ELETRONIC 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. Potencial 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: 160
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. Eletrostactic 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. Eletric 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 (symbology, 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 ahed 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: 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 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: Eletromagnetic II
Class hours: 80
Syllabus: Transmission of signals in lossy lines. Impedance matching. Analytical, graphic and computational methods. Reflection, transmission and refraction in dielectric surfaces. Guided waves. Propagation modes in plane, rectangular and cylindrical waveguides, metallic and dielectric. Rectangular and cylindrical cavity resonators. Scattering matrix. Microwave circuit components. Applications in telecommunications and industry. Antenna basics.

Course: Telecommunications
Class hours: 80
Syllabus: Signals in the frequency domain. Spectra. Signal strength. Decibel. Spectral density. Autocorrelation. Random signals. Noise. Elements of a telecommunications system. Analog modulations. Sampling. Pulse modulations. Quantization. PCM modulations. Line codes. Baseband data transmission. Error correction codes. Detection of binary signals in the presence of noise. Interference between symbols. Antennas in a communication system: basic notions. Antennas: directivity and gain. Received signal strength and noise power. Noise figure and noise temperature. Friis formula. Fresnel ellipse.

Course: Microcontrollers and Embedded Systems
Class hours: 160
Syllabus: Microprocessor Architecture (Overview): Harvard and Von Neumann; RISC and CISC; bank of registers; bus; memory; peripherals; interruptions; instructions. C language for embedded: code structure; optimizations; pointers; compilation theory. ARM: internal architecture, toolchain; Development of projects using microcontrollers; Function of the modules of a microcontroller (ADC, Timer, PWM etc). Embedded projects and basic communication with dashboards via Http protocol. Sensors and actuators; how to monitor and control the outside world through na embedded system.

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.

FIFITH 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: Internet of Things and Real Time Systems
Class hours: 80
Syllabus: Overview of real-time systems and Internet of Things (IoT). IoT systems architecture. Concurrent programming. Task synchronization (critical region, mutexes, semaphores). Network protocols for IoT. Services and platforms for Internet of Things. Storing large volumes of data in databases (Big Data concepts). Data protection and privacy in IoT applications. Energy and power consumption in IoT systems. Applications and use of visualization panels (dashboards).

Course: Instrumentation and Automation
Class hours: 160
Syllabus: Introduction. Basic elements of a feedback control system. Features and theory of sensor devices. The PID controller. Main actuators used in control. Other types of controllers: split-range, feedforward, cascade. Parametric and non-parametric identification of industrial processes. Safety Instrumented Systems (SIS) e SIL. Typical equipment used in the automation of industrial processes. Automation Systems; Open Systems; Programmable Logic Controllers (PLC); Programming languages for PLCs; Industrial networks (fieldbuses). Supervisory and Control Systems. SCADA (Supervisory Control and Data Acquisition) Systems. Explosion Risk Areas, Intrinsically Safe equipments, Concepts of MES and PIMS.

Course: Information Security
Class hours: 80
Syllabus: Definitions in the Information Security Area, Classical Cryptography, Private Key Algorithms, Public Key Algorithms, Hash Functions, Digital Signatures, Digital Certificates, PGP,

Security in the TCP/IP Model, Introduction to Pentest, Security Analysis, Ethical Principles, Laws and Regulations, Responsibilities required for an Information Security Professional.

Course: Engineering Techniques for High Frequencies
Class hours: 80
Syllabus: Measurements and instrumentation: spectrum analyzer; Network analyzer and split line. Reflectometry (TDR - Time Domain Reflectometer). Spreading parameters. Transmission lines, planar structures (microfies). Filters. Computational simulation. Antennas: theory and design.

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: 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: 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: Supervised Internship
Class Hours: 160

ELECTIVE COURSES

Course: Digital Signal Processing - Applications II
Class Hours: 80
Syllabus: THEORY: Image formation. Discrete Cosine Transform (DCT). 2D images. Application in detection of contour. Application in recognition. Application in fingerprint. Application in restoration of image. Application in blind deconvolution. Application in JPEG. LABORATORY: Manipulation of the Image. Discrete Cosine Transform (DCT). Images. Detection of contour. Project with hardware: recognition. Project of software: Fingerprint. Restoration of image. Blind deconvolution. JPEG.

Course: Artificial Neural Networks

Class Hours: 40
Syllabus: Introduction. Concepts and evolution of artificial neural networks. Architectures and learning rules: unsupervised, supervised and competitive learning. Multi-layer networks trained by the backpropagation algorithm. Associative networks: linear and Hopfield network. Kohonen self organizing maps. Applications of artificial neural networks: signal processing, control and data analysis.

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.

Course: Control Systems II
Class Hours: 80
Syllabus: Experimental identification of systems. Tuning PID Controllers. Discrete PID Controllers. Project of multi-loop controllers. Multivariable controller design. Representation of dynamic systems with state space variables. Stability analysis in state space representing systems. Solution of state space equations. Discrete state space representing. Controlability and observability. Design of feedback controllers for state space systems. Design of state space observer. Optimal control introdution. LQR (Linear Quadratic Regulator) control. Kalman filter. LQG control (Linear Quadratic Gaussian Quadratic regulator). Identification by Minimum Squares Methody. Fuzzy logic and fuzzy control.

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.

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.