Transilvania University of Braşov, Romania

Study program: Engineering of Renewable Energy Systems

Faculty: Product Design and Environment

Study period: 4 years (bachelor)

1st Year

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Mathematical analysis	DIAM01	5	2	3		

Course description (Syllabus): Relations; The Body of Real Numbers; Numerical series; Real functions of variable; Strings and series of functions; Real n-dimensional space; Limit and continuity; Differentiable functions of several variables; Applications of differential calculation; Riemann Integral; Double integral; Improper integral; Parameter integral. Euler's functions. Curvilinear Integral of the first species; Curvilinear Integral of the second species.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Chemistry	DICH01	4	2		1	

Course description (Syllabus): General concepts of chemistry. The structure of the atom. Classification of chemical elements. Properties of elements. The laws of chemistry. Relationship between structure and properties of substances. Chemical bonds. Chemical kinetics. Chemical reactions. Renewable energy applications. Water hardness. Water softening and demineralization. Molecular and colloidal dispersed systems. Metals. Corrosion. Thermochemistry. Fuels. Materials of economic and practical importance for renewable energy equipment. Special materials used in renewable energy systems. Electrochemical energy conversion. Pollution and environmental protection. Notions regarding the development of new materials for photovoltaic conversion.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Computer programming and Programming Languages I	DIPC01	4	1		3	

Course description (Syllabus): Computer hardware. Central unit. Input and output peripheral units. Organization and management of data. Physical organization of data: files and folders. Logical organization of data: organization systems. Computer management programs - operating systems. Text editing with Microsoft Office Word. Elementary operations in Word documents. Formatting characters and paragraphs. Tables and graphics in text documents. Spreadsheet calculation with Microsoft Office Excel. Basic operations. Formatting cells. Formulas, functions, charts.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Computer assisted graphics I	DIGA01	6	2		4	

Course description (Syllabus): The importance of standards in technical drawing. Classification of technical drawings. Representations used in industrial design. Representation of views. Ruptures and interruptions. Sections. Quotation in industrial technical drawing. Representation and quotation of some machine organs. Indication of the execution accuracy of the parts. The overall drawing.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Materials science and engineering	DISM01	5	3		2	

Course description (Syllabus): Introduction to materials. Types of materials. The atomic structure and imperfections in the atomic structure. Crystalline networks. Defects. Balance diagrams. Solidification of metals and alloys. Ferrous alloys. Non-ferrous alloys. Polymers. Thermoplastic polymers. Composite materials. Ceramic materials. Extractive metallurgy. Execution of parts by casting. Processing of metals and alloys by plastic deformation. Processing of plastics and composites.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Renewable energy systems	DISER01	3	1		1	

Course description (Syllabus): The profession of renewable energy systems engineer; legislative framework, integration into the labor market. Interdisciplinarity of the profession of renewable energy systems engineer. The relationship of energy - environment - sustainability - economic development. The role of the fundamental disciplines in solving the problem of renewable energy systems. The role of the field disciplines in solving the problem of renewable energy systems. Horizontal competencies required in the profession of renewable energy systems engineer.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Linear algebra, analytical and differential geometry	DIAG02	5	2	2		

Course description (Syllabus): Sets. Binary Relationships. Systems of linear equations. Composition laws. Vector spaces. Vector subspaces. Linear transformations. Vectors. Line and plan in space. Generation of surfaces. Analytical geometry. Differential geometry of curves.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Computer programming and Programming Languages II	DIPC02	4	1		3	

Course description (Syllabus): Object-oriented programming concepts. Objects. Encapsulation and transmission of messages. Classes. Inheritance and polymorphism. Concepts from DELPHI. Development of applications with simple structures. Forms. The structure of a DELPHI application. Components: Label, Text Box Components and Conversion Functions, Command Buttons, Radio Buttons, Validation Boxes, List Boxes. Component Self; Format and Input Box functions. Main menus and pop-up menus. Handling exceptions. Windows for displaying messages; Show Message procedure; MessageDlg function. Fundamentals of graphics. CANVAS object; Properties and methods CANVAS. Image component. ImageUsr user component; Setting the graphical user mode.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Computer assisted graphics II	DIGA02	5	1		3	

Course description (Syllabus): Introduction to AutoCAD. WCS and UCS coordinate systems. Drawing tools, primary drawing commands. Drawing configuration, Limits and Units commands. Line and Point drawing commands. Editing objects in AutoCAD. Information commands, visualization commands. Osnap modes, Circle, Arc, Ellipse, Polygon, Rectangle, Donut commands. Viewing commands: Zoom, Redraw, Pan, Polar Traking. Work with layers, line types and colors. Other drawing commands: Solid, Sketch, Xline, Ray, Mline, etc., selection means. Basic editing and editing techniques. Editing commands. Modify commands. Advanced working techniques. Advanced editing commands. Advanced drawing commands: drawing polylines. Creating hatching patterns. Defining a new style of text, types of writing, writing in AutoCAD with examples. Isometric representation. Quotation. Editing quotas, creating dimensioning styles, adding tolerances and deviations of form and position, dimensioning examples, with examples. Blocks, blocks of attributes. XREF command. Other useful commands: MSlide, VSlide, Script, drawing plot, Regen, Boundary. OLE AutoCAD-Word relationships. Image insertion commands: Raster Image.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Mechanics	DIMC02	5	3	2		

Course description (Syllabus): Reduction of forces acting on a rigid. Mass centers. Static solid state. Static rigid systems. The friction balance of the rigid. Kinematics of the material point. Kinematics of the material point in relative motion. Kinematics of the rigid. Fundamentals in dynamics. Fundamental theorems in dynamics. d'Alembert's principle. Dynamics of the rigid.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Physics	DIFZ02	5	2	1	1	

Course description (Syllabus): Mechanics and acoustics. Thermodynamics and statistical physics. Electromagnetism. Wave optics. Corpuscular optics. Notions of atom physics. Solid physics. Notions of nuclear physics

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
General economy	DIEG02	3	1	1		

Course description (Syllabus): Economic theory: definitions, evolution. Principles of economic thinking. Fundamentals of economic analysis. Market: demand, supply, market balance. The assembly of the economic circuit. Economic fluctuations.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Modern languages (English, French, German, Spanish)	LS01 LS02	3 3	1 1	1 1		

Course description (Syllabus): Introductory course. The Noun. The Adjective. The English Verb System. Present tense. Past tense. Future tense. Modal verbs. Sequence of Tenses. Conditional sentences. Reported speech. Revision.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Physical education and sport	EF01 EF02	1 1		1 1		

Course description (Syllabus): The basic technical elements of the optional sports discipline, the rules of integral practice of the chosen sport. Practicing under the prescribed conditions of the chosen discipline. Variety of exercise complexes depending on the chosen sport. Exercise complexes with the weight of your own body. Exercise complexes with objects. Exercise complexes with partner. Exercise complexes for mobility development. Exercise complexes for the development and education of the musical rhythm, the rhythmic education.

2nd Year

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Special mathematics	DIMS03	4	2	2		

Course description (Syllabus): First order differential equations: differential equations with separable variables, homogeneous differential equations, first order linear differential equations, Bernoulli differential equations. Differential equations with homogeneous and non-homogeneous constant coefficients. Systems of linear differential equations. Symmetrical systems. Equations with partial derivatives of the first order. Elements of field theory, 2nd order operators, vector integrals, particular vector fields. Complex functions of complex variable; holomorphic functions. The residue theorem and its applications. Laplace transform. Original functions. Laplace transform.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Databases and statistical processing	DIBD03	4	1		1	

Course description (Syllabus): The Project Manager tool. Working with tables. Creating tables. Opening and closing tables. View and change the structure of the tables. Adding records to tables. View the records. Record indicator. Modifying records. Deleting records. Sorting data using table indexing. Storing tables in databases. Creating queries. Create queries based on a table or view. Updating the records with the help of local views. Creating queries with data from multiple tables or views. Statistical data processing. Statistical parameters that characterize the distribution of data. Systematization and presentation of statistical data.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Numerical methods	DIMN03	5	2		2	

Course description (Syllabus): Numerical methods for solving the various technical problems specific to the engineering activity. The stages of solving an engineering problem using a numerical method. Errors of numerical calculation. Numerical approximation of functions. Solving nonlinear algebraic equations. Solving systems of linear equations. Numerical derivation and integration. Integration of ordinary differential equations. Numerical design and optimization.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Strength of materials	DIRM03	5	3	1	2	

Course description (Syllabus): Introduction to the strength of materials. Chart drawing rules. Traction-compression stress. Conventional calculation of pure shear bars. Torsion stress of the straight bars. Bending stress of straight beam. Theories of resistance. Tensions at compound stress. Energy methods for calculating deformations. Dynamic stresses with shock. Stability of straight bars.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Mechanisms I	DIME03	6	3		1	1

Course description (Syllabus): Technical functions solved with the help of mechanisms in the context of current social and economic requirements. Geometric and kinematic bases of gears. The basis of the structure of the mechanisms. Structural, kinematic and dynamic aspects of linkage mechanisms. Elements of geometry and kinematics of cam mechanisms.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Electrotechnics	DIEA03	4	2		2	

Course description (Syllabus): Electrostatics: Electric charge and electric field; Coulomb's formula; Intensity of the electric field produced by a point load; Electrical voltage; The mechanical work of electric forces. Electrokinetics: Electric current; Characteristic regimes for electromagnetic phenomena; Electric Voltage, Capacitors, Resistors, Serial and Parallel Bonding; DC direct current circuits. Electrodynamics: Magnetic field; Magnetic field electric sources; Fundamental regimes of electrodynamics; Coils, electromagnetic induction, electromagnetic voltage sources and printed fields. Powers cut and absorbed by consumers. Simple circuits in DC and AC. Powers in AC power installations. The power factor of industrial installations and methods of improving it. Use of renewable energy to obtain electricity. Renewable sources of energy (solar panels, wind turbines, etc. - construction principles, basic components). Transmission of electricity produced by renewable energy systems. Power electronics components for renewable systems: diodes, transistors, thyristors. Power electronic circuits used in renewable systems: Inverters, regulators for battery charging.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Basis of computer-aided design	DIBP04	3	1		3	

Course description (Syllabus): Drawing sketches in 2D (geometric entities, constraints, symbols, colors). 2D geometric modeling techniques (drawing elementary shapes, geometric constraints). Resampling commands (connections, deletions, limitations, contour closures). Multiplication commands (by symmetry, translation, rotation, scaling). 3D geometric modeling (extrusion, cutting, drilling, revolution parts, circular channels, ribs, reinforcements, connections, hinges, prism, pyramid trunks, threads). Boolean operations (bodies, assemblies, associations, intersections). Body assemblies. The preparation of the technical documentation for a virtual model (overall drawing, views, sections, execution drawings for specific bodies of a mechanical transmission).

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Sustainable development	DIDD04	3	2		1	

Course description (Syllabus): Sustainable development: history; promotion, development, current status and prospects. The components of sustainable development: economic, social, educational, legislative and security aspects; integrated approach. Sustainable development and energy; Sustainable energy. Renewable energy sources and systems; conversion principle, systems, components, legislation, policies, strategies, European and national organisms, market penetration: Solar-thermal, photovoltaic, wind, micro-hydro, geothermal, biomass and hybrid systems. Promoting the principles of sustainable energy at the society and authorities level.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Fluid mechanics and hydraulic machines	DIMF04	3	2		1	

Course description (Syllabus): Fluids. Equations of static equilibrium of perfect fluids. Fluid action forces at rest on solid walls. Notions of fluid kinematics. Equations of fluid dynamics. Euler's equations for an ideal fluid. Particular cases. Bernoulli's equation and its extension for a current tube and for viscous and incompressible fluids. Pitot-Prandtl probe. The impulse theorem. Formulation of the problem for a current tube. The principle of the turbine with action. Hydrodynamic similarity. Reynolds criterion. Permanent movement in forced pipes. The flow of viscous fluids in laminar regime through forced pipes. The turbulent flow. Relations for the calculation of load losses in forced pipes. Flow measuring devices based on Bernoulli's equation. The principle of the measurement method, restrictions in the application of the method. Practical devices for estimating the flow. Disturbances in compressible fluids. The propagation speed of the disturbances in forced pipes. Methods to mitigate the effects of the ram. Effluent movements. The flow of incompressible fluids through small holes and nozzles. Expansion fluid flow through small holes and nozzles. The characteristic of a pipe. Pipes in series or parallel. Hydraulic machines (classification, energy parameters). Centrifugal pump. Bulk machines (pumps and motors). Hydrostatic drives.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Electrochemistry and corrosion	DIEC04	4	3		1	

Course description (Syllabus): Notions of chemical kinetics: elements of formal kinetics of simple reactions and of compound reactions. Factors influencing reaction rate; the influence of temperature and catalysts. Electrolyte solutions: Electrolytic dissociation, Solution theories, Particular electrolyte solutions, Transport phenomena in electrolyte solutions. Processes in heterogeneous electrochemical systems. Practical applications of electrochemical processes: energy conversion, storage of electricity. Elements of photo-electrochemistry. Corrosion of metallic materials (chemical and electrochemical corrosion; passivation and corrosion protection).

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Thermotechnics and thermal machines	DITMT04	3	2		1	

Course description (Syllabus): Thermodynamic systems. Sizes and units of measurement of some fundamental state parameters. Pressure. Temperature. Mechanical work in thermotechnics. Heat, specific heat, latent heat. Internal energy. Enthalpy. The first principle of thermodynamics. Polytrophic transformation of ideal gases. Thermodynamic cycles. Thermal efficiency. Thermal efficiency. Carnot cycle. The second principle of thermodynamics. Entropy. Internal combustion engines. Vapor. Steam charts. Specific sizes. Vapor state transformations. Steam power installations (Rankine cycle), scheme, operating principle, thermal efficiency. Refrigeration system with mechanical vapor compression in one step. Wet air. Fuels. Combustion of fuels. Caloric power of fuels. Compressors. Classification, operating principles. The ideal compressor. Technical compressor. Heat transfer. Ways and laws of heat propagation. Field and temperature gradient. Fourier's Law. Heat transfer regimes. Conduction heat transfer through flat walls, Conduction heat transfer through cylindrical walls. Heat transfer by conduction through spherical walls. Transmission of heat by convection. Radiation heat transfer.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Mechanisms II and Machine elements	DIOM04	5	3		1	1

Course description (Syllabus): Structural, kinematic and dynamic aspects of fixed-wheel gear mechanisms. Structural, kinematic and dynamic aspects of planetary mechanisms. Introduction to the study of machine elements. Joints: threaded assemblies, screw-nut transmissions, feather assemblies, grooves, pins, bolts, shape, pressed assemblies, by tightening on the cone, with truncated rings. Springs: general characterization, materials and technology, characteristic of springs, coil springs, torsion bar springs, lamellar springs, ring springs, disc springs, rubber springs. Mechanical couplings: general characterization, calculation load, permanent couplings, intermittent couplings.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Domain practical work	DIPD04	4	90			

Course description (Syllabus): The practical work aims to familiarize the students with the real environment in companies and to stimulate the use of the knowledge gained in faculty into the practical activity. Casting technology. Plastic deformation technology. Thermal treatments. Galvanic coatings. Welding. Machining processes: lathing, grinding, planning, mortising, milling, broaching, sawing, reaming.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Electrical machines and actuation or Elements of electronics	DIMEA04/ DIEE04	3	2		1	

Course description (Syllabus): Electrical machines and actuation: electric transformer, the synchronous machine, the asynchronous machine, the DC machine, elements of electric drives. Elements of electronics: signals in electronics, semiconductor physics, optoelectronic devices, rectifier diodes, field effect transistor, resistive reaction network circuits, nonlinear circuits.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Modern languages (English, French, German, Spanish)	LS03 LS04	2 2	1 1	1 1		

Course description (Syllabus): Introduction, Verb Phrases: V-ing vs. To V, Active vs. Passive, Causation, Obligation and Requirements, Ability and Inability, Cause and Effect, Relative Clauses, Clauses of Result and Purpose, Quantifiers, Contrasting Ideas Revision

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

Course description (Syllabus): The basic technical elements of the optional sports discipline, the rules of integral practice of the chosen sport. Practicing under the prescribed conditions of the chosen discipline. Variety of exercise complexes depending on the chosen sport. Exercise complexes with the weight of your own body. Exercise complexes with objects. Exercise complexes with partner. Exercise complexes for mobility development. Exercise complexes for the development and education of the musical rhythm, the rhythmic education.

3rd Year

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Finite element method	DIMEF5	5	2		3	

Course description (Syllabus): The general problem of analysis with the finite element method (FEM). Types of problems that can be solved with the FEM. The general modeling and analysis algorithm with the FEM. Finite element modeling methods. Finite element types. Material modeling. Modeling of constraints and loads. 1D/2D/3D modeling. Modeling of unknown physical parameters. Numerical model and finite element analysis of the bar-type mechanical structures. FEM software.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Product design and development	DIDP05	4	2			2

Course description (Syllabus): Engineering design. Technical products/systems. Structural analysis of the product design process. The phases of the life of a technical product and its associated cycles. Generalized algorithm for product design. The main structural stages of the design process of a technical product: the specifications or the list of requirements; conceptual design; constructive design; detail design; development of a product. Conceptual design. Constructive design. Detail design. Prototyping and simulation in product design. Update of product design specifications.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Solar thermal systems	DISST05	6	3		1	1

Course description (Syllabus): Energy. Energy demand in the built environment. Thermal energy demand. Solar energy. Solar energy conversion in thermal energy. Solar thermal systems. Solar thermal collectors. Storage tanks. Solar pumps. Heat exchangers. Safety devices: safety valves, expansion vessels. Solar controllers. Design of the solar thermal systems. Feasibility of the solar thermal systems. Implementation, operation and maintenance of the solar thermal systems.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Assisted modelling of mechanisms	DIMAS05	6	3		2	

Course description (Syllabus): Mechanical system. Structural modeling of mechanical systems using traditional methods/MultiBody Systems Method (MBS). Kinematic modeling using MBS: kinematic model, direct and inverse kinematics, modeling of geometrical and kinematic constraints, general form of position functions, speeds and accelerations, examples. Kinematic synthesis. Dynamic modeling using MBS: dynamic model, dynamic problems, direct dynamic analysis, inverse dynamic analysis, equilibrium position, examples. Dynamic synthesis

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Machine elements II	DIOM05	4	2			2

Course description (Syllabus): Mechanical transmissions. Gears. Belts transmissions. Chain transmissions. Transmissions by friction wheels. Frontal drive, conical drive, toroidal drive, spherical drive. Rolling bearings. Sliding bearings. Contact seals, contact seals.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Communication	DIDC05	2	1	1		

Course description (Syllabus): Communication for (self) presentation. Curriculum vitae. Letter of intent. Documentation for a given topic in the field of renewable energy systems. Written scientific communication - techniques for organizing ideas for a given topic in the field of renewable energy systems. Communication of scientific data - communication through mass media vs. scientific article; analysis of a media article in the field of renewable energy systems. Oral scientific communication: presentation of the topic in the field of environmental engineering, adapted for a certain target audience.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Recyclable materials or Special materials	DIMR05 DIMS05	3	2		1	

Course description (Syllabus): Recyclable materials. Polymerization and polycondensation macromolecular compounds. Organic polymers with silicon. Inorganic polymers. Glass. Ceramic materials. Composite materials. Materials used in the depollution of waste water. Ion exchangers, the power plant ash. Metallic materials. Use of used materials. New techniques regarding the recovery of household waste.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Photovoltaic systems	DISF06	5	2		2	1

Course description (Syllabus): Solar energy. Solar angles. Photovoltaic conversion. Photovoltaic cells. Photovoltaic modules. Photovoltaic systems. Testing and recycling of photovoltaic modules. On-grid photovoltaic systems. Off-grid photovoltaic systems. Storage solution for electrical energy. Electrical energy demand. Solar energy potential. Energy loses in a photovoltaic system. Design of the on-grid and off-grid photovoltaic systems. Special photovoltaic systems. Implementation of photovoltaic systems in the built environment.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Conceptual design	DIDC06	5	2	2		2

Course description (Syllabus): Product design process. The product with its input and output entities; the function of a product. Conceptual analysis based on representative examples. Modeling the design process of the technical products. Modeling the life cycle of a technical product. Basic features of the design theme. Modeling the conceptual design of technical products. Elaboration of the list of requirements. Algorithms for modeling conceptual design. Generalized variant of conceptual design modeling. Establishing the principle solution by evaluating the conceptual variants. FRESH formula. Establishing the conceptual solution of a technical product. List of product requirements (simplified version). Identification of the global function. Detailed function of the global function. Generation of conceptual variants: Generation (synthesis) of solution variants, Establishment of conceptual variants. Multicriteria evaluation of conceptual variants. Examples of solutions of functions with wide technical use. Sum of M = 2 movements; the indefinite distribution of one movement in other M = 2 movements. Sum of 2 moments; the indefinite distribution of a moment in 2 other moments. Power transmission with reduced speed under constant ratio. Transmission of mechanical energy, without changing speed. Propulsion solutions in fluid environments. Bionic solutions and equivalent technical solutions.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Wind systems	DISE06	5	2		1	1

Course description (Syllabus): Wind energy. Energy production in Romania. Wind characteristics. Major problems in the implementation of wind turbines. Wind turbines classification. Wind turbines components. Design of the wind turbine systems. Feasibility of wind turbine systems. Social and environmental interaction. Policies. Market

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Micro-hydropower systems	DISMH06	5	2		1	1

Course description (Syllabus): Hydro energy. Small hydro power systems. Hydro energy potential in Romania and Brasov region. Fluid flow through open and closed channels. MHC input parameters: flow and head measurement. Types of hydropower systems: components, construction, operation. Problems specific to hydraulic turbines. Economic aspects. Problems of social and environmental interaction. Maintenance of hydropower systems. Case studies

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Speciality practical work	DIPS06	4	90			

Course description (Syllabus): Individual and group activities, depending on the specific place of practice, in the field of energy efficiency and renewable energy systems implemented in the built environment.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Tolerances and dimensional control or Mechanical vibrations	DITCD06 or DIVM06	3	2		2	

Course description (Syllabus): Mechanical measuring instruments. Optical measuring instruments. Tolerances and adjustments for smooth cylindrical surfaces. The geometric state of the surfaces. Accuracy of the geometric shape of the surfaces. Tolerances and adjustments for threaded parts. Tolerances and adjustments for gear wheels. Tolerances and adjustments for feather and groove assemblies. Measurement of angular dimensions. Pneumatic measuring devices. Coordinate measuring machines.

Introduction to mechanical vibration. Defining vibrational phenomena. Vibration classification. Definition of elastic and damping components. Models used in the study of mechanical vibration. Static rigidity. Binding of elastic elements. Systems with a degree of freedom. Systems with two degrees of freedom. Systems with more degrees of freedom. Approximate methods for calculating own pulses. Rayleigh method. The Holzer method. Transfer matrices method. Continuous systems. Longitudinal vibrations. Free response and forced response. Continuous systems. Transverse vibrations. Free response and forced response. Finite elements method applied in vibration study. Systems stability

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Aesthetics and Ergonomics or Ecodesign	DIEE06 DIED06	3	2			1

Course description (Syllabus): The object of aesthetics. Areas of aesthetics. Aesthetics in art. Everyday aesthetics. Information aesthetics. Industrial aesthetics. The laws of industrial aesthetics. The functions of industrial aesthetics. Notions, categories and aesthetic principles. Sensory perception. Visual perception. The aesthetics of the forms. Color perception. Textures perception. Proportion and proportionality. Application of aesthetic principles in product design. Aesthetics of product promotion. Economic and social impact of aesthetic design of products. Aesthetic design of industrial products using CAD techniques. Notions of ergonomics. Anthropometry. Work conditions. Product ergonomics.

Ecodesign. Production of materials and use of raw materials. Manufacture of products. Transport and distribution of products. Use of products. End-of-life options. Tools for assessing the ecological impact of the products (Eco Web Design, ecological footprint, ecological backpack, the amount of energy stored, life cycle assessment, rethinking the relationship of the designer with the environment). Product life cycle assessment.

4th Year

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Measurement, command and control systems	DISMC07	5	2		2	

Course description (Syllabus): The role of command and control techniques. Electric drive systems. DC machine. The synchronous machine. Step-by-step engines. Pneumatic drive systems and Hydraulic drive systems. Sensors and sensory systems. Elements of systems theory. Circuits for signal conditioning Continuous linear behavior of control systems. Discrete linear systems over time (numerical control). Structure of the control system.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Constructive design	DIDC07	5	2			4

Course description (Syllabus): Welded assemblies. Riveted assemblies. Special bearings. Seals. Actuators. Stages of constructive design. The basic rules of constructive design. Principles of constructive design: principles of task transmission, principles of division of the design problem, principles of self-control, principles of stability, principles of error minimization. Elements of constructive design. Elongation or contracting of elements. Protection against surface degradation. Use of standards. Design for manufacture. Design for assembly. Evaluation of product development

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Hybrid systems and cogeneration	DISHC07	5	2		2	

Course description (Syllabus): History of hybrid and cogeneration systems. Structure of hybrid and cogeneration systems. Classification of hybrid and cogeneration systems. Major problems regarding the implementation of hybrid and cogeneration systems. The parameters used in the design of hybrid and cogeneration systems. Criteria for choosing hybrid system components. Weather data. Simulation of hybrid electric systems. Simulation of hybrid thermal systems. Simulation of the additional energy requirement and the cost of this energy. Economic aspects, policies and the market

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Biomass based energy systems	DISB07	5	2		2	

Course description (Syllabus): Biomass as an energy source. Biomass sources. Physical, chemical and biochemical characteristics of biomass. Structure, properties, metabolism of biochemical constituents of biomass. Possibilities of using different types of biomass / biomass waste in sustainable communities. Notions of biotechnology. Bioreactors. Biocatalysts enzymes. Aerobic and anaerobic processes of biomass conversion. Biotechnological processes for the transformation of biomass by enzymatic hydrolysis and fermentation to obtain biofuels and compost biofertilizer. Technologies for the conversion of biomass into thermal energy and biofuels. Technologies for the conversion of biomass into biofuel biodiesel. Characterization of biodiesel obtained from vegetable oils and used compared to diesel. Mixed biomass conversion processes. Biological and thermal conversion, thermal and biological conversion. Biomass waste recovery. Energy plantations.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Quality management	DIMC07	3	2			1

Course description (Syllabus): General information on product quality and product quality industrially. Specific quality terminology in accordance with ISO 9000. Specific requirements of the quality system according to ISO 9001. Elements of continuous quality improvement, according to ISO 9004. Auditing elements of the management system organizational, in accordance with the recommendations of ISO 19011. Product certification. Product conformity

assessment. Assessing the conformity of the management system. International accreditation system for conformity assessment bodies.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Energy audit	DIAE07	3	2			1

Course description (Syllabus): Terms, definitions, symbols and units of measurement used in energy auditing. Thermal and energetic analysis of the building. Assessing the current condition of the building by comparison with the project solution. Determining energy performance and annual energy consumption. Indicators of the economic efficiency of the technical solutions for energy rehabilitation / modernization of existing buildings. Establishing technical solutions to increase energy performance for construction and installations, applicable to buildings. Elaboration of the energy performance certificate of a building

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Detailed design	DIDD08	2	1	1		

Course description (Syllabus): Technical design documentation. Extraction of information from the virtual model. Identification of components. Verification of the technical documentation. Details of how to purchase the typical components. Detailed manufacturing processes for non-standardized components. Assembly of components. Detailed testing, operation and maintenance of the product. Product repair, procedures. Establishing the first wear parts. Detailed transport and delivery of the product. Removing and disassembling the product. How to recycle the product components. Aspects regarding environmental protection and product promotion.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Detailed design - Project	DIDDP08	2				2

Course description (Syllabus): The project consists in the detailed design of some elements from a complex mechanical system, in the field of renewable energies, having as input data: the previously obtained 3D model and / or the drawing of the mechanical system, the detailing functions and the functional structure of the requirements list (Product Design Specifications).

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Project management	DIMP08	2	1			1

Course description (Syllabus): Project definition. Concepts. Time. Budget. Quality. Participants' expectations. Compromises. Organizational structure of projects. Planning of projects. Structure and stages of a project. Profitability-risk. SWOT analysis - strengths, weaknesses, opportunities, threats. PEST analysis - political, economic, social, technological. Goal setting. Feasibility study. Organizational structure of the project. The 7P's of planning. Detailed work schedule, task sheet, project diagram, resources, GANTT chart. Realization of the project. Authority. Team building. Delegation. Staff motivation. Performance evaluation. Negotiation. Communication. Conflicts. Conduct of meetings. Training. Stress management. Time management.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Hydrogen technology	DITH08	2	2		1	

Course description (Syllabus): Hydrogen. Hydrogen compounds. Industrial technologies and installations for hydrogen production. Gasification. Pyrolysis. Thermochemical methods. Electrolysis. Photolysis. Analysis of the sustainability of the methods of obtaining hydrogen. Hydrogen transport and storage. Hydrogen storage facilities under pressure. Hydrogen liquefaction. Advanced hydrogen storage methods. Use of hydrogen. Fuel mixtures. Fuel cells. Hydrogen economy

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Waste management	DIMD08	2	1		1	

Course description (Syllabus): Waste management. National Waste Management Plan. Basic principles. Waste management at international and national level. Legislative and normative framework of waste management. Impact of waste on the environment and population health. The main stages of solid waste management. Solid household waste. Sanitation of localities. Minimization of waste quantities. Waste collection and transport. Methods for sorting and separating solid waste. Methods of recovery and recycling of solid waste. Heat treatment. Incineration. Co-incineration. Heat treatment. Pyrolysis. Gasification. Chemical and biochemical reduction of solid waste. Composting. The elimination. Organic waste landfills.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Systems maintenance	DIMS08	2	1	1		

Course description (Syllabus): Reliability and maintainability. Elements of probability theory. Classical distribution laws used in reliability and maintainability. Basic elements regarding reliability. Reliability indicators. The mathematical model of reliability. Maintenance and maintenance of products and systems. Maintenance and maintainability concept. Corrective maintenance. Preventive maintenance. Criteria for appreciation of maintenance efficiency. Mathematical models of maintenance analysis. Maintenance management. Factors that influence the level of maintenance activities. Maintenance of solar energy conversion systems. Maintenance of wind energy conversion systems. Maintenance of hydraulic energy conversion systems.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Practical work for BSc Thesis elaboration (4 weeks x 22h/week)	DIPP08	6	88			

Course description (Syllabus): Individual and group activities, depending on the specific place of practice.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
BSc Diploma Project (14 weeks)	DIEP08	4				4

Course description (Syllabus): Individual and group activities, depending on the specific place of project.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Smart products or Mechatronic products	DIPI07 DIPM07	4	2		1	1

Course description (Syllabus): Smart design, smart materials, smart products and smart technologies. Artificial intelligence. Artificial neural networks. Fuzzy logic. Genetic algorithms. Expert systems. Automatic learning. Artificial vision. Intelligent agents. Multi-agent systems. Smart product design. Smart strategies in product design. Smart materials. Alloys with shape memory. Ferroelectric and piezoelectric materials. Optical fiber. Smart products. Intelligent product modeling techniques. Intelligent devices: the components of intelligent machines. Real-time interface. Smart sensors. Intelligent handling devices. Transmission of data and signals in digital systems. Smart cars. Architecture, controllers and applications. Signal processing techniques. Integration of detection, monitoring and control. Smart car networks. Intelligent self-diagnosis machines. Robotics and intelligent robotic systems. Types of robots, intelligent controllers for robots. Industrial robots, smart mobile robots, service robots, smart home robots. Design and control of intelligent robotic systems and automatic machines. Robot design and control. Human-machine systems.

Evolution of mechatronic products. Definition of mechatronics. The advantages of introducing mechatronics. Representative examples of mechatronic products in the field of renewable energy systems. Mechatronic systems. Functions of mechatronic systems. Synthesis of a mechatronic systems. Modeling of mechanical systems. Sensors

used in mechatronic products. Engines and actuators used in mechatronic products. Control **and control of** mechatronic products. The use of mechatronics in Activity Daily Leaving. Mechatronic systems in renewable energy systems. Mechatronic systems in the PC.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Geothermal energy or Air conditioning systems	DIEG08 DIIC08	3	2		2	

Course description (Syllabus): Structure and evolution of energy demand. Geothermal energy. Geothermal potential at global, European and national level. Geothermal conversion systems. Systems for the conversion of geothermal energy with heat pumps. Characteristics. Classification. Geothermal heat exchangers. Heat pumps. The operating principle of heat pumps. Reversibility of heat pumps. Evaluation of the energy performance of heat pumps. Working agents used in systems with heat pumps. The technical-economic feasibility of geothermal energy conversion systems with heat pumps. Applications of geothermal energy conversion systems with heat pumps. Systems with heat pumps with other heat sources (water, air, waste heat). Hybrid systems based on heat pumps.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Energy management or Management of environmental quality and audit	DIME08 DIMC08	3	2	2		

Course description (Syllabus): Evolution and structure of energy needs at global, European and national level. The need for energy management in buildings. Legislation in the field of energy management. Energy demand in the built environment. Assessment of electrical energy demand. Methods to reduce the electrical energy demand. Assessment of the thermal energy demand. Methods to reduce the thermal energy demand. Conventional sources used to provide electrical and thermal energy. Renewable sources used to provide the electrical and thermal energy. Energy mixes. Energy management systems. Modeling and simulation of energy management systems. Implementation of energy management systems. Assessing the impact of energy management systems on energy performance and energy consumption. The role of environmental management. The objectives of environmental management. Environmental management systems. Terms specific to environmental management. General principles and evolution of environmental management concepts. Integrated approach of the environmental component in the production systems. Representative models for environmental management systems. Preparing the organization for the implementation of an environmental management system. The requirements of the environmental management system. Environmental audit.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Clean technologies or RES implemented in the built environment	DITC08 OR DIIS08	2	2		1	

Course description (Syllabus): Clean technologies strategy in the EU and in Romania. The design of the products in order to use them after they have been used. Clean technologies applied in the metallurgical industry, the machine building industry, the building materials industry, the chemical and petrochemical industry. Clean technologies applied to biomass gasification for biofuels. Clean biotechnology technologies. Structure and properties of biochemical compounds. Bioreactors. Management of biotechnological processes. Aerobic and anaerobic biotechnological processes applied in the processes of depollution of waste water and contaminated soil. Industrial biotechnological processes applied to obtain enzymes, biofuels, food, medicines, biomaterials.