

ELETRICAL ENGINEERING PROGRAMME

FIRST YEAR

Course: Differential and Integral Calculus I

Class hours: 160

Syllabus: Intervals, inequalities and absolute values. Single variable functions: definition, elementary functions and invertibility. Limit and continuity. Fundamental limits. Derivatives: definition; geometric and kinematic interpretation. Derivative as a rate of change. Differentiation rules, and implicit differentiation. Applications of derivatives. Theorems involving differentiable functions. Analysis of function variation. Optimization problems. L'Hôspital's rule. Taylor series and approximation error. Antiderivatives. Riemann integrals. Area between curves. Fundamental Theorem of Calculus. Integration techniques. Volumes of solids of revolution. Improper integrals.

Course: Vectors, Curves and Surfaces

Class hours: 80

Syllabus: Vectors in bi and three-dimensional geometric space: definition, addition, scalar multiplication and properties. Dot product, vector projection, cross and triple product. Lines and planes in three-dimensional spaces: equations, relative positions and applications to geometric problems. Definition of curves in two and three-dimensional spaces. Cartesian equations and parameterization of curves in two-dimensional spaces, with an emphasis on lines, circles and conics. Quadric Surfaces. Parameterization of curves in three-dimensional spaces such as intersection of cylindrical, spherical, quadratic and planar surfaces. Vector function ideas. Functions of two real variables: definition, graphical representation and contour lines. Tangent planes and normal lines to surfaces. Partial derivatives: definition and geometric interpretation.

Course: Physics I

Class hours: 160

Syllabus: Theory: physical quantities and their measures. Motion in two or three dimensions. Applied forces. Newton's laws. Equilibrium of particle. Dynamics of particle. Work and kinetic energy. Potential energy and energy conservation. Power. Momentum, impulse and collisions. Center of mass. Equilibrium of rigid bodies. Laboratory: Physical quantities and their Measures. Measuring instruments. Experiments involving the topics of the subject matter.

Course: Drawing

Class hours: 80 horas

Syllabus: Basic geometric constructions; Projection systems, systems of representation. Reading and interpreting drawings. Technical standards. Sketch orthographic views. Parallel isometric perspective. Auxiliary views and sections, 3D visualization, solid modeling and effects of realism in 3D computer visualization.

Course: Algorithms and Programming

Class hours: 80 horas

Syllabus: Logic. Logic for Engineers. Computer Programming. Algorithm. Flowchart. Data: variables and constants. Numerical, logical, strings and user-defined types of data. Programming structures: sequential, conditional and repetitive. Subroutines. Programming language as a tool for logic development.

Course: General Chemistry

Class hours: 160 horas

Syllabus: Scientific Method; Magnetic Properties; Electronic Distribution; Ionic Bond; Metallic Bond; Molecular Orbitals; Band Theory; Semiconductors; Insulators; Physical-Chemical

Properties; Covalent Bond; Lewis Theory; Molecular Geometry (VSEPR); Polarity; Intermolecular Forces; Ideal Gas Model; Real Gas Model (van der Waals); Compressibility Factor; Thermodynamics; Enthalpy, Entropy; Free Energy; Spontaneity; The Study of Chemical Reactions; Equilibria; Chemical Kinetics; Redox Reactions; Electrolysis; Electrochemical Cells; Corrosion.

Course: Engineering Fundamentals

Class hours: 160 horas

Syllabus: Fundamental dimensions. Significant figures. Dimensional analysis. Homogeneity of equations. Systems of units and conversions. Physical measurements and treatment of experimental data. Electronic spreadsheets. Tables and graphs. Curve fittings, linear and non-linear models. Linearization. Trusses, machines and gantries. Optimization. Making prototypes. Oral, written and graphic communication.

Course: Projects and Special Activities I

Class hours: 40

Syllabus: Development of competencies, skills and attitudes relevant to the formation of future Engineer, through electives and student-centered practical activities. Training of interpretation and analysis skills. Problem solving methodologies. Development of engineering projects. Technical visits, lectures, workshops, seminars and technological competitions. Participation In undergraduate monitoring programs, scientific projects and technological research, as well as participation in social responsibility projects.

SECOND YEAR

Course: Differential and Integral Calculus II

Class hours: 80

Syllabus: Partial derivatives: Tangent plane, normal straight. Differentiability. Chain rule and implicit differentiation. Directional derivative and gradient vector. Maximum and minimum values and Lagrange multipliers. Double integrals: definition, properties, polar coordinates and applications. Triple integrals: definition, cylindrical and spherical coordinates and applications. Variable changes in multiple integrals. Vector calculation: vector fields, conservative fields, line integrals, Green's theorem, rotational and divergent operators, surface integrals, Stokes's theorem and Gauss's theorem.

Course: Computational Mathematics

Class hours: 80

Syllabus: Computer arithmetic / Errors: Type and Propagation / Taylor Series; Matrices and Matrix Operations / Introduction to Linear Systems / Direct Method (Gaussian Elimination) / Iterative methods (Jacobi and Gauss-Seidel) / Stopping and Convergence Criteria / Notions on Conditioning; Algebraic and Transcendent equations / Bisection Method / Newton Method; Approximation of functions / Interpolation / Linear and Polynomial Fit / Transformations / Determination Coefficient; Numerical Integration (Trapezoidal Rule, First and Second Simpson Rules); Solution of Ordinary Differential Equations / Numerical Solution (Euler and Runge-Kutta Methods) / Notions of Stability of the Solution / Errors / Solution of Higher Order Ordinary Differential Equations as a System of First Order Ordinary Differential Equations; Notions of Partial Differential Equations.

Course: Mechanics

Class hours: 80

Syllabus: Frenet frame (Moving Trihedron). Rigid Bodies Kinematics: velocity and acceleration fields, moving reference frames. Rigid Bodies Dynamics: mass distribution, center of mass theorem, angular momentum and angular momentum theorem, kinetic energy and kinetic energy theorem.

Course: Physics II

Class hours: 160

Syllabus: THEORY: Electromagnetic interaction. Electric Field. Gauss's Law. Electric potential. Electrostatic energy. Electric current. Magnetic induction. Biot-Savart's Law. Ampere's Law. Faraday's Law. Periodic and oscillatory motions. Simple harmonic motion. Physical concepts of forced oscillations, resonance and damped oscillations. Mechanical waves. Energy propagation. Standing waves. Maxwell's equations. LABORATORY: D.C. generator. Electric Field. Filiform conductors. Capacitors. Oscillatory motion. Biot-Savart's Law. Earth Magnetic Field. Faraday's Law. Photoelectric effect. Diffraction.

Course: Data Structures and Programming Techniques

Class hours: 160

Syllabus: INTRODUCTION TO C LANGUAGE - compilers, programming environments, primitive data types, control-flow commands, functions and program structure, fundamental data structures: vectors, pointers, strings and files. PROGRAM DESIGN - program refinement, data and functional abstraction, modularity and testing. ABSTRACT DATA TYPES AND THEIR ALGORITHMS - concepts, implementations and applications of sequences, stacks, queues, graphs, digraphs, linked lists and trees. DOCUMENTATION - textual and graphical representations of the structural, functional and state aspects of C programs. INTRODUCTION TO RELATIONAL DATABASES - entity-relationship diagrams, manipulation of databases with SQL (Structured Query Language), programming with C and SQL.

Course: Fundamentals of Digital Circuits

Class hours: 80

Syllabus: Numbering systems; Two's complement negative numbers; arithmetic. Truth Table; Binary Codes; Boolean algebra; Karnaugh maps and logic function simplification. Logic gates (symbolology, voltage levels) and flip-flops. Latches. Combinatorial logic circuits. Registers and shift registers. Counters.

Course: Fundamentals of Analog Circuits

Class hours: 80

Syllabus: Voltage and electrical current; electrical energy and power; Ohm Laws; linear and nonlinear elements; resistors. Voltage and current sources: independent and dependent. Kirchhoff Laws; Node Method; Loop Method. Analysis principles: Superposition, Proportionality and others; Thévenin and Norton Theorems. Capacitor and inductor; reactancies; analysis for RLC circuits in Direct Current DC).

Course: Strength of Materials

Class hours: 80

Syllabus: Statics applied to Strength of Materials. Geometrical properties of an area. Internal forces and moments Diagrams. Axial load: tensile and compression. Pure shear stress: riveted and welded joints. Stresses in symmetrical bending. Bending deformation of straight beams. Torsion of bars with circular cross section. Trusses. Cables.

Course: Transport Phenomena

Class hours: 80

Syllabus: Introduction to fluid mechanics. Concept of fluid particle. Properties of fluids. Statics of fluids. Basic concepts about flow analysis: velocity, flow, mass flow. General equations of fluid

mechanics: Bernoulli equation. Equation of continuity. Equation of energy. Flow in pipes, external flow. Differential analysis of heat transfer: conduction, convection, radiation and introduction to heat exchangers.

Course: Projects and Special Activities II

Class hours: 160

Syllabus: Practical, interdisciplinary and independent studies of methodologies for proactive learning, aiming the development of skills, abilities and attitudes with relevance to the formation of the future engineer, using elective activities and student-centered. Training of skills concerning interpretation and analysis. Troubleshooting methodologies. Development of Engineering projects. Technical visits, lectures, workshops, seminars and competitions. Participation in scientific initiation projects and technological research.

THIRD YEAR

Course: Statistics

Class hours: 80

Syllabus: Descriptive Statistics: tabular and graphical presentations, location, variability and distribution shape measures; Probability: basic concepts, unidimensional random variables and common discrete (binomial and Poisson models) and continuous distributions (exponential, Weibull and Gaussian distribution); Estimation: sampling and estimation concepts, sampling distribution, confidence interval (for a population mean, proportion and variance); Hypothesis Tests: basic concepts, testing a single population mean, proportion and variance; testing multiple population means (ANOVA).

Course: Electric Circuits

Class hours: 160

Syllabus: 1) Laplace Transform; 2) General theory of Circuits; 3) Direct Current Circuits (DC); 4) Circuits in the S-Domain (Laplace Transform); 5) Transient Analysis in electric circuits; 6) Sinusoidal steady-state analysis; 7) Balanced Three-phase circuits; 8) Two-Port network.

Course: Electromagnetics I

Class hours: 160

Syllabus: 1. Maxwell's equations, boundary conditions, constitutive relations. 2. Static electric field: Laplace and Poisson equations - analytic and computational solutions, resistance and capacitance, graphical method, method of images, partial capacitances and conductance, energy, forces, dielectric polarization, practical examples. 3. Magnetostatics fields: scalar and vectorial potentials, vectorial Poisson equation, analytical and computational solutions; magnetic circuits and inductance, energy, forces, magnetic polarization, permanent magnets, hysteresis. 4. near-stationary fields: electrodynamics potential, induction, Foucault losses. 5. Electromagnetic planar waves, lossless and lossy propagation, Poynting vector, waves reflection, computer simulations, radiation. 6. Transmission lines - lossless and lossy, transients, sinusoidal behaviour, Smith's chart, applications.

Course: Analog Electronics

Class hours: 160

Syllabus: Diodes and their applications: circuits, rectifiers and limiters. Zener and special diodes. Bipolar junction transistors (BJT) and applications: using transistor as key drives, signal amplifiers, power amplifiers and differential amplifiers. Regulated power supplies and voltage regulators. Constant current source. MOSFET and its applications. Introduction to power electronics: thyristor, TRIAC and DIAC. Voltage comparators. Operational amplifiers and their applications:

filters, PID controllers, adders, differential amplifier, voltage follower. Electric Motor Drive: H bridges and pulse width modulation (PWM). Design and simulation using CAD software.

Course: Digital Electronics

Class hours: 160

Syllabus: Encoder e decoders circuits; multiplexers and demultiplexers circuits; adders and subtractors circuits; carry look ahead adder (CLA); RAM and ROM memories; association of memories; finite state machine; microprocessors and microcontrollers; arithmetic logic unit (ALU); programmable logic devices (PLD); state machines for PLDs; microprocessor architecture; fetch cycle; instructions; microcode; Von Neumann architecture and Harvard. Laboratory: simulation of digital circuits in Multisim; encoder / decoder; multiplexer / demultiplexer; adders; projects with state machines; digital timer project; Introduction to CPLD - Altera; multiplexed display (CPLD); VHDL language; FPGA. Advanced projects with Arduino.

Course: Systems and Signals

Class hours: 160

Syllabus: Fourier: analogy between vectors and signals; exponential Fourier series; Fourier transform; properties of the Fourier transform; analysis in permanent and harmonic regime; convolution and energy. Laplace Transform: meaning of s plan. Dynamical systems and their models in s. Z transform: formalization of the sampling theorem; mapping s plan in the z plane; z plan stability analysis; difference equation and its meaning; analysis of digital filters. Laboratory: acquire voice signals: voice processing approach applied to analysis formants of vowels; principles of pattern recognition. Modeling of electronic systems. Working with biological signals (ECG and EEG) and audio signals. Applications and design.

Course: Projects and Special Activities III

Class hours: 160

Syllabus: Practical, interdisciplinary and independent studies of methodologies for proactive learning, aiming the development of skills, abilities and attitudes with relevance to the formation of the future engineer, using elective activities and student-centered. Training of skills concerning interpretation and analysis. Troubleshooting methodologies. Development of Engineering projects. Technical visits, lectures, workshops, seminars and competitions. Participation in scientific initiation projects and technological research.

FOURTH YEAR

Course: Control Systems I

Class hours: 160

Syllabus: Analysis of the stationary error in permanent regime. Project of PID and similar controllers using root locus. Project using Nyquist and Bode method. Z-Transform and sampling theorem. Analysis of stability of discrete time systems. Project of controllers in discrete time domain. Laboratory: utilization of the Matlab and Simulink, simulation and control of nonlinear and linear systems, systems parameters estimation, practical implementation of control systems.

Course: Power Electronics and Drivers

Class hours: 120

Syllabus: Power amplifiers and use of heat sinks. Technical characteristics of various semiconductors used in power electronics, computer simulation techniques and study of static power converters.

Course: Energy Conversion Systems

Class hours: 120

Syllabus: Fundamentals of Energy Conversion; Fundamentals of Electromechanical Energy Conversion; Reactors and Transformers types, equivalent circuit, power and torque; Pulsating and Rotating Electromagnetic Fields; Three-Phase Induction Motors types, equivalent circuit, power and torque; Induction Machines operating as a motor, brake and as a generator; AC Adjustable Speed Drive with induction motor and VSI/PWM inverter driver ; AC Synchronous Generators; Moto-Generators-Sets with synchronous generators; DC Motors types, equivalent circuits, power and torque ; DC Adjustable Speed Drives with DC motors and AC/DC and DC/DC converters drivers.

Course: Electrical Installations

Class hours: 80

Syllabus: Energy sources; national energy matrix. Revision of resolution of single phase and three phase circuits (balanced and unbalanced). EMF generation and concept sequence of phases; major low voltage connections. Electricity tariffs. Design electrical installations. Isolation devices, protection and grounding. Lighting technique. Installation of electric motors. Building Automation. Control circuits and signaling. Installation of lightning rod. Power Factor Correction. Electrical energy inputs; Eletropaulo standard. Project includes residential electrical installation system developed in CAD.

Course: Power Systems

Class hours: 160

Syllabus: Presentation of a System Electric Power. Values per unit (pu): Representation of electrical equipment in pu; advantages of the pu system. Symmetrical components: application in unbalanced three-phase circuits; Study of faults of various types. Nodal analysis in SP; solution of matrix equations; eliminating knots. Study of SP under permanent regime: Foundations; dependence on active and reactive power with voltage and frequency; energetic balance; basic formulation of the power flow problem; net power in one node; Iterative methods applied in the power flow solution: Gauss Seidel and Newton-Raphson; linearized power flow. Laboratory activities: Single-phase circuits in AC - permanent sinusoidal (AC) regime. Three-phase AC circuits with balanced and unbalanced loads. Power measurement and experimental verification of Blondel's Theorem. Measurement of electrical quantities using the energy analyzer. Determination of the percentage impedance of a transformer. Connection of transformer banks. Transformer parallelism. Determination of symmetrical components. Resistance measurement. isolate / earth, Computer simulation.

Course: Power Generation and Transmission

Class hours: 80

Syllabus: Fundamentals of power systems and its representation. Materials applied to power systems. Three-phase circuits, symmetrical components and p.u. values. Basics of electricity-generating plants. Operation of systems. Basics of electrical system protection. Insulation coordination. Electric power transmission in AC and DC. key aspects and calculation of transmission line parameters (R, L, C). Transmission lines for static and transient phenomena. ABCD and pi model. High, medium and low voltage.

Course: Distribution, Regulation and Power Quality

Class hours: 80

Syllabus: Distribution of electricity: factors and characteristics. Basics of load forecasting and planning. Design of distribution systems. Tension control, reactive compensation and voltage regulation. Circuit sizing techniques. Power quality: development of history subject in Brazil and abroad. Institutional and regulatory aspects of the Brazilian electricity sector. Definition of quality phenomena of electricity. Harmonic distortion of voltage and current; flicker effect; voltage imbalance; short duration voltage variations (SAG and SWELL). Causes and consequences of

the phenomena of electric energy supply quality. Standardization and regulations. Methods of measurement and analysis. Methods of compensation or mitigation of effects on production processes of high sensitivity.

Course: Entrepreneurship and Management

Class hours: 80

Syllabus: Brief history of the evolution of the Business Administration in the modern World. Systemic vision of a company, through the General Theory of Organizations Conceptualization and practical application of: Strategic Planning, Marketing Planning, Operations Planning and Financial Planning, through the design of a Business Plan of a new company, thus encouraging the entrepreneurial spirit of the students.

Course: Projects and Special Activities IV

Class hours: 160

Syllabus: Practical, interdisciplinary and independent studies of methodologies for proactive learning, aiming the development of skills, abilities and attitudes with relevance to the formation of the future engineer, using elective activities and student-centered. Training of skills concerning interpretation and analysis. Troubleshooting methodologies. Development of Engineering projects. Technical visits, lectures, workshops, seminars and competitions. Participation in scientific initiation projects and technological research.

FIFTH YEAR

Course: Undergraduate Thesis

Class hours: 160

Syllabus: Introduction: Conceptualization of project. Scientific research and applied research. Administration and management of projects. Project requirements definitions. Systemic view of the project. Planning: Formation of the team-work. Structure, activities, resources and project budget. Management: Decision. Negotiation processes. Monitoring techniques (chronograms and PERT diagrams). Technical Report and Monograph: concept, characteristics, planning and preparation. Formal presentation: Public presentation skills. Attitudes and behaviors. Use of audiovisual resources. Public exposition at Eureka.

Course: Dynamics of Electrical Systems

Class hours: 80

Syllabus: Analysis of static power systems. Power Flow Analysis by Newton Raphson method. Power Systems controls and operation. Operational limits and control requirements. Power systems dynamics analysis. Transient stability analysis by Euler and Runge-Kutta methods. Power Systems voltage control and dynamic stability. Dynamic stability and variations to small signals. Load and frequency control and CAG - Automatic generation control. Emergency controls and protection. Energy Management System (EMS) functions.

Course: Industrial Installations and Automation

Class hours: 80

Syllabus: Planning electrical installations. Application of main equipment used. Technical standards at high voltage and low voltage installations. Regulations for telephone installations. Lighting technique. Graphical symbols for design and implementation of electrical / telephone installations. Selection of cables and equipments. Tracing circuits. Electrical substations in building and industrial installations. Arrester. Grounding. Control and protection of electric motors. Apparent, active and reactive power and power factor correction. Emergency generator. Notions of rational and economical use of electricity. Designing circuits in CAD software. Wiring and

brackets (ducts and gutters), basic industrial circuits. Table distribution of Alternating Current (CA), protection (grounding and fuses), communication (telephony and data), Human Machine Interface (HMI), lighting, simple control panel, automatic control panel. Industrial controllers. Programmable logic controllers. Industrial Instrumentation. Industrial networks. Drives on networks. Frequency inverters in industrial networks.

Course: Eletric Machines

Class hours: 160

Syllabus: Polyphase induction machines: constructive aspects and operation principle; equivalent circuit; torque and current equations from Thévenin principle; parameters determination from tests, considering skin effect in cage conductors; rotor resistance effects on torque characteristic; Synchronous machines: constructive aspects and operation principle; no load and short circuit tests; load angle; capability; "V" curves; salient poles theory; permanent magnets synchronous motors; Direct current machines: constructive aspects and operation principle; excitation types and analytical modelling.

Course: Protection Systems

Class hours: 80

Syllabus: Modeling of power systems: Values in per unit (p.u.); Symmetrical components; Model of transmission lines; Model of generators; Model of transforming; Analysis of Lacks: Three-phase lacks; Anti-symmetrical lacks; Transitory defects; Defects of high impedance. Beddings of protection: Protection of over current; Distinguishing protection; Protection of surge and under voltage; Directional protection; Protection of distance. Transducers: Target; Transforming of chain and potential; Precision and saturation. Applications of Systems of Protection: generators; engines; transforming; bars; lines (Radial Mesh and); reactors and of capacitors, primary cabin. Reclosing and systems of emergency control: Control of emergency ERAC. Events control: Registers and analysis of events.

Course: Economics

Class hours: 80

Syllabus: Concepts and economic relations: definition of economics. Object of the economy and basic economic problems. Theory and economic analysis: a new microeconomics. Notions of macroeconomics: concept, measures of economic activity and economic policy instruments. International Economics: Balance of Payments and current economic analysis. Brazilian Economy and Contemporary World.

Course: Hygiene and Work Safety

Class hours: 40

Syllabus: Prevention; Accidents at work; Diseases of work; Notions of occupational hygiene; Specific themes; FOODS: biological agents: assessment and control measures; biosafety; security in cold rooms; AUTOMATION AND CONTROL: ionizing and non-ionizing radiation; dangerousness; ELECTRICAL: low, medium and high voltage, electrical and fire safety. MECHANICS: occupational vibration: evaluation and measures control; safety in machinery and equipment; safety in boilers and pressure vessels; safety in welding; PRODUCTION: transportation safety and handling; warehousing and material handling; safety in layout; risk management; accident investigation. CHEMISTRY: chemical agents: assessment and control measures; safety in laboratories and transportation of hazardous materials; safety signage and labeling; Hazard and Operability Study - HAZOP.

Course: Business Law

Class hours: 40

Syllabus: Fundamentals of Law. Civil Law. Business Law. Trademarks and patent. Labor Law. Tax Law. Environmental Law. Consumer Law. System CONFEA/CREA.

Course: Supervised Internship

Class Hours: 160

ELECTIVE COURSES

Course: New Technologies in Media

Class Hours: 40

Syllabus: Opportunities for the technology market in new media. Standards of the Brazilian Digital TV, multimedia platforms; fundamentals of digital video and digital audio, audio coding systems, video and data: compression techniques and cases of interactivity; multiplexing and information systems; modulation of digital TV systems, transmission systems, analysis of distance range and performance; production (journalism, sport, entertainment), systems engineering TV (capture, post-production, transmission and exhibition); trends and media convergence. Transmission over the Internet: architecture and application layer. Internet and networks. Information security. New media concepts.

Course: Electrical Substation

Class Hours: 40

Syllabus: Transmission systems and power distribution and voltages standardized. Types of line diagrams and their applications. Tests: Essays dielectrics. Code number of the functions of switching devices, control and protection of power systems as Brazilian standard. Power transformer. Shunt reactors. Bushings for transformers and reactors. Current transformers. Potential transformers. Arrester. Switchgear. Breakers. Capacitors.

Course: Power Plant and Substation Project

Class Hours: 40

Syllabus: Specification of the main electrical equipment of a Power Generation Plant: Synchronous Generator, Speed Controller, Voltage Regulator, Auxiliary Services, Medium Voltage Circuit Breakers, Power Transformer, Potential Transformer, Current Transformer, Ground Transformer, Ground Relays protection. Specification of main main electrical equipment of a substation: Line disconnecting switches, busbar disconnecting switches, earth blade disconnecting switches, high voltage circuit breaker dead tank, high voltage circuit breaker, live transformer, measuring current and protection transformer, potential of measurement and protection, ground transformer, for lightning, protection relays, auxiliary services. Develop control logic for a plant and a substation, Interlocks, alarms and protection. Develop single-line diagrams, three-wire diagrams, equipment lay-out, command and control and protection, cabling and cable lists.

Course: Electromagnetic Transients

Class Hours: 80

Syllabus: Fundamentals of Electrical Transients; Simple Switching Transients; damping; Abnormal switching transients; Transients in Three-Phase Circuits; Transients in Direct Current Circuits; Electromagnetic phenomena of importance under transient conditions; Traveling waves on transmission lines; Principles of transient modeling of power systems and components; Modeling of equipment and behavior of such devices under transient conditions; Computational treatment of electrical transient calculations; Atmospheric discharge

Course: Topics in Biomedical Engineering

Class Hours: 40

Syllabus: History and basic concepts of biomedical engineering; Human physiology and circulatory system; Medical instrumentation; Electrodes, sensors and transducers; Biopotential

amplifiers; Monitoring of physiological quantities; Life support equipment; Diagnostic Imaging Equipment.

Note: The student may apply for enrollment in any course offered by the CEUN-IMT, as an elective to complement the required workload, provided it has the approval of the Course Coordinator.