identifying industrial processes; Practical aspects of identifying patterns of industrial processes; Calculation of the mathematical model parameters using recursive/extended/generalized smallest squares algorithm; Validation of identified models; Choosing the optimum process model.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Project Management [O4]	SMMPRO	3	2	1		

Course description (Syllabus): Definition and position in the technical sciences; Concept –I dea, 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
Quality Management [O4]	SMMGCL	3	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
Practical activity (90h)	SMPRS3	2				

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

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Heat Treatment	SMTTER	4	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	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Processing of Materials in Liquid State	SMPMSL	6	2		1	2

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. Centrifugal casting. Permanent mold casting. Shell molding Technology. Investment casting Technology. Casting defects.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Processing of materials in solid state	SMTDPI	6	2		1	2

Course description (Syllabus): General and specific elements about the design of 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 technology to hammers – design. Plastic deformation technology to presses – design. Rolling technology – design. The effect of plastic deformation process on microstructure, residual stresses and typical defects. Severe Plastic Deformation, (severe plastic deformation of titanium alloys for medical implants). Superplasticity and Superplastic Forming.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Ceramic and Refractory Materials	SMMCRE	3	2	1		

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. Density, pore structure. Clays and their classification, quartz, polymorphism of quartz. Drying of ceramics, biscuit firing and glost firing, action of heat on tri-axial body. Particulate solids and water role in different ceramic raw materials. Loss on ignition, plasticity, thermal shock, corrosion resistance, abrasion resistance, refraction. Properties of insulation materials.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Nanomaterials and Nanotechnologies	SMNANO	3	2	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	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Powders metallurgy [O5]	SMMPP1	4	2		2	

Course description (Syllabus): Development of powder metallurgy-scope of powder metallurgy, characterization of metal powders. Physical properties-particle size and shape determination, technological properties-apparent density, flow rate etc. and chemical properties. Powder manufacture: Reduction, electrolysis, and atomization processes. Compaction and sintering: Die compaction and other consolidation techniques, sintering, sintering with liquid phase. Powder metallurgy products: bearing, filters, friction parts.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Smart Materials [O5]	SMMIN1	4	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.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Clean Technologies in Materials Science [O6]	SMECOL	4	2	1		

Course description (Syllabus): Fundamentals of environment; Categories of pollutants in the industrial environment; Environment. Avoiding environmental pollution; Ecological reconstruction of the environment; Management of resources; Monitoring key environmental factors; ERE optimization technology extend sustainable development by applying clean technologies; Clean technologies applied in metallurgy; Clean technologies applied to minimize losses by recycling; Clean technologies used in exhaust systems (prefabricated chimneys); The concept of Environmental Management.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Virtual Instruments [O6]	SMINVR	4	2	1		

Course description (Syllabus) Programming language; language structures, local variables and global variables; Understanding virtual instrument concepts; Virtual Instrumentation and its components; Advanced programming techniques; Creating Virtual Instruments for practical works; Performance profile, presentation of results, execution speed, memory usage, data storage formats.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Modeling and optimization of industrial processes	SMMOPI	4	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	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Thermochemical Treatments	SMTTCH	5	2		1	2

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	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Amorphous and Monocrystalline Materials	SIAMOM	4	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	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Corrosion and Materials Protection	SMCOPM	4	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 (anodic protection, cathodic protection, inhibitors, surface treatments, corrosion protection by design).

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Biocompatible Materials [O7]	SMMBIO	3	2	1	1	

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
Sensors and Actuators [O7]	SMSENZ	4	2	1	1	

Course description (Syllabus): General notions regarding sensors and transducers. Measuring systems. The notion of sensor and transducer. Transducer's features. Static and dynamic features. Energetic and structural features. Temperature sensors, pressure, speed and level. Gear and revolution sensors, power and couple. Pressure, speed and proximity sensors. Actuators: general aspects, classification, features. In-line, hydraulic and compressed-air actuators. Revolving, electrical, hydraulic and compressed-air actuators. Micro-sensors and micro-actuators.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Composite Materials [O8]	SMMCOM	4	2		2	

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	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Smart Materials II [O8]	SMMIN2	4	2		2	

Course description (Syllabus): 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	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Practical activity (60h)	SMPRS4	2				

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