Transilvania University of Braşov, Romania

Study program: Electrotechnics

Faculty: Electrical Engineering and Computer Science
Study period: 4 years (bachelor)

1st Year

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Mathematical Analysis	ET101	6	3	2		

Course description (Syllabus): Strings, substrings. The convergence criterion of Cauchy. Elements of real topology. Continuity, differentiability. Polynomial and Taylor's Formula. Riemann integrability. Improper integrals; convergence criteria. Sequences and series of functions; Simple and uniform convergence. Power series: radius of convergence; Derivation and integration. Taylor series. *n R* space; Scalar product; Norm; Euclidean metric; Topology. Partial derivatives and; Jacobian Matrix. Functions differentiability. Class *C1*. Diffeomorphism. Higher order partial derivatives; Schwarz's Theorem; Hessian Matrix. Taylor's Formula. Integrals. Euler Functions. Double and triple integrals; Variable changes. Integral formula.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Linear Algebra, Differential Geometry	ET102	6	3	2		

Course description (Syllabus): Free vectors in plane and in space. Free vector products and applications. Line and plan in space, angles and distances. Coordinate transformations in plane and in space. Tapered. Quadra. Vector spaces, subspaces. Numeration bases. Elements of coding theory. Linear binary codes. Boole algebra. Boolean functions. Elements of graph theory.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Computer Programming and Programming Languages I	ET103	4	2		2	

Course description (Syllabus): Introduction. Computing systems. The structure of a computer system: hardware - software. Programming languages. How to run a computer program. Programming bases in the C programming language. The structure of a program in the C programming language. Variables, constants; types of data, type declarations, type modifiers. Operators and expressions. Designing programs. Conditional instructions and repetitive structures. Functions. Data files. Pointers.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Physics I	ET104	3	1	1		

Course description (Syllabus): Mechanics: cinematic, dynamic, mechanical oscillations. Thermodynamics fundamentals. Electrical field and electrostatic interactions. Continuous electrical current. The magnetic field. . Electromagnetic induction. Electromagnetic waves. Wave characteristic phenomena. Geometric optics fundamentals. The corpuscular nature of the light. Atomic physics fundamentals.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Chemistry	ET1045	3	2		1	

Course description (Syllabus): Chemical compound. Oxides, acid, base and salt. The laws of chemistry (law of mass conservation of matter, chemical equivalents law). The relationship between structure and properties of substances. Chemical bonds (ionic, covalent, coordinative-covalent, metallic, hydrogen bonds, van der Waals forces). Water. Molecular and colloidal disperse systems (ebulioscopie, freezing electrolytic dissociation, pH, hydrolysis, buffer systems. Water hardness. Water softening and demineralisation. Electrolysis of melts and solutions. Metals. Preparation. Properties. Corrosion. Methods and techniques for corrosion protection. The electrochemical conversion of energy. Cells used in the automotive industry. Macromolecular compounds. Composite materials. Glass.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Technological Methods and Procedures	ET106	3	2		1	

Course description (Syllabus): General elements of electrical systems technology. The structure of matter and models used to study electrical product. Conductive materials. Superconducting materials. Semiconductor materials. Dielectric materials. Magnetic materials.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Communication	ET107	3	1	2		

Course description (Syllabus): An overview of the syllabus objectives. Concepts and analysis of communication process. Types of communication, chatactetistics, axiomes of communication. Career concept. The concept of professional career – Profession, job, position, occupation. Career planning tools: Questionnaire, SWOT analysis. Culture and civilization at the beginning of 21st Century - About values, culture, civilization, technology, technology, artifacts. Profession of engineering and electrical engineering - Mission, requirements, procedures, legislation, AIR and IEEE professional organizations.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Foreign Languages I	ET108	2	1	1		

Course description (Syllabus): Introduction. Objectives . Classification of verbs. Definitions . Morphology of lexical verbs. Structure of the verb phrase. Tenses of the indicative mood. Definitions. Tense. Forming tenses. Modality Tenses. Present. Present Simple. Present Continuous. Present Perfect. Present Perfect Continuous. Past. Past Simple. Past Continuous . Past Perfect. Past Perfect Continuous .Future . Future Simple. Future Continuous. Future Perfect. Future Perfect Continuous

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Sport Activities I	ET109	1		1		

Course description (Syllabus): Walking on the flat and when climbing the slope and turns; Methodical sequence of direct and oblique descent learning; Ski braking - techniques; Ways and means for improving learning and detours; Succession methodical learning bypassing the plug; Succession methodical learning plug detour in half; Cornering methodical sequence learning by rotation;

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Special Mathematics	ET210	6	3	2		

Course description (Syllabus): Mathematical methods which lead to differential equations. Equations of the first order and degree. Cauchy Problem. Existence and uniqueness Theorem. Separation variables. The homogeneous type.

Linear equations. Bernoulli equations. Exact equations. Integrating factors. Linear equations of higher degree, (with variable coefficients and with constant coefficients). Differential systems: Linear systems with constant coefficients. Prime integral. Symmetric systems. Stability Theory. Basic concept. Stability of linear and non-linear systems. Complex Functions: Complex number. Complex plane. Sequences. Series. Elementary functions. Continuity, derivability, Cauchy-Riemann conditions. Complex Integral. Cauchy's Integral Formulas. Taylor and Laurent series. Residues. Applications. Laplace Transform: Definition, properties and theorems. Inverse of the Laplace Transform. Applications in solving differential and integral equations. Fourier series: Basic results on Fourier series. Fourier Transform. Applications. Z – Transform: Basic results ans applications.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Computer Programming and Programming Languages II	ET211	5	2		2	

Course description (Syllabus): The presentation of the programming language C ++. Functions with / without parameters, overloading the functions, inline functions, recursion. Pictures: initialization, scanning, dimensional arrays, arrays as parameters. Characters- using sequences of characters, character arrays. Pointers- operators, variables and pointers, pointers to pointers, pointers to functions. dynamic memory, data structures, and other types of data. Classes, objects, constructors / destructors, overloading builders / operators, static members. Functions / classes friendship, inheritances between CALS, multiple inheritance. Polimorfism- pointers to base class members virtual abstract base class.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Computer Aided Graphics	ET212	3	1		2	

Course description (Syllabus): Introduction to AutoCAD. General standards in technical drawing. Formats, indicator lines, ladders etc. and the way to set them in AutoCAD. Practical applications for drawing commands (LINE, FULL, etc.). Practical application of editing commands (MOVE, EDIT, etc.). Commands and supporting facilities. Practical applications aimed to inserting text, make hatches and dimensioning in drawing. Structural drawings, work with layers and working with blocks.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Physics II	ET213	5	3		1	

Course description (Syllabus): Physical quantities, measurement units, international system of units, dimensional analysis, calculation of errors. Elements of classical mechanics. Kinematics. Dynamics. Theory of Relativity. Mechanical Oscillations and Waves (analogy with electromagnetic systems). Elements of thermodynamics and statistical physics. Thermodynamic transformations. Principles of thermodynamics. The ideal gas. Maxwell and Boltzmann distributions. Electromagnetism. (Static, stationary and variable regimes)Macroscopic electromagnetic theory of light. Geometrical optics principles. Interference, diffraction and polarization of light. Elements of quantum mechanics and atomic physics. Photoelectric and Compton effects. Thermal radiation. Heisenberg's uncertainty relations. Wave functions. Elements of solid state physics. Crystals. Semiconductors. Semiconductor Devices.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Electrical Circuit Theory	ET214	6	2	3	1	

Course description (Syllabus): Faraday's law of induction. Magnetic circuit law. Capacitor. Coil. Inductances. Magnetic couplings. Energy in the electromagnetic field. Resistors, sources, t.e.m. and current sources. Methods for solving DC circuits. Single-phase circuits in sinusoidal permanent regime. Three-phase electrical circuits in sinusoidal permanent regime.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Elements of Mechanics Engineering I	ET215	3	2	1		

Course description (Syllabus): Static of material point. Rigid stand. Static rigid systems. Applications of the technical statics. Kinematics of the material point. Kinematics stiffness. The relative motion.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Foreign Languages II	ET216	2	1	1		

Course description (Syllabus): Electronic components: Introduction. Vacuum tubes. Transistors. Integrated circuits. Resistors. Capacitors. Inductors. Sensing devices and transducers. Analogue and digital electronic circuits. Power-supply circuits. Analogue circuits. Amplifier circuits. Oscillators. Digital circuits. Switching and timing circuits. Digital logic. Telecommunications: Introduction. History. Telegraph. Commercial growth of the telephone. Emergence of broadcasting. Telecommunications operation principles: Introduction. Creating and receiving the signal. Transmitting the signal. Communication network.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Sport Activities II	ET217	1		1		

Course description (Syllabus): Walking on the flat and when climbing the slope and turns; Conversation, explanation, exercise, demonstration, individual experiment, educational games, the comprehensive and fragmented. Succession methodically direct and oblique descent learning; Apply the brakes Ski - techniques; Methods and means for learning and improvement detours; Succession methodical learning bypassing the plug; Succession methodical learning plug detour in half; Methodical sequence learning rotating cornering.

2nd Year

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Numerical Methods	ET301	4	1		2	

Course description (Syllabus): Numerical Methods for solving non-linear equations: Halving interval method; Variable chord method; Tangent method. Numerical Methods for solving linear equations systems: Gauss Elimination method; Gauss-Seidel method. Interpolation and Regression of functions: Linear interpolation; Spline interpolation. Regression of functions. Least Squares method. 4. Numerical Integration: The rectangle method; The trapezium method; Simpson method. 5.Numerical Methods for solving the differential equations and differential equations systems: Euler method; Runge-Kutta IV-th order method; Runge-Kutta Method for differential equations systems. The numerical solving of the electrical circuits and networks in steady state: Graph theory elements; Nodes potentials method; Loop currents method.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Computer Programming and Programming Languages III	ET302	4	1		2	1

Course description (Syllabus): Introduction in MATLAB. Programs structures. Matrices, vectors and scalars. Logical and relational operators. Loops. Vector operations. Numerical operations in MATLAB. Common mathematical functions. Data interpolation and curve fitting. Graphics in MATLAB: 2D and 3D. Simulink – part I (introduction); Simulink – part II (modeling and simulation of electrical circuits) Symbolic MATLAB operations.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Electromagnetic Field Theory	ET303	6	2	3		

Course description (Syllabus): Electrostatic. Introducing the concepts of electrical charge densities of electric charge, electric field, electric moment, the electric polarization. Laws and theorems characteristic electrostatic regime. Capacitors. Determination of the electrostatic field methods: electric flow method, images, magnetic field lines approximation, analytical equations to integration field. Electrodynamics. Introduction of the concept of magnetic field. Laws of the magnetic filed. Magnetic circuits, magnetic circuits solving. Inductance. Energy magnetic field. Force in the magnetic field. Magneto statics. Electrical circuits in transient regime. Quadripole and electric filters. Quadripole parameters. Determining the parameters analytically or by testing. Quadripole connections. Filters. The calculation of the filters.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Electrotechnics Materials	ET304	4	2		2	

Course description (Syllabus): Materials laws and electromagnetism theory. Electrical conductibility of materials. Study of conductive materials. Study of dielectrics. Study of magnetic materials.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Analog Electronics	ET305	4	2	1	1	

Course description (Syllabus): Introduction. Fundamentals on electrical circuits; The modeling principles, circuit elements; Fundamental circuit configurations and equivalent circuits. Semiconductor diode. Diode simplified models; Diodes applications: half-wave and bridge rectifier, capacitive filter, diode limiting circuits. Bipolar junction transistors (BJT). BJT operation, large signal models, BJT inverter; DC analysis, transistor bias, computing of quiescent point, command circuits with BJT; AC analysis of BJT, the small-signal equivalent circuits of BJT; The voltage amplifier model, single-stage transistor amplifiers. The field-effect transistors (FET). N-channel enhancement metal oxide semiconductor (MOS) FET: structure, physical operation, equivalent circuits, static characteristics; Bias circuits and the small-signal operation and models of FET; Amplifiers. Classification of amplifiers; Low-frequency power amplifier. Ideal operational amplifier (OpAmp), the basic function and applications: inverting and non-inverting configurations, current-voltage and voltage current converters; Real operational amplifier: DC and AC limitations and parameters, single supply operation. Voltage regulators. Zenner diode and parametrical voltage regulator; Voltage regulators with feedback, integrated voltage regulators. Pulse Waveform Circuits. Linear and non-linear shaping circuits, RC and OpAmp integrator and differentiator; Voltage comparators, comparators with hysteresis; Rectangular and triangular signal generators.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Digital Electronics	ET306	4	2		1	

Course description (Syllabus): General description of logical systems. Combinational logic circuits – analysis and synthesis. Logical functions minimizations. Karnaugh diagram and Quine McCluskey method. Logical functions implementation with electromagnetic relays. Logical functions implementation with SSI circuits. Logical functions implementation with MSI circuits. Logical functions implementation with LSI circuits. Combinational specialized logic circuits.Hazard in logic circuits.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Elements of Mechanical Engineering II	ET307	2	1		1	

Course description (Syllabus): Elements of basic dynamics. Fundamental theorems of dynamics. Rigid body dynamics.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Foreign Languages III	ET308	2	1	1		

Course description (Syllabus): Computer Users; Computer Architecture; Computer Applications; Peripherals; Interview:Former Student; Operating Systems; Graphical User Interfaces.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Sport Activities III	ET309	1		1		

Course description (Syllabus): Getting to the ball - movement games handball specific discipline; Conversation, explanation, exercise, demonstration, individual experiment, teaching games; Movement in the ground for attack and defense; Procedures for keeping, catching and bird balls; Driving the ball; Disposing gate in place and running; Disposing jump gate; Disposing wearing diving save; Remove the ball from the opponent; blocking shot on goal, blocking the opponent with the body; Applications on technical and tactical training content in the game of handball.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Microprocessors Systems	ET410	3	2		1	

Course description (Syllabus): Computers fundaments. Structural and operational representation of computational systems. Computer structure. Buses. Microprocessors types. Performance computers assesment. Structural and operational fundaments of Centrel Processor Unit (CPU). Processor structure: data bus, control unit, elementary CPU architecture, condition and control flags, interfaces, interrupts and exception, stack memory, pipeline type structures. Operation: addressing mechanism, main memory selection, external bus type signals. Instructions: set of instructions, CISC/RIST processors type, addressing methods. Memory organization. Destination. Main features. Hierarchical structure. Static and dynamic RAM. Cache memory. Memory administration technics. Virtual memory implementation. Inputs/Outputs system structure. Interfaces. Synchronous and asynchronous serial communications. I/O interchange ways. Some standard type of interfaces: ISA, PCI, EIA232, USB.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Energy Sources	ET411	3	2		1	

Course description (Syllabus): Introduction. Conventional energy sources. Fundamentals of thermodynamics. Steam power plants. Rankine cycle. Gas turbines. Nuclear power plants. Renewable energy sources. Hydropower plants. Microhydropower generation. Solar energy. Solar thermal generation. Photovoltaic power generation. Wind power. Geothermal and biomass power. Energy storage.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Electrical and Electronic Measurements	ET412	4	2		2	1

Course description (Syllabus): 1. General aspects. The measurement as experimental operation. Electrical quantities. Measuring instruments and systems. Types of measurement errors, expressions, calculation. Deflectional measuring instruments. Moving coil instruments, ammeters, voltmeters, multimeters. Moving iron instruments. Electro-dynamic instruments, the wattmeter. Induction instruments, the single-phase electricity meter. Instrument transformers. The rectifier instrument. Applications. . Bridges and potentiometers. Balanced and unbalanced DC bridges. The Wheatstone bridge. The Thomson bridge. AC bridges, balance conditions. Inductance bridges, the Maxwell-Wien bridge. Capacitance bridges, the Wien bridge. DC potentiometers. Applications. 4. Analogue electronic instruments. DC and AC millivoltmeters and voltmeters, voltage measurement (peak, r.m.s., average). Selective voltmeters. Electronic ammeters and ohmmeters. Electronic frequency and phase meters. Hall and magneto-resistive ammeters. The oscilloscope. Constructional and functional characteristics of the analogue dual channel oscilloscope. The cathode ray tube (CRT), other types of displays. Structure and operation of the time base. The trigger circuit. Measurement

methods. Impedance measurement. DC and AC voltage and current measurement. Power, energy and power factor measurement. Frequency, period, time interval and phase difference measurement.Impedance measurement. DC and AC voltage and current measurement.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Electromagnetic Converters I	ET413	5	2		2	

Course description (Syllabus): The electric transformer. The single phase transformer. Principle of working. The equivalent circuit. The equivalent circuit. Diagram of the phasors. The losses in the transformer. No-load operation. Short-circuit test. Load operation. The three-phase transformer. Constructive features. Theory of the three-phase transformer. The connections of the transformer. No-load operation. Operation under unbalanced load. Utilisation of different types of connections. Parallel operation. The autotransformer. Main issues of the general theory of AC electrical machines. The induced e.m.f. for one turn and one phase. The A.C. windings. The characteristic of the e.m. f. produced by the winding. The curve of the magnetic induction in the air gap. 3.The asynchronous machine and the asynchronous machine drives Construction and principle of operation. The equations of the voltages. Electrical parameters. The equivalent circuit. Diagram of the phasors. The torque. The losses and efficiency. The diagram of the current. Determination of the parameters from the results of no-load and locked-rotor tests. The operating characteristics. The parasite torques. Starting of the asynchronous motors: with wound rotor and with squirrel-cage rotor. Speed-control of the asynchronous motors, possibilities of speed-control. Speed control by modification of the rotor circuit's resistance; speed control by variation of the supply voltage at constant frequency; speed control by means of frequency inverter. Braking methods for the asynchronous motor: braking as recovering generator, braking with counter-current, dynamic braking, braking in unbalanced conditions. The transitory duties of the asynchronous machines. Connection of the asynchronous motor. Disconnecting of the asynchronous motor. The sudden shortcircuit of the asynchronous machine.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Electrical Equipments	ET414	5	3		3	

Course description (Syllabus): . Introduction, generalities, functions of electrical equipment, contents of the lecture. . Fundamentals of electrical apparatus. Commutation of electrical circuits (without electric arc). Electric switching arc and his suppression. Voltage recovery, interaction between the circuit breaker and the grid. Electrical contacts. Thermal, electro dynamic and electric stability of electrical equipment. High voltage electrical equipment. Isolating switches. Circuit interrupters and earthing switches. HV Circuit breakers. Current-limiting reactors and arresters. Instrument transformers (current transformers, voltage transformers). Low voltage electrical equipment. Switches. Fuses. Air circuit breakers. Relays.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
System Theory and Control	ET415	4	2	1	1	

Course description (Syllabus): Dynamic systems. Structures. Systems classification. Dynamic models. Signals used in systems theory. Direct and inverse Laplace transform. Transfer functions. Block diagrams. Analysis and simulation of time response. Stability. Analysis of frequency response. Bode diagrams. Nyquist stability. Nyquist stability criterion.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Foreign Languages IV	ET416	2	1	1		

Course description (Syllabus): The Internet . The World Wide Web. Websites. Interview: Webpage Creator .Communication Systems. Computing Support. Data Security. Interview:ex hacker. Software Engineeering. People in computing. .Recent Developments in IT. .The Future of IT. Interview:Electronic Publishing

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Sport Activities IV	ET417	1		1		

Course description (Syllabus): Getting to the ball - movement games handball specific discipline; Conversation, explanation, exercise, demonstration, individual experiment, teaching games. Movement in the ground for attack and defense; Procedures for keeping, catching and bird balls; Driving the ball; Disposing gate in place and running; Disposing jump gate; Disposing wearing diving save; Remove the ball from the opponent; blocking shot on goal, blocking the opponent with the body; Applications on technical and tactical training content in the game of handball.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Practice I (90 hours/year)	ET418	4				

Course description (Syllabus): Solving the problems in electrical engineering by computer programs. Understanding the operating principles of transformers, electrical machines, static converters, electrical equipment, installations producing electrical energy. Mathematical modeling of electromagnetic field problems and circuits with applications in electrical engineering. Assessment of the quality and performance of functional electrical systems by specific methods

3rd Year

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Microcontroller Programming	ET501	5	2		2	

Course description (Syllabus): General description; Bloc-schematics; Internal architecture; Central Processing Unit; Peripheral devices description; Microcontroller families; Different microcontrollers description; Design principles.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Sensors and Transducers	ET502	3	2		1	

Course description (Syllabus): Introduction. Classification, general requirements. Types of measurement errors. Static and dynamic characteristics. Sensors parameters. Optoelectronic sensors, such as: photovoltaic diodes, photoconductors, photodiodes, phototransistors, positron-sensitive photo detectors, photodiode arrays, charge-coupled devices, light-emitting diodes, injection lasers and liquid-crystal displays. Mechanical sensors, such as: metallic, thin-film and semiconductor strain gauges, diffused silicon pressure sensors, silicon accelerometers, solid-state displacement transducers, piezoelectric field-effect transducers, tunnel-diode strain sensors, surface acoustic wave devices, silicon micromechanical switches. Thermal sensors, such as: platinum resistors, thermistors, diode temperature sensors, silicon transistor thermometers, integrated temperature transducers, PTAT circuits, thermocouples, thermopiles, piezoelectric thermometers, quartz thermometers, power transistors and thick-film thermal print heads. Pressure transducers. Sensors and transducers based on elastic deformation of the bodies. Level sensors. Hydrostatic sensors and transducers. Electrical and radioactive radiation transducers. Ultrasonic transducers. Flow sensor. Solid-state flow meters and electronic flow controllers. Magnetic sensors. Electromagnetic sensors and transducers. Hall-effect devices, integrated Hall devices. Sensors and displacement transducers. Speed sensors and transducers. Density and viscosity transducers.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Electromagnetic Converters II	ET503	5	2		2	1

Course description (Syllabus): THE DC-MACHINE: Construction. Principle of operation as generator and as motor. Principle of realisation of DC windings. The induced e.m.f. The reaction of the armature. Comutation. Means for improving the commutation. The electromagnetic torque. The losses and efficiency of the DC-machine. The DC-generator. The generator with separate excitation. The generator with shunt excitation. The generator with series

excitation. The generator with compound excitation. Working in parallel of the DC-generators. The DC-motor. The equation of the voltages. The equation of the torques. Starting of the DC-motors. The DC-motor with shunt excitation. The DC-motor with series excitation. THE SYNCHRONOUS MACHINE: Operation parts. Principle of operation of the synchronous generator. The equation of the voltages of the synchronous generator with non salient poles in sinusoidal duty. The equation of the voltage of the synchronous generator with salient poles. The reaction of the armature of the synchronous generator with salient poles. The phasors diagram of the voltages and current for the synchronous generator with salient poles.The losses and efficiency of the synchronous generator. Parallel connection of the synchronous generators. The oscillations of the synchronous generators operating in parallel. Summation of powers and electronagnetic torques. The V-shape curves of the synchronous generator. Principle of working of the synchronous motor. The equation of the voltages for the synchronous motor. The phasors diagrames for the voltages and currents of the synchronous motor. Operation of the synchronous motor when connected to infinite power mains. The V-shape curves. The synchronous compensator. The working characteristics of the synchronous motor. Starting of the synchronous motor. Starting method by means of an auxiliary motor. Starting method in asynchronous duty.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Static Converters	ET504	4	2		3	1

Course description (Syllabus): Introduction. Base theory of converters. Power electronics systems structure and applications. Processors and power converters. Classification of power converters. Power semiconductor devices (diode, thyristor, BJT, IGBT, MOSFET). Loss in power semiconductor devices. Series and parallel connection of power devices. Protections. AC-DC power conversion. Rectifiers. Rectifier and inverter operating modes. Rectifier parameters. Natural commutation rectifiers. Forced commutation rectifiers. DC-AC power conversion. Base principles of DC-AC power conversion. Types of Inverters. Voltage single phase inverters. Current single phase inverters. Bases of PWM control. Single phase PWM inverters. Three phase PWM inverters. AC-AC power conversion. Base principles of AC-AC power conversion. Control of frequency and voltage. Direct control: cycle-converters, matrix converters. Indirect control: frequency converters with dc intermediary circuit. Power electronics industrial applications.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Project-Static Converters	ET505	2				1

Course description (Syllabus): Using the basics of power semiconductor components. Theoretical and practical knowledge of the basic notions regarding the electronic circuits of power static converters. Design of relatively simple circuits with static converters.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Production, Transmission and Distribution of Electric Energy	ET506	4	2		1	1

Course description (Syllabus): Power plants: Main types. General characterization. National power system load curve covering. Electric energy transport and distribution systems. Electric networks classification. Electric networks operating regimes. Power system parameters. Power lines parameters. Transformers parameters. Distribution substations and transformers. Typical Bus Configurations. Transformer substations equipment. Electrical networks design. Allowable voltage drops in steady-state regime. Calculation hypotheses for radial bus networks. Power losses calculation for radial bus networks. Energy losses calculation for transformers and radial bus networks. Power systems faults. Definition, classification. Faults calculation hypotheses and methods. Neutral grounding. General considerations. Comparison of main grounding methods. Power systems stability. Stability criteria and operating states. Primary and secondary frequency regulation. National electro-energetic system. General characterisation; major faults.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Accounting Fundamentals	ET607	3	2	1		

Course description (Syllabus): Understanding the role and importance of accounting within the entity's information system.Knowledge of the assets and liabilities of the balance sheet, of the structures of income and expenses, as well as of the accounting procedures for their instrumentation, evaluation, monitoring and control; Knowing the information users and the qualitative characteristics of the financial information with the new general financial reporting principles; The correct use of the specific accounting tools for recording the economic processes and the results of the activity.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Programmable Logic Controllers	ET608	3	2		2	

Course description (Syllabus): Overview of the Process Control. PLC System. Processor and memory organization. Program scan. PLC Programming languages and programming environments. IEE 61131 Standard. Statement list (STL). Structured text (ST). Ladder diagram (LAD). Function block diagram (FBD). Sequential function chart (SFC). Methods of structured design of programs for PLC. Examples. ASi (Actuator Sensor interface) networks. Communication processor. Use of ASi network for process control with SIEMENS PLC. PROFIBUS networks. Use of PROFIBUS network for process control with SIEMENS PLC. CAN open network. Use of PROFIBUS network for process control with EATON (MOELLER) PLC.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Data Acquisition	ET609	4	2		1	1

Course description (Syllabus): General aspects. Introduction to DAQ systems. Recent trends. Technologies, platforms and standards. Developing DAQ systems using specific hardware. Description of the architecture of DAQ systems. Sensors and actuators. Signal conditioning elements. Acquisition boards. DAQ system design. Designing and modelling the architecture of DAQC systems. Main architectures and platforms for acquisition and control. The OSI model. Software for DAQ applications. Introduction to Virtual Instrumentation and Graphical (G) Programming. Main LabVIEW elements used for developing DAQ systems. Configuration of DAQ systems with dedicated communication buses and interfaces. The serial interface: RS family. The parallel interface: GPIB bus. Modular instrumentation: VXI, PXI. Dedicated interfaces: USB, Ethernet, CAN. Configuration of Wireless Acquisition Systems. Smart sensors and MEMS. Description of Wireless Sensor Networks. Interfaces, standards and network topologies.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Frequency Converters	ET610	4	2		2	

Course description (Syllabus): Introduction. General description of the system and components role; Structure of VS Frequency Converters; Modern PE switches; PAM and Multilevel Inverters. PWM inverters. Induction Machine models. Clasical models, adecvated for V/f converters. Dynamic IM models. Vectorial model. Bi-phase models. IM Models applications. FOC. Sensorless drives. Starting voltage and frequency. Starting torques evolution (dynamics). VS Frequency Converters Control circuits for IM . Synchronous Machine Models. Electromagnetic excitation salient SM model. PM SM model. VS Frequency Converters structure and Control circuits. Brushless DC Models. Machine model. Converter structure and operation modes.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Electrical Drives I	ET611	4	2		2	

Course description (Syllabus): Mechanic elements in electrical drive; Mechanic characteristics for electrical machines and load machines; Integration to functional equation; The state functionality of electrical machines; Static converters; The control of the speed to direct current machines; Brushless direct current machines.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Practice II (90 hours/year)	ET612	4				

Course description (Syllabus): Electrical system design using computer-aided design software. The design of electrical installations that include measurement and numerical data acquisition systems. The design of automatic control systems of electric drives using dedicated software. The design of control systems with dedicated microprocessors or PLCs using specific programming environments and technologies. The design of low voltage electrical installations at the load level. The design of the power supply of industrial loads.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Protection of Electrical Installations	ET513	4	2		1	1

Course description (Syllabus): General about course, importance of protection in electrical networks. Major faults in power systems. Relays used for protection. Protection of electric lines. Protection of electric distribution networks. Protection of electric generators. Protection of electric transformers Automation of power systems. Digital protections.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Thermotechnics	ET514	4	2		1	1

Course description (Syllabus): The first principle of thermodynamics. Second law of thermodynamics. Thermodynamics vapor exposure. Combustion of exposure, interactive course. Theoretical cycles of heat engines gas. Internal combustion engines. Compressors. turbinesgas. Heat transfer.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Storage Energy Systems	ET615	3	2		1	

Course description (Syllabus): Electrical energy storage systems. General issues: the main parameters of accumulator batteries. Classification of electrical energy storage systems. Presentation of the different types of storage systems, with the focus on the areas of application, advantages and disadvantages, cost, development prospects in the future. Comparative study between electrical energy storage technologies described above. Applications of energy storage systems in the renewable energy systems. Examples of existing plant systems + renewable energy storage system.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Electrical Domestic Appliances	ET616	3	2		1	

Course description (Syllabus): The concept of Intelligent Houses Green Energy for intelligent house. Intelligent house lighting systems. Intelligent house security systems. Home intelligent control system.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Sound Synthesis and Audio Files	ET617	4	2		2	

Course description (Syllabus): Sampled signals. Sampling ideal. Reconstruction of a signal from its samples. Sampling frequency domain. Sample files. Tones (tones). Characterization of tones: high (pitch), timbre and strength (loudness), attack (onset) and duration. ADSR amplitude envelope (attack-decay-sustain-release).Discrete-time signals. Elementary discrete signals. Fourier analysis of discrete-time non-periodic signals. Fourier transform of

discrete-time signals. Generalization of Fourier transform for discrete-time non-periodic signals. Discrete Fourier transform. Meshing frequency. Fast Fourier transformation. Modulated signals. Amplitude modulation with sinusoidal carrier. If sinusoidal signal modulator. If the modulating signal as the sum of sinusoidal oscillations. If a non-periodic signal modulator. Or phase modulated signals in frequency with sinusoidal carrier. Representing signals in time-frequency fields. Introduction to wavelet analysis functions. Short-term Fourier transform discrete-time signals. Discrete wavelet transform. Audio file types. Coding samples (linear dither, dither logarithmic representation sample values as signed or unsigned). Data format (header, saving bytes in order "little-endian" or "big-endian"). Restrictions on sample rate, bit depth, number of channels.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Image Processing for Electrotechnics	ET618	4	2		2	

Course description (Syllabus): Introduction. Fundamentals of digital image processing. Sources and types of images. Image acquisition. Examples and applications. The basics of a digital image processing application. Mathematical representation of images. Pixels. Pixel relationships. Operations on images. Logical operators. Spatial transformations and filters. Histogram analysis. Morphological processing of black and white images and images with shades of gray. Image filtering. Noise in digital images. Types of filters used to reduce noise. Filtering images in the frequency range. Fourier transform. Detection of points of interest and edges in digital images. Image segmentation I. Thresholding. Labeling. Region Growing. Split and go. Watershed. Segmentation of images II. Clustering algorithms. Color image processing. Human perception of color. Color spaces. Segmentation of color images Texture analysis. Texture analysis techniques in digital images. Segmentation of medical images.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Electric Lighing	ET619	4	2		1	1

Course description (Syllabus): Radiometry. Electromagnetic waves. Radiation sources. Sizes. Radiometric. Metering. Photometric sizes. Photometry laws. light sources. point, whiskers, surface and volume. Photometric sizes. Reflection and light transmission. Laws of reflection and refraction. Optical fibers. The characteristics of human vision. The human eye. Field of vision. Accommodate, adapt, and visual acuity. Glare. Visual comfort. 5. Production of light. Thermal radiation. Radiation lightning in the gas and metallic vapor. (luminescence). Electric lamps. Lighting. Calculation photometric lighting installations. Method for the use of Lumen. The analytical method (point to point).

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
CAD for Electrical Installations (Autocad, Cadelec)	ET620	4	2		1	1

Course description (Syllabus): Introduction. The object of the course. Electrical technical documentation. Classification of technical documentation. Structure of technical documentation. Content of written documents. Items that must be entered in the electrical installations projects. Making highlighting the field and drawing scale. Methods of measurement and estimation of size. Representation of existing installations. Measurement scale used to represent the plans. List of electrical equipment that is used frequently and their symbols in drawings. Symbols used in wiring diagrams for different types of devices (lights, sockets, etc). Symbolizing complex aggregates (lathes, mills, crane, etc.). Niches and paintings, single line diagram. Components of cubicles and panels (bar systems, fuses, measurement systems). Realization of single line diagrams according to electrical wiring diagram in plan. Types of cables and their symbolization drawings. Recognize the main types of cables commonly used in electrical. Symbols in the drawings for cables. Facilities provided by the programming environment Caddy Electric. Program Overview. Facilities offered by the program. Existing databases symbols. Establishing measurement scale. Creating connection points. Connecting cable. Editing drawings of Electric Caddy. Fixing the types of cables used. Generating reports using programming environment Caddy Electric .

4th Year

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Industrial Control using Computers	ET701	5	2		2	

Course description (Syllabus): Connection to process: signal conversion, signal filtering, galvanic isolation. Input/output process with computer modules: scheduled transfer, transfer to interruptions, DMA transfer. Industrial series network: the serial port, adapting serial port for connection multipointcontrol of the circulation of information, types of serial networks, the role of the data link, MODBUS protocol, CAN and CAN open networks, BACnet networks, Industrial computer modules: analoginputs/outputs modules, binary inputs/outputs modules, pulse input/output modules. Real time operating systems: the role of operating systems in the computer system resource management, multitasking operating systems and multithreading.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Fundamentals of Modeling, Designing & Testing Electrical Systems	ET702	5	2		3	1

Course description (Syllabus): Overview of Real time systems: Definition, evolution, typology, structure and applications. Temporal Modeling and specification of real time systems: State diagram, finite automata model, Petri-net, state chart and mode chart, Q-model, formal methods. Real-time simulation systems. Case studies. Qualitative Modeling. Automatic Generation Control: Load frequency control of Single and multi-area power systems, real time implementation of economic dispatch through load frequency control system. Megavar voltage control, fundamental characteristics: typical excitation systems, automatic voltage regulator (AVR) for generator excitation control. Reactive power dispatch and its coordination with active power dispatch. Energy control center: Computer configuration in energy control centers, data acquisition and transmission, man-machine interfaces, functions performed in energy control centers. State estimation: introduction to the problem of state estimation, maximum likelihood estimation and weighted least-estimation, bad data identification, concept of power system monitoring, the line power flow state estimator. State variable Modeling: Continuous Dynamic Systems. Solution methods for Nonlinear Differential equations. Bond Graph Techniques. Simulation Software.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Electrical Drives II	ET703	5	2		1	1

Course description (Syllabus): Spatial fasor theory; Induction motor model; Field oriented control principle of induction motor; Field oriented contol systems for induction motor; Direct torque control of induction motor; Sensorless control of the speed and position for induction motor.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Electrical Installations	ET704	5	2		2	1

Course description (Syllabus): General rules for design of electrical installations. Types of loads. The power required by electrical installation. Electric switchgear and electrical protection for consumers Power supply low voltage consumers Calculation of low voltage electrical installations for consumers Protection equipment. Earthing equipment. Electric shock protection. Protection against overvoltage. Indoor and outdoor lighting installations. Power factor improvement. Detection and harmonic filtering in electrical installations. Energy efficiency in electrical installations. Legislation in electricity. Recap and discussion on topics.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Electromagnetic Compatibility	ET705	5	3		2	

Course description (Syllabus): Introduction in Electromagnetic Compatibility (EMC). Sources of Electromagnetic interference and disturbances. Interference coupling mechanisms. EMC requirements. Electromagnetic radiation and health.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Fundamentals of Electrical Systems Optimization	ET806	4	2		2	

Course description (Syllabus): Electrical systems modeling. Characteristic quantities and parameters. I/O quantities. Ordinary differential equations and algebraic correlations between characteristic quantities. Dynamic modeling. State-space models synthesis. Ways of selecting the state variables based on algebraic correlations between the characteristic quantities of the system. Functions of the energy management systems. One dimensional optimization methods. Multidimensional optimization without constrains. Powell algorithm. Gradient descent optimization. Constrained multidimensional optimization. Penalty methods. Barrier methods. Intelligent control system design. Neural network control systems. Learning in neural networks. Genetic algorithms. Evolutionary design techniques.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Traction/Electrical Vehicles	ET807	4	2		2	

Course description (Syllabus): Base principles of traction. General definitions. Railway electric traction systems in use worldwide. Motion train equation. Tensile strenght train. Total resistance force to advance train. Wheel-rail system. Traction caracteristica and operatin modes. Electric drives traction used vehicles. Transmission of electrical power system, DC motor traction. Induction motor traction. General considerations. Sizing and characteristics induction motor. Induction motor parameters and control. Feature drive for induction motor. Synchronous motor traction. General considerations. Sizing and characteristics synchonous motor. Synchonous motor parameters and control. Feature drive for synchonous motor motor. Propulsion of hybrid and electrical vehicles. Block diagrams used in automotive propulsion. Energy storage sysytems for automotive propulsion. Technical and economical aspects.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Statistics and Reliability	ET808	3	2		2	

Course description (Syllabus): Probability theory. Random variables. Probability density function. Probability distribution. Basic theory of technical statistics. Determination of the parameters of a probability distribution. Reliability indices. Relaibility of systems. Calculation of short circuit currents.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Entrepreneurship	ET809	2	2	1		

Course description (Syllabus): Entrepreneurship and business. Concepts, characteristics. The approach of business. Business planning and strategic business decision. Entrepreneurship and innovation. Creativity. The sources of entrepreneurial innovation. Entrepreneurial strategies. Employ all available resources. Strike the open market. Use the gaps in the market. Change the values and the characteristic. Building the entrepreneurial organizations.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Diploma project elaborating (6 hours x 10 weeks=60 hours)	ET810	4				

Course description (Syllabus): Validation of the proposed mathematical model and elaborating the theoretical part of the project (the current state of the subject and the theoretical bases). Deepening modeling and simulation for the proposed model: Simulation of electrical and electronic circuits. The choice of components and calculations based on data catalog. Writing the diploma project.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Practice III (for elaborating the diploma project 60 hours/year)	ET811	6				

Course description (Syllabus): Practical implementation of the proposed model and experimental measurements. Implementation of a program dedicated to a specific application in electrical engineering, eg .: industrial automation, measuring device and data acquisition. Installation projects for medium and low voltage circuits. Experimental measurements (where applicable).

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Energy and Environment	ET712	5	2		2	

Course description (Syllabus): Energy and energy source: Evolution of the energy concept; Technological Energy; The concept of energy conservation; Analysis of main energy sources. Primary energy resources and energy balance structure: Technological energy resources; Electricity - high tech energy; Case study-Evaluation of a hydropower potential. Environmental impact of power plants: Impact of hydropower; Impact of power plants; Impact of nuclear plants. Environment and Energy: The environment; Environmental factors and their protection; Pollution from power plants; Accident caused by electric current; Radioactivity; The influence of overhead lines on farmland and forests. Energy Policy: Concepts, energy and environmental indicators; Current guidelines of the Energy Policy; Developments and challenges in the energy area. The role of power electronics in energy and the environment conservation. Energy – Transport – Environment: The implications of globalization on CO2 emissions from transport; Assessment of CO2 emissions under different scenarios; Increased of efficiency in transport; Energy requirements and environmental impact assessment in forest transportation.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Electrosecurity	ET713	5	2		2	

Course description (Syllabus): Characteristic phenomena of electric current flow through the human body. Characteristic phenomena of electric current flow through the earth. Generator structures of accidental voltages. Protection systems against accidental voltages in low voltage electrical installations. Permanent control of insulation resistance. Automatic protection disconnection use in the event of a isolation fault, means of protection against accidental voltages. Measuring methods for determining the grounding resistance.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Automotive Electrical Equipment	ET814	4	2		3	1

Course description (Syllabus): The role of the vehicle electrical and electronic equipment; General operating conditions. Power supply system, storage battery, alternator. Automatic voltage regulator. Parallel operation of the storage battery, alternator and loads. Ignition system. electronic ignition. Electric start system. The lighting system of the vehicle. The braking system ABS. The control system; gauges, transducers. Hybrid car, electric car.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Energy Efficiency in Electrical Energy Systems	ET815	4	2		3	1

Course description (Syllabus): Modern technologies to reduce electricity consumption: the role of power electronics. New technology in electric drives, high efficiency electric motors. Saving electricity in pumping, ventilation and compression. New technologies in electric lighting. Electric Light Sources. Electronic modules in lighting technology. Semiconductor lighting (LED). Strategies control lighting systems. New technologies in electrothermics. Industrial electro thermal equipment General principles of respect converting electrical energy into thermal, electrical circuit

equivalent energy indicators. Heating by resistance. Heating by electromagnetic induction. Heating capacitive dielectric materials. Microwave dielectric heating materials.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Micro and Nanotechnology	ET816	3	2		2	

Course description (Syllabus): Methods and systems for producing thin films and nanostructured systems. Methods of investigating the structural properties of surfaces. Control techniques and manipulation of nanostructures at the atomic scale. Tunnel microscopy, atomic force microscopy and magnetic. X-ray diffraction and electron nanostructures. 3. Magnetic properties of thin films and structures nanogranulare. Micromagnetic modeling magnetization curves. Electrically conductive in thin layers and nanogranulare systems. Applications: magnetic field sensors, rotation sensors, the galvanic insulation monitoring of electrical quantities, memories type MRAM. Logic circuits with thin magnetic layers. Active and passive electronic elements. Resistors, inductors and capacitors film. And transistor technology with C nanotubes, nano-transistors. Applications: thin film sensors for gas detection, detectors, temperature sensors Films. Micro electromechanical systems (MEMS); physical principles of operation; techniques of production: technology and polymer, poly Si, SiGe. Integrating MEMS with CMOS technology. Nanotechnology in producing and storing electricity. Applications of nanotechnology in medical diagnosis. Electrochemical biosensors and magnetic. Magnetic nanodots with applications in medical diagnosis and treatment through magnetic hyperthermia.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Power Supply of Industrial Consumers	ET817	3	2		2	

Course description (Syllabus): Installations for generation, transmission and distribution of electric power. Consumers and power consumption. Study of neutral within power networks. The optimization of reactive power flow within power networks. Compensation of power factor. Calculation of short circuit currents.