Transilvania University of Braşov, Romania
Study program: Electrical Engineering and Computers

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

1st Year

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Mathematical Analysis	5	3	2	-	-

Course description (Syllabus): This is a basic course in Mathematical Analysis, meant to give the student the understanding of the fundamental notions of Mathematical Analysis (sets, sequences, series, limits, continuity, differentiability and integrability) and the necessary skills when operating with them.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Linear Algebra and Analytic. Geometry	5	2	2	-	-

Course description (Syllabus): 1. Basic notions of linear algebra (vector spaces and subspaces, examples; basis and dimension of a vector space, changes of bases; linear transformations on finite dimensional spaces). 2. Analytic geometry in plane and in space (operations with Euclidean vectors and their applications; coordinate systems and coordinate transformations in plane and in space; linear geometry -study of planes and lines- in space; quadratic geometry in plane and in space; generation of surfaces.

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

Course description (Syllabus): The aim of the course „Applied computer science is to outline the importance of using graphs theory in modeling many electrical systems. This course contains several basic graphs problems: Graph searches (generic search, depth first search and breadth first search) and their applications (topological sort and determining the connected components); Minimum spanning tree problem; The problem of determining Eulerian and Hamiltonian tours. The students are taught how to identify practical problems that can be modeled as graphs problems.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Computer assisted graphics	4	2	-	2	-

Course description (Syllabus): General information about computer graphics; AutoCAD GUI (graphical user interface) presentation. Interactive drawing; Commands for drawing; Commands for editing; Other commands and supporting facilities; Text inserting in drawing and hatches; Structure drawings, work with layers and blocks.

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

Course description (Syllabus): This is a basic course in Physics, meant to give the student the understanding of the fundamental notions of Physics that are necessary to understand the functioning of various applications in electrical engineering. 1. Kinematics and dynamics of the material point: References systems, vectors; kinematics, laws of motion; Dynamics, classification of forces, fundamental laws of dynamics; Conservation laws: energy, momentum and angular momentum conservation. Gravitational field and the Cavendish's experiment. 2. Dynamics of rigid bodies:

Basic relations on rigid bodies rotational inertia; the principal axes of inertia, calculation examples; The fundamental equation of rotational movement of the rigid body; Conservation of the angular momentum; The energy of the rotational movement of the rigid bodies; Technical applications: the gyroscope and the flywheel. 3. Mechanical oscillations: Harmonic oscillations; General expressions, movement equations, the energy of an oscillator. Free damped and forced oscillations; The resonance phenomena; Composition of harmonic oscillations; Practical applications. 4. Thermodynamics: 0th Law of thermodynamics; temperature, state equations, thermodynamics variables; instruments; First Law of thermodynamics, thermodynamic processes, mechanical work, internal energy and heat exchanged in these processes; technical aspects; Second Law of thermodynamics; the concept of the entropy; thermal engines (Carnot, Otto, Diesel, Stirling), efficiency of a thermal engine; Third Law of thermodynamics. 5. Electric phenomena: Electrostatics laws, electric field and potential; Electrokinetics, electrical conduction, mechanism of conduction; Dielectrics, conductors, semiconductors; the energy of the electric field; capacitors; technical applications; Electromagnetism; Biot-Savart law, Ampere's circuital law; Substances in magnetic field. Technical applications; Electromagnetic induction; Waves, general characteristics; electromagnetic waves. 6. Optics: Elements of photometry; Thermal radiation; Propagation of light. Reflection and refraction of light; Interference and diffraction of light; Technical applications and optical devices.

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

Course description (Syllabus): Information representation. Fundamentals of programming languages C/C++; Input/output devices. Input/output functions for the console; Data types.; Constants. Variables; Operators and expressions; Instructions (expressions, composed instructions, decision instructions, loop instructions); Arrays and strings; Pointers (operations with pointers, arrays and pointers, dynamic variables); Functions (data transfer, function pointers, recursion;. Defining your own types (enumerations, structures, bit fields, unions).

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
German language I	2	1	1	-	-

Course description (Syllabus): The German language course aims to develop communication skills in an international language by familiarizing students with effective oral presentation techniques in German and with the vocabulary specific to the areas of interest in their field. It also aims at to develop practical-applicative and communication skills, by developing the ability to understand and produce some texts from specialized literature written in German and the students' oral communication ability in German (from simple conversations to those that require complex linguistic skills), focused on various socio-professional situations. Students will learn to actively use German vocabulary to solve specific problems in their field in relation to the market. The following chapters will be studied during this course: Interview, presentation of the family, presentation of the apartment, the verb conjugation, W-questions, yes/no question, favorite food, negation, daily activities, hobbies.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Web programming	4	1	-	2	1

Course description (Syllabus): The course has three parts dedicated to work on Internet, with dynamical WebPages and databases. Building and editing HTML webpage: Headings and Comments, Paragraphs, Line break,Horizontal rule, Text Formatting, HTML Lists, Images, Hyperlinks – Links; MySQL: Running MySQL, Creating a data base, Tables, Data types, Operators, MySQL Functions, Keys, Data sort & filtering, Aggregate functions, subquery, Grouping data, Unions of tables, Elements related to database security; PHP: Introduction in PHP, Forms, Constants, variables, operators, PHP Statements, PHP Functions, "Mathematical" functions, Data display, Processing strings functions, Massive in PHP, Variables cookie; Common use of HTML, PHP and MYSQL.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Ethics and Academic integrity	3	1	-	1	-

Course description (Syllabus): Main issues: Introduction to academic ethics and integrity. Specific aspects that have shaped the field. The importance of academic ethics and integrity for future electrical engineering specialists. Definition of concepts: ethics, morality, integrity. Essential values in academia: honesty, responsibility, respect. Fundamental values: honesty, fairness, respect, responsibility; Reglementări și principii ale integrității academice: University codes of ethics and national regulations (e.g., Education Act). Norms and standards in academic writing and research. Institutional and individual responsibility; Forms of deviation from academic integrity: Plagiarism, self-plagiarism, incorrect paraphrasing. Falsification of data, fabrication of results. Exam fraud, contracting work, use of AI without acknowledgment; Ethics of academic writing. Creativity and intellectual property: Correct citation of sources Originality vs. influence – the fine line; Ethics in scientific research and publication: Ethical conduct in research: data collection, interpretation, and reporting. Ethics of collaboration and co-authorship. Conflict of interest, copyright, multiple publication; Academic integrity in the age of digital technology and artificial intelligence: Current challenges in maintaining academic integrity: access to online resources, copy-paste, commercial writing services. Responsible use of digital tools: AI platforms (e.g., ChatGPT, Grammarly, Quillbot, etc.). Acceptable limits of technology use in writing, research, and assessment. Risks and best practices in the digital educational environment.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Special Mathematics	5	3	3	-	-

Course description (Syllabus): Scalar field, gradient; Vector field, divergence, rotor, Hamilton operator; Integral vector, integration formulas; Particular fields: conservative, solenoid, harmonic; Complex functions of real variable; Complex functions of complex variable; holomorphic functions; Complex integrals, Cauchy formulas. Complex series: Taylor and Laurent; Residues, the residue theorem, applications; Directly integral equations. Linear equations and equations reducible to linear equations. Higher order equations; applications. Linear partial differential equations; applications. quasilinear equations; nonlinear equations; Laplace transform: Original functions. Laplace transform for derivative and for convolution product of functions; applications of Laplace transform.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Computer Programming and Programming Languages II	5	2	-	3	-

Course description (Syllabus): C++ language foundations; Functions in C++; Classes and objects. Handling objects; Friend functions and friend classes; Operators overloading. Type conversions; Inheritance. Derived classes; Virtual classes and polymorphism; Template functions. Template classes; Exception handling.

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

Course description (Syllabus): Programming with Python - Course Description: Introduction to programming; Creating Code with Python; Data representation, problem-solving methods and algorithm development. Data abstraction, program design; Data types; Functions, library functions, keyword def; Errors; Variables; Comments; Pseudocode; Strings and Parameters; Formatting Strings; Integers; Floats; Returning Values; debugging, testing, and documentation. Conditionals, if Statements, Control Flow, elif, and else; or; and; modulo. Loops; While Loops; For Loops; User Input; Lists; Length; Dictionaries. Exceptions; Runtime Errors; try; else; Creating a Function to Get an Integer; keyword pass; I/O Files; Object-Oriented Programming: Classes, Class Methods, Static Methods, Inheritance, Operator Overloading; Dictionary Comprehensions; enumerate; Generators and Iterators.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Electromagnetic Field Theory I	5	1	1	-	-

Course description (Syllabus): This is the first part of the course entitled "Electromagnetic field theory". The materials presented in classes and seminars are designed to give students adequate knowledge and skills about electrical phenomena that are necessary to understand and develop basic applications in electrical engineering.

The topics covered are: **Electrostatics:** Coulomb's Law; Integral and differential forms of Gauss's Law; The electric potential produced by electric charges at rest; The charge conservation law; Calculation of the electric fields and potentials generated by different charge distributions; Electric field in the presence of metals; Screening effect – the Faraday cage; Applications in electrical engineering; **Electric field in the presence of dielectrics**: Electric dipole; Polarisation of dielectrics; Applications; Electric displacement vector, the capacitors and the energy of electrostatic fields; Boundary conditions for the electric field and electric displacement vectors; **Electrical conduction phenomena:** Law of electrical conduction; Differential form of the Ohm's law; Conductors and semiconductors; Resistors; Basic aspects on electrical circuits; Applications in electrical engineering; **Static magnetic field:** The Biot-Savart law. Integral and differential form of the Ampère circuital law; Calculation of magnetic fields produced by different currents distributions; The components of the magnetic field strength vector; **Substance in magnetic field**; Origin of magnetism; The relationship between magnetic induction, magnetic field strength and magnetic polarization vectors; Boundary conditions for the magnetic field strength and magnetic flux density; Applications in electrical engineering; **Time dependent magnetic and electric fields:** The integral and differential form of the electromagnetic induction law; Calculation of the induced electromotive force in different types of magnetic circuits; The displacement current and the magnetic field produced by it; Applications in electrical engineering.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
German language II	2	1	1	-	-

Course description (Syllabus): The German language course aims to develop communication skills in an international language by familiarizing students with effective oral presentation techniques in German and with the vocabulary specific to the areas of interest in their field. It also aims at to develop practical-applicative and communication skills, by developing the ability to understand and produce some texts from specialized literature written in German and the students' oral communication ability in German (from simple conversations to those that require complex linguistic skills), focused on various socio-professional situations. Students will learn to actively use German vocabulary to solve specific problems in their field in relation to the market. The following chapters will be studied during this course: free time activities, shopping, competences and abilities, health, modal verbs, holidays, past tense, the conjunctions "because", the noun.

2nd Year

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Math. fundamentals of computers	3	1	1	-	-

Course description (Syllabus): Course description (Syllabus): The aims of the course „Mathematical fundamentals of computers" are to show the reasons for the binary, octal and hexadecimal number systems' association with computers, to prove the importance of finding an optimal combinatorial circuit for a given logic function and to outline the importance of using graphs theory in modeling many electrical systems. This course contains 4 chapters. The first one, „Numbers systems" deals with binary, decimal, octal, hexadecimal number systems, conversions among bases and base *b* arithmetic. In the second chapter representations of integer numbers (Sign and magnitude, One's complement, Two's complement) and real numbers (The IEEE 754 Floating Point Standard) are presented. The chapter „Basics Logic Design " is dedicated to Boolean functions, their normal forms, and their minimization using Veitch-Karnaugh maps or Quine McCluskey's method and designing the corresponding optimal combinatorial circuits. The Reed-Müller expansions and the generalized Reed-Müller expansions are also presented. The last chapter contains two basic graphs problems: the shortest paths problem and the maximum flow problem. The students are taught how to identify practical problems that can be written using Boolean functions or modeled as graphs problems.

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

Course description (Syllabus): The course aims to ensure the students with the knowledge about general principles of object oriented programming. After completing successfully the course, the students will be able to: Name, explain and apply the core concepts and constructs used in object-oriented programming (Java exemplify). Develop small programs or modify existing ones, to solve clearly defined programming problems. Given a clearly described component, develop a test set and test code for the component. Run and analyze a given program, describe how well it or identify ways in which it fails.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Energy Sources	5	2	-	2	-

Course description (Syllabus): Introduction; Conventional Energy Sources: Fossil Power Plants The operational concept and major components; Hydroelectric Power Plants The operational concept and major components; Nuclear power plants The operational concept and major components; Geothermal Power Plants The operational concept and major components. Generators and Transformers; Power Supply Networks: Conventional and Distributed Generation Ecology, Pollution and Sustainable development Renewable Energy Sources: Small and Micro Hydro Plants; Wind Generators; PV and Solar Thermal Panels; Biomass and Waste Treatment. Energy Saving. Power Electronics and Energy Conversion Conditioning Technologies.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
System Theory	6	3	2	-	-

Course description (Syllabus): Mathematical modeling of dynamic systems; The Laplace transformation; Transient response analysis and steady-state error analysis; Frequency response analysis; Root-locus analysis; The state-space representation of the control systems. Design and compensation techniques; Introduction in the discrete-time systems analysis. The bilateral z-transform.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Electromagnetic Field Theory	6	3	3	1	-

Course description (Syllabus): The course and seminar teaching hours are designed to give students adequate skills that are necessary to understand and develop various applications in electrical engineering. General aspects on the theory of the electromagnetic field and on the structure of substances; Introductions of the state quantities of the electromagnetic field in vacuum; The laws of the electromagnetic field; The energy of the electromagnetic field; Electrostatics; Electrokinetics; Magnetic phenomena; Electrodynamics; Passive circuit elements. The Argand diagram. Parallel wire transmission line.

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

Course description (Syllabus): Solving of non-linear equations; Solving of linear equations systems; Interpolation and regression of functions; Numerical integration; Numerical Solving of differential equations; The computation of electrical circuits and networks by numerical methods.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
German language III	2	1	1	-	-

Course description (Syllabus): This course is designed to develop students' German language skills with a direct focus on professional communication in the fields of electrical engineering, computer science and information technology. Beginning with the formation of essential vocabulary and basic grammatical structures, the course gradually introduces specialized terminology relevant to technological engineering. Vocabulary topics progress from broader themes such as the European Union and economic contexts to specialized areas like industrial environments, office communication, negotiations, offers and demands, and fixed expressions used in business and technology.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Electric and electronic Measurements	4	2	-	2	-

Course description (Syllabus): The course presents the main instruments and methods/techniques used in Electrical Measurements. The course contents: 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. 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. Operation modes, alternate, chopped. Special oscilloscopes, multi-channel, double time base. The digital storage oscilloscope, structure, operation, block diagram. 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. Power, energy and power factor measurement. Frequency, period, time interval and phase difference measurement

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Electronics I	5	3	2	1	-

Course description (Syllabus): Lectures presents: the principles of circuit analysis and design, the basic concepts and characteristics of the electronic devices and circuits. Tutorials develop the ability of analyzing actual electronic circuits that implements the basic circuits presented at the lectures. Laboratory work has been developed to give the students practice in the experimental setup, measurement, and analysis of basic electronic devices and circuits. The course as a whole outlines some ways of thinking about analog circuits that will help to develop intuition. By the end of this subject, students should have acquired reasonable proficiency in the analysis and design of basic electronic circuits.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Object – oriented programming	3	1	-	3	-

Course description (Syllabus): . The general objective of this course is developing advanced applications using Java Object Oriented Programming (OOP). The content of the course: Inheritance and interfaces in Java; Types of classes used in OOP Java; VS1 Collections; Generics; VS2; Treating exceptions; I/O Streams; Multiple threads.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Electrical Circuits Theory	7	3	3	-	-

Course description (Syllabus): Electrical circuits components, DC circuits solving; AC circuits solving; Three phase theory & symmetrical components; Two-port networks; Analysis of non-sinusoidal waveforms.

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

Course description (Syllabus): Introduction in Electrical Material Science and Engineering (Tendencies in advanced material development; Discipline objectives; Atoms and bonding forces; Material properties and parameters; Classifications); Electromagnetic Theory and Material Laws (Material Laws; Electrical conduction law; Polarization law; Magnetization law); Electroconductive Materials (Electrical conduction in metals; Classical theory of conduction; Factors which influence the electric conduction in metals; Quantic theory of electrical conduction; Mathiessen law; Superconductivity**:** Historical view; Barden-Schrieffer-Cooper theory; Applications); Semiconductive Materials **(**General characteristics; Intrinsic electric conduction; Extrinsic electric conduction; Temperature and light effects; n-p junction, Applications); Dielectrics (Particularities of electrical conduction in dielectrics; Classifications; Polarization in constant and harmonic fields; Losses and equivalent schema. Dielectric breakdown; Lifetime of electroinsulating materials; Applications); Magnetic Materials (Atomic theory of magnetism; Classifications; Diamagnetism and paramagnetism of materials; Materials with magnetic order; Theory of soft and hard ferromagnetic materials; Magnetic losses; Applications); Nanomaterials (Magnetorezistive materials and ferroelectrics; Applications).

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Object – oriented programming	2	-	-	-	1

Course description (Syllabus): Establishing the project theme and the work groups; State of art regarding the software Java tools used in project development; Studyng, understanding, running and modifyng programs from the specific thematics; Developing the own application using classes and OOP tools from Java.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
German language IV	2	1	1	-	-

Course description (Syllabus): Students will develop receptive and productive language skills through a wide range of topics and texts. They will identify key information, initiate and sustain complex conversations using technical vocabulary, express opinions, compare and contrast information, and respond to requests within professional and engineering-related scenarios. Furthermore, students will enhance their ability to prepare and present projects in pairs or small groups based on the course topics. Emphasis is placed on understanding and producing both written and oral messages within technical and professional contexts. To develop a functional German vocabulary and basic grammatical structures, followed by the introduction of specialized engineering terminology. The course aims to build the ability to understand and produce written and oral messages in technical contexts relevant to engineering.

3rd Year

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Switchgear equipments	6	3	-	3	-

Course description (Syllabus): Generalities: Evolution and presentation of Switching Electrical Apparatus (SEA). General structure and characteristics of SEA. Classification: Electrical Contacts: Physical processes in the conduction state and in the switching of electric contacts; thermal problems; designing of electric contacts. Electromagnets, clasifications; calculus of attraction fortce; characterstics. Thermal calculus of electrical apparatus**.** Electric arc. Switching of electrical circuits – Connection and disconnection of D.C. and A.C. circuits. Quenching condition of D.C. electric arc; Disconnection of A.C. electric arc: condition of A.C. quenching arc; determination of reestablish voltage. Quenching of electric arc: quenching methods and quenching chambers. Low Voltage Apparatus. SEA: Circuit breakers, industrial plugs and sockets; electric relay, electromagnetic contactors, automatic interrupters. Static SEA. High Voltage Switching Apparatus. Circuit breakers: constructive types (oil, compressed air, vacuum, SF6). Isolators: characteristics and parameters; constructive types. Protection Apparatus. Protection relays. Electrical fuses: fusible burning theory; characteristics; constructive types. Arresters.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Static converters	5	2	-	2	-

Course description (Syllabus):): Introduction. Definition of power electronics. Types of power converters. Basic function of the switching converter. Efficiency and losses of the switching converter. Design solutions. Power electronics applications and power levels. The need for switching in power electronic circuits. The ideal and the practical switch. Losses in power semiconductor devices. Power semiconductor devices: power diode, thyristor, BJT, IGBT, MOSFET. AC-DC conversion-Rectifiers. Single phase uncontrolled and controlled rectifiers. Three phase rectifiers: full controlled and half-controlled bridge topology. Rectifier and inverter operating modes. The analyze of the power flow. Rectifier parameters. Review of Fourier series. DC-DC power conversion. DC- DC Buck converter analyze. DC-DC Boost converter analyze. DC-AC power conversion-Inverters. Types of Inverters. Four quadrant operation. Basics of sinusoidal PWM control. Single phase inverters: Half bridge and full bridge topology. Three phase inverters: six step and sinusoidal PWM inverters. Frequency converters.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Electrical machines I	4	2	-	2	-

Course description (Syllabus): The general discipline objective consists in training the skills in the domain of electrical machines. The course content covers the following topics: introduction to machinery principles (main laws and principles), transformers (construction, operating principle, design features), AC machinery fundamentals, induction machines (construction, operating principle, operating modes), synchronous machines (construction, operating principle, operating modes), DC machines (construction, operating principle, operating modes).

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Analog Integrated Circuits	4	2	1	1	-

Course description (Syllabus): This course is intended to provide the next level of understanding of analog circuits (after Electronic Devices and Circuits). The lecture presents: general amplifier concepts, (including frequency analysis); the ideal operational amplifiers and theirs linear applications, the non-idealities of operational amplifier, dc and ac effects and limitations; the non-linear circuits, voltage comparators and applications; function generators and oscillators; signal processing circuits, including active filters; voltage regulators, linear and switching types; SPICE simulator used for analog circuits. The main goal of the course is to develop the ability to understand, model, simulate and test low complexity electronic modules.

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

Course description (Syllabus): The course describes the principles and advantages of using relational databases for electrical engineering applications by considering the most used programming languages and techniques. The students will be able to build from scratch a database on which a simple application can be developed. Course main issues: Basic operations on databases; Tables, views, stored procedures; Insert data; Update data; Read data; Remove data.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Electrical machines I	2	-	-	-	1

Course description (Syllabus): The general objective consists in acquiring the skills related to the general design of a three-phase induction motor with squirrel- cage rotor. It focuses on finding the main geometrical dimensions of the motor and on familiarization with the materials and specific electric and magnetic parameters involved.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Microsensors and actuators	3	2	-	1	-

Course description (Syllabus): Integrated circuit technology. Sensor materials technology; Thin films deposition techniques. Nanostructures, self-organizing nanostructures, C nanotubes and graphene. Photolithographic and nanoimprint techniques; Passive and active components obtained by IC technology; Spintronic microstructures. Modern characterisation techniques. Structural, magnetic and electric. Sensors. Classifications. Physical principles of sensing. Static and dynamic transfer functions. Interface electronic circuits. Excitation circuits; Signal conditioning circuits; C-V, Q-V circuits, etc.; Two-wire, four-wire sensing; Bridge amplifiers; Noise; Shielding; Analog-to-Digital convertors – Basic aspects; Displacement, velocity and acceleration sensors; Thermal accelerometers; Girosensors; Examples of IC microsensors; Force, strain, and tactile microsensors; Examples and circuitry; Humidity and moisture sensors; Examples and circuitry; Temperature and radiation microsensors; Examples and circuitry; Magnetic microsensors; Magnetoresistive and Hall effect sensors; Spintronic microsensors; Magnetometers, rotation sensors; current sensors; MRAM based on spintronic sensors; MEMS based actuators; Physical principles of actuation and microactuation; Integrated microactuators; Micro pumps, micromanipulators, microcalorimeters, etc.; Microsystems used for energy harvesting; microgenerators based on piezoelectric, thermoelectric and triboelectric effects; Applications for autonomous sensors.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Power electronic circuits simulations	3	2	-	1	-

Course description (Syllabus): The general discipline objective consists in enhancing the ability to use a dedicated software for the simulation of power electronic converters. The course content covers the following topics: main aspects related to the modelling and simulation of power converters; introduction to MATLAB/Simulink with focus on the Specialized Power Systems/ Power Electronics library; main aspects regarding the simulation steps; results interpretation; comparison with similar simulation programs; modelling and simulation of specific power converters for renewable energy sources, electric drives and power system; real-time simulation – HIL technology.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Numerical Signal Processing	3	2	-	2	-

Course description (Syllabus): The course presents the main principles and methods used by Digital Signal Processing in order to design filters. The course contents: General aspects: Introduction to discrete-time sequences and LTI systems. Periodic sampling; Aliasing. Sampling low-pass signals. Sampling band pass signals. Fourier transform for digital signals**,** Discrete Fourier Transform (DFT). Inverse DFT. DFT Leakages. DFT of rectangular functions. Fast Fourier Transform (FFT). The radix-2 algorithm. Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) filters; Averaging. FIR filter structures. Convolution. Low pass FIR filter design. The Laplace transform. The Z transform. IIR filter structures. Specialized Low pass FIR filters Frequency Sampling Filters (FSF). Interpolated FIR filters (IFIR). Filters with decimation. Sample Rate conversion. The quantization process. Analogue to Digital Conversion (ADC) principles and main types of ADCs. Digital to Analogue Conversion (DAC) principles and main types of DACs.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Sensors and Data Acquisition	4	2	-	2	-

Course description (Syllabus): main issues: Sensors, transducers, and data acquisition: Sensor materials technology; General structure of a data acquisition system; General concepts regarding sensors and transducers and their place in the DAQ system. Definitions, classifications. Physical principles of detection: types of phenomena and sensors underlying detection. Structure, characteristics, and general performance of transducers: transfer function, linearity, accuracy, hysteresis error, resolution, calibration errors, output signal type, and others; Sensors and transducers for mechanical quantities: Transducers for forces, deformations, pressures, displacements, rotations, speeds, accelerations; Design principles, sensors used, static and dynamic characteristics; Piezoelectric and MEMS

accelerometers; Examples of connection diagrams; Applications;Temperature sensors and transducers: General information on temperature measurement; Types of temperature sensors, encapsulation, connection circuits, linearization and signal conditioning circuits; Static and dynamic characteristics; Thermal radiation sensors: radiation pyrometers, bolometers; Applications; Magnetic field transducers: Hall effect, magnetoresistive, and inductive magnetic field transducers; applications for DC/AC current transducers, frequency band, rotation transducers, presence transducers, current line detection, and others; Gas and humidity transducers: Phenomena and types of sensors used; Applications; Electronic interface circuits: Voltage amplifiers, instrumentation amplifiers; Current-voltage (I-V) amplifiers and load amplifiers (Q-V); Excitation circuits for sensors – voltage references or current sources; Use of bridges to improve signal thermal stability and reduce external influence parameters; signal connection and transmission modes: 2, 4, and 6 wires; importance of shielding; analog filters; use of differential connection; circuit examples; Data acquisition board (DAQ): General structure; Analog multiplexer (MUX); Ground-referenced and differential connections; Integrated instrumentation amplifier with adjustable gain; Sampling and hold (S-H) circuit; A/D and D/A converters; Resolution; A/D conversion methods – successive approximation, dual slope, sigma-delta, and others; communication interfaces; The need for signal conditioning applied to the DAQ card to improve conversion resolution; Examples of DAQ boards, dedicated systems, and interfacing/acquisition software – NI, Labjack, LECROY TELEDYNE HDO 4024 digital oscilloscope; Processing signals from DAQ: Signal processing and analysis using Fourier transform and FFT, digital filters, fitting, interpolation, statistical noise reduction methods; utilization of acquired data.

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

Course description (Syllabus): The materials presented the course provide students with the basic training in microcontroller architecture necessary to understand how computer systems are organized and developed for controlling applications in electrical, electronic, and telecommunications engineering. The materials presented in the laboratory classes provide students with training in the design of microcontroller systems and the implementation and debugging of C programs running on microcontrollers. The course content: Introduction to Microcontroller Architecture (structure, historical perspective, microprocessor/ microcontroller comparison, embedded systems); The ISA - Instruction Set Architecture (ISA features, instruction format, instruction types, typical addressing modes, CISC / RISC comparison); Fundamentals of the microprocessor core (data path, control path, status register, I/O configuration registers, interruptions and exceptions, stack memory, introduction to pipelining techniques); Memory system (data memory, program memory, cache); Timing and counting circuits (structure, configuration, precision, delays programming mode, typical applications); Digital and analogue inputs / outputs (main features, mode of use, program transfers or interruptions); Serial interfaces (UART, SPI, I2C).

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Electrical machines II	4	2	-	2	-

Course description (Syllabus): The general discipline objective consists in expanding the knowledge in the domain of electrical machines. The course content covers the following topics: single-phase and special-purpose motors, specific electrical machines from power plants and sub-stations, specific electrical machines form renewable energy systems, the use of electrical machines in traction/propulsion systems and the dynamics of electrical machines, .modeling of electrical machines.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Sensors and Data Acquisition	4	2	-	2	-

Course description (Syllabus): Temperature and Humidity Monitoring System: example project application to ue sensors (e.g. DHT22) with a microcontroller, log data over time, emphasis on sampling rate and calibration; Light Intensity Data Logger: measure ambient light using and LDR or photodiode; Multi-Sensor Environmental Monitoring Station: collect temperature, humidity, pressure, emphasize sensor integration and data reliability; Biological

Monitoring Application: capture biomedical signals: apply filtering to remove noise and artifacts; Smart Energy Monitoring System: acquire current adn voltage data, compute power consumption in real time; Sampling theory and Analog-to-Digital Conversion projects.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Electronics II	4	2	-	2	-

Course description (Syllabus): Digital Computers and Information; Combinational Logic Circuits - Gate Circuits and Boolean Equations; Combinational Logic Circuits - Circuit Optimization; Combinational Logic Circuits - Additional Gates and Circuits; Combinatorial Logic Design - Implementation Technology and Logic Design; Combinatorial Logic Design - Combinatorial Logic; Combinatorial Logic Design - Arithmetic Functions; Sequential Circuits – Storage Elements and Sequential Circuit Analysis; Sequential Circuits – Sequential Circuit Design; Selected Design Topics - Delay and Timing, Programmable Logic; Memory Basics .

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Computer Interfaces and Peripherals	3	2	-	1	-

Course description (Syllabus): The chapters are: Interfaces and Peripherals – introduction; Input/Output System; Input/Output Operations; USB Protocol and Architecture; Microcontrollers; SPI Protocol; Drive systems - DC Motors; 1-Wire Interface; External interrupts of ATmega 328p microcontroller; Timers- Normal mode (ATmega 328p microcontroller); Timers – CTC mode (ATmega328p microcontroller); Analog to digital converter (ATmega328p microcontroller); Buses and Direct memory access; Displays

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

Course description (Syllabus): Introduction to computer architecture: Historical perspective of Computer architecture: ISA, organization, implementation, architecture classification, computer system; System buses: bus structure, multiple bus hierarchies, arbitration, timings; Measuring performance: Evaluation of computer performance, CPU execution time, response time, throughput, latency, comparison between different machines, CPI, Other metrics: MIPS, MFLOPS, different benchmarks, Amdahl's Law for compute the performance improvement; Memory system: Memory hierarchy, main characteristics; Main memory: ROM, static RAM, dynamic RAM - standard and advanced DRAM organization-, memory address map, memory connection to CPU; Associative memory, hardware organization, match logic, read operation, write operation; Cache memory , mapping types, writing into cache; Memory management: static and dynamic allocation, segmentation, paging and page translation, memory protection; Virtual memory , address space and memory space, address mapping using pages, associative memory page table, page replacement; Input-Output organization: Input-Output Interface, isolated versus memory-mapped IO; Asynchronous data transfer, strobe control, handshaking; Modes of Transfer (programmed, by interrupts, by DMA); Introduction in parallel processing architectures: advanced pipelining; Branch prediction, out-of-order execution, predicated execution, speculative execution, data speculation; VLIW Architectures, organization, advantages and limitations; Vector processor architecture, vector processing and vector operations; Introduction to multiprocessor architecture, characteristics of multiprocessors, multithreading, classification of architectures for parallel processing.

4th Year

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

Course description (Syllabus): Basic principles for the electrical drives analysis; The reference-frame theory; The direct-current machine's dynamic behavior; The direct-current machine converter supply and control; The field-oriented control of the induction machine; The synchronous machine dynamic and static operation; Theory of the

brushless-dc machines; Controlled 3-phase bridge converters for the rotating-field electric machines supply; Stepper-motor drives.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Electromagnetic compatibility	5	2	-	3	-

Course description (Syllabus): Introduction in ElectroMagnetic Compatibility (EMC); History and actual debates; Sources of Electromagnetic interference and disturbances; Interference coupling mechanisms: galvanic coupling, inductive coupling, capacitive coupling and radiation coupling. EMC Requirements in UE, ECM directive; Anti-disturbing measures.

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

Course description (Syllabus): Generalities; Producing, transport and distribution of electric energy; High, medium and low voltage electric networks; Low voltage electric networks at the consumer; Designing of low voltage electric networks; Lighting and socket installations; Increasing quality of electric energy; Electro-security in electrical installations; Electric equipment.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Electrical equipment monitoring and diagnosis	4	2	-	1	-

Course description (Syllabus): The lecture provides basic theoretical and practical knowledge for the design, measurement, diagnosis and use of automotive electric, electronic, and mechanical components, as well as for the study of their acoustical and vibrational behaviour. The objectives of the lecture are about the noise sources present inside an electrical engine; digital signal processing notions; the structure and functioning of systems within the vehicle; the structure and functioning of communication and diagnostic systems for a motor vehicle; basic notions of vibrations and acoustics, modal analysis, structural testing; using hardware and software tools to identify faults in an electric motor or during vehicle operation.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Graphical user interfaces design	4	2	-	1	-

Course description (Syllabus): The course describes the principles of designing graphical user interfaces for specifical electrical engineering applications in correlation with the most advanced programming technologies. The students will be able to build from scratch a simple electrical engineering specific GUI program. Course main issues: GUI components -The basic, advanced and custom components used for GUI programs are presented; GUI Layout Manager - Several options most used for obtaining the best layout according to the specific cases and the greatest usability level are presented (grids, groups, nested layouts); GUI for engineering graphical charts - The graphical charts most used in engineering applications are presented; Design of interactive functionality - The menus, toolbars and listeners techniques are presented; Assembling of components - All the components are assembled together into a single program to assure the required functionality; Testing - The components and the program are tested for acceptance according to the quality level.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
CAD for electrical engineering I	4	1	-	2	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, containing the situation plan, 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 electric cars, 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, Technical data should be considered when choosing the types of cables, Symbols in the drawings of 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 Generate reports on conductor size and apparatus used: Editing drawings of Electric Caddy, Fixing the types of cables used, Generating reports using programming environment Caddy Electric

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Operating systems	4	1	-	2	1

Course description (Syllabus): Operating Systems key concepts, definitions, architecture; History of modern operating systems; OS stucture and services, user interface; Processes and threads: implementation, context switching, scheduling algorithms; Inter-process communication: mechanism, race conditions, synchronization tools; Memory management; dividing memory to multiple processes, virtual memory, paging, MMU implementations; Data storage: secondary storage systems, HDD scheduling, error detection and correction; Security and safety considerations in operating system, data protection, malicious software, attack vectors, vulnerabilities.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Management	5	2	-	-	2

Course description (Syllabus): The students will understand different aspects regarding internal and external environment of a firm, organizational structures and how human resources are contributing to the objectives of the company. Also, they will understand what are the differences between a manager and an entrepreneur, what a start-up and a francize mean and how they are obtaining profit, and aspects regarding marketing and corporate social responsibility, as the company is expected to act like a citizen - having wrights and duties.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Industrial Control	6	3	-	3	-

Course description (Syllabus): The Industrial Control course aims to present concepts and principles that support students in the design, implementation, and operation of hardware structures and software programs intended for controlling industrial processes, primarily using programmable and microprogrammed controllers. The focus is on familiarizing students with both hardware and software aspects in the context of using programmable controllers in industry, covering fundamental theoretical concepts as well as illustrating their practical application through case studies. Additionally, high-level software platforms used in process control are also introduced. Main chapters: Industrial Information Systems; Microprogrammed Controllers; Vector Controllers; Designing Programs for Programmable Logic Controllers (PLCs); Examples of Programs for Different Types of Controllers from Various Manufacturers; Mini-Controllers; Controller Networks; Using OPC Technology for Control and Monitoring of Applications with Programmable Controllers; Software Platforms for Process Control.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Data transmissions and protocols	5	2	-	2	-

Course description (Syllabus): Among the course's main topics are the following: Data communications models and the evolution from service-centered telecommunications networks to service independent, all-over IP data networks; The main elements of a protocol and key concepts regarding the design of protocols; The TCP/IP protocol stack and the OSI reference models; The application layer: client - server and peer-to-peer architectures, the HTTP and DNS

protocols; The transport layer: general rules for designing a reliable data transfer protocol, UDP vs TCP protocol analysis, developing networked applications using socket programming; The network layer: datagram protocols vs virtual circuit protocols, IPv4 and IPv6, designing and configuring an IPv4 network (subnetting), routing; The data link layer: link layer services, main types of MAC protocols, Ethernet and link layer addressing, switching; Wireless communication technologies and protocols: WiFi, WiMAX, Bluetooth, ZigBee; Industrial communication technologies and protocols: Fieldbus industrial networks vs. Ethernet-based industrial networks.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
CAD for electrical engineering II	3	1	-	2	-

Course description (Syllabus): Introduction in EPLAN work environment, basic functions; Project management: Editing a graphic - Creating cover page and a page schematic; Basic Functions - Menu Bar, copy and modify pages; Graphics core functions - Inserting and auto binding symbols, symbolization Black boxes for complex electronics (rectifiers, frequency converters, etc.); Block editing. Macros / Selection and referencing contactors: Managing a parameter; Schematic Macros; cross referencing; Select Contacts. Clasps, strings of terminals / cables and ratings: Clamps and connectors; Cables. Database, the mounting. Settings / Parameters; Create and modify database; Selection, award and modification of components in electrical circuits; Automatic generation of material lists and control lists; Printing forms. Import and export databases; Panel mounting (mounting plate); Generating plate components; Sizing (quoting dynamics) - Methods for quotation; Import / export of DXF / DWG.

Course title	No. of credits	Number of hours per week			
		course	seminar	laboratory	project
Software engineering	3	2	-	2	-

Course description (Syllabus): Introduction to Software Systems Architecture; Monolithic architecture and Event-Driven Architecture (EDA); Microservices Architecture; Service-Oriented Architecture (SOA); Application rationalization and transformation of IT into the cloud.