MECHANICAL ENGINEERING BSC

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: Strength of Materials
Class hours: 160
Syllabus: Static applied to the Strength of Materials. Geometric features of plane figures. Internal forces and moments Diagrams. Trusses. Normal and shear stress. Simple traction and compression. Thermal deformation. Pure shear. Torsion of bars with circular and non-circular cross section. Stresses in symmetrical and unsymmetrical bending. Bending deformation of straight beams of constant and variable cross section. Shear stresses in bending. Combined loadings. Stress transformation. Criteria of resistance. Buckling of columns. Laboratory of Experimental Analysis of Structures. Transdisciplinary project: practical approach of concepts of tensions, deformations and structural stability.

Course: Introduction to Design and Manufacturing
Class hours: 160
Syllabus: Machine elements. Standards for representation of machine elements. Standard numbers. Standard machine elements. Assembly drawings and details. Standards and specifications. Adjustments and tolerances. Roughness. Criterion for materials selection. Materials for machine elements. Understanding of manufacturing processes to machine elements. Fundamental concepts and purposes of metrology. International system of units. Measurement standards. Gauge blocks. Direct and indirect measures. Instruments and devices for metrology. Calipers, micrometers, dial indicators and goniometers. Checkers threads and gap. Calibration. Errors and accuracy. Dimensional control. Deviations of form and surface finish. Surface Roughness Measurement. Introduction to the operation of machines: lathe, mill, drill, saw, grinder and manual adjustment. Notions of machining parameters. Reading and interpreting of technical drawing.

Course: Mechanical Construction Materials I
Class hours: 80
Syllabus: Materials science. Metal alloys. Equilibrium diagrams. Introduction to mechanical construction steels. Fe-C equilibrium diagram. TTT diagrams. Heat treatment of steels. Thermochemical treatments. Stainless steels. Aluminum alloys. LAB: Study and realization of the main mechanical tests: tensile, hardness, impact. Penetrant and magnetic particles. Metallography of steels and aluminum. Fatigue test.

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: Projects and Special Activities II
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 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.

THIRD YEAR

Course: Structural Mechanics
Class hours: 160
Syllabus: Analysis of plane and spatial isostatic and statically indeterminate structures using the force method and the displacement method. Deflections in structures using energy methods. 3D stress state. Generalized Hooke´s Law. Strength criteria. Plane strain analysis. Extensometry techniques. Experimental analysis of structures. Shear flow in thin-walled profiles. Thermal deformations in beams due to temperature gradient. Tensions in pipes. Pressure vessels stress analysis according to ASME-Section VIII - Division I. Displacement method - matrix analysis of structures. Introduction to the Finite Element Method. Implementation of structural calculations using the displacement method using general programs such as Matlab and Octave. Introduction to the use of professional finite element software.

Course: Mechanical Construction Materials II
Class hours: 80
Syllabus: Introduction to polymers. Physical characteristics of polymers. Relationship between structure and mechanical properties. Types of polymers and elastomers. Selection of polymers for technological applications. Properties of molten polymers and processing. Injection, extrusion and other molding processes. Polymer degradation. Adhesive applications. Polymer recycling. Composites, polymeric matrix, reinforcements, synthetic and natural fibers. Projects and processing of composites. Basic calculations in composites. Laboratories for identification and characterization of polymers, synthesis of polymers, adhesives, preparation of composites and projects.

Course: Machine Design
Class hours: 160
Syllabus: Machine design. Development stages of an Engineering Project. Project development. Drawings and sizing calculations. The design of machine components. Tolerances and adjustments. Surface finish. Methodology for troubleshooting. Machine components. Work. Energy. Power. Analysis of forces. Balance. Bearings. Main types of bearings and sliding bearings. Sizing. Elements of power transmission: belts and pulleys. Selection and sizing of belts. Sizing Machines Elements. Typical applications for machine elements. Sizing criteria. Allowable stresses. Stress concentrations. Fatigue. Threaded elements. Non-permanent joints. Bolts and nuts. Screws movement. Yield. Sizing fasteners. Springs: application, materials and sizing.

Course: Analytical Mechanics

Class hours: 80
Syllabus: Lagrange¿s method. Generalized coordinates and degrees of freedom. Principle of virtual work. Equilibrium. Potential Energy. Stability of Equilibrium. Lagrange equations. Application of Lagrange equations for plane and three-dimensional systems. Newton's method. Dynamic analysis of plane mechanisms. Dynamic internal forces and moments. Rolling resistance. Vehicle Dynamics, longitudinal movement. Computer simulation of vehicle performance. Principal moment of inertia of three-dimensional bodies. Dynamics of a rigid body with fixed axis. Balancing of rigid rotors. Dynamics of rigid bodies in general three-dimensional motion.

Course: Energy Conversion Systems I
Class hours: 80
Syllabus: Thermodynamics applications. Some concepts and definitions. Properties of a pure substance. Ideal gas model. Work and heat. The First Law of Thermodynamics for closed systems. The First Law of Thermodynamics for control volumes. The Second Law of Thermodynamics. Entropy. The Second Law of Thermodynamics for control volumes. Irreversibility and availability. Thermodynamics and environmental issues. Brief presentation of power and refrigeration cycles.

Course: Fluid Mechanics I
Class hours: 80
Syllabus: Introduction to Fluid Mechanics; dimensional analysis and similarity; fluid statics; mass, momentum and energy equations: Control Volume analysis; viscous flow in ducts.

Course: Electricity
Class hours: 80
Syllabus: Electricity fundamentals. Electric power and electric energy. Ohm's law in the resistor. Direct current circuits. Circuits with relays. Study of electronic laboratory instruments. Sensors frequent users in automation. Voltage divider and Wheatstone bridge. Diodes and rectifier circuits.

Course: Electricity and Automation
Class hours: 80
Syllabus: Electrical circuits in alternating current. AC electrical power and power factor. Three-phase circuits and FP correction three-phase. Single-line diagram. Transistor operating as a switch. Thyristors. Operational amplifier. Motors: types, characteristic curves, selection criteria, speed control.

Course: Heat Transfer I
Class hours: 80
Syllabus: Basic concepts of heat transfer. Heat transfer and the environment. Steady heat conduction. Fins. Heat generation in solids. Transient heat transfer. Brief concepts of convection. Radiation heat transfer. Combined heat transfer by conduction, convection and radiation.

Course: Projects and Special Activities III
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.

FOURTH YEAR

Course: Heat Transfer II
Class hours: 80
Syllabus: Solving heat transfer problems through CFD and finite element softwares. Natural convection. Internal forced convection. Pool boiling. Film condensation. Room heat load calculation. Heat exchangers. Automotive radiator project.

Course: Método dos Elementos Finitos
Class hours: 80
Syllabus: Fundamentals of the Finite Element Method for Structures. Direct Method for discrete systems and Variable Methods and Weighted Residues for continuous systems. Principle of Virtual Work and Principle of Minimum Total Potential Energy. Equations of Elasticity Theory in the Plane. Constitutive Relationships for Isotropic Elastic Material. Development of the stiffness matrix and the force vector for uni, bi and tri-dimensional elements. Functions of form and isoparametric formulation. Numerical integration by the Gaussian quadrature. H and p methods for obtaining more precise results. Development of simple programs using a programming language. Use of commercial software for case study solution. Application of boundary conditions and systems solution. Numerical solution techniques for static, dynamic, termal and eigenvalue problems. Convergence criteria. Experimental validation through strain gages. Transdisciplinary project: numerical modeling through commercial software.

Course: Machine Construction II
Class hours: 120
Syllabus: Theory - Classification of geared transmission systems - Spur and helical cylindrical gears - Gear geometry and kinematics - Standardization of transmission ratios and modules - Interference and degree of recoating - Geared pairs¿ correction - Materials recommendations for manufacturing gears - Design of gears by the criteria of resistance bending and contact pressure - Bevel and worm gear - Planetary and Harmonic Reducers - Mechanisms and kinematics pairs - Kinematics and dynamics of mechanisms - Design and sizing bars and cams mechanisms - Practical work and projects - Project with details of mechanisms systems and geared - Assembling and disassembling of geared systems, checking W measures, distances between centers, diameters, widths, angle pressure and modules.

Course: Vibration Mechanics
Class hours: 120
Syllabus: Linearization of differential equations. Free vibration with and without damping with one degree of freedom. Harmonically excited vibrations with and without damping with one degree of freedom. Rotating unbalance. Response of a damped system to the harmonic motion of the base. Accelerometers. Vibrometers. Vehicle suspension. Vibration isolation. Superposition Principle. Fourier Series. Free vibrations without damping with two degrees of freedom. Harmonically excited forced vibrations without damping with two or more degrees of freedom. Modal analysis. Direct method. Undamped dynamic vibration absorbers. Vibrations of beams and shafts. Bernoulli-Euler beam model. Beam vibrations with lumped masses. Rayleigh method. Structural vibrations using the Finite Element Method.

Course: Flow Machines
Class hours: 80
Syllabus: Energy transformation machinery: flow, volumetric and special machinery; associated quantities model for flow machines; flow machine selection parameters; association of rotors; fundamental equation of flow machines; triangle of speeds; characteristic curves and similarity theory. Cavitation: definition, identification, analysis of facilities, calculation of NPSH.

Hydroelectric plants: installed power, elements; reversible installations; types of turbines; energy transformation; triangle of speeds; environmental impacts. Pumping plants: installations, loss of load; system curve; characteristic curves; point and operation control; constructive aspects; valves; sizing of facilities. Fans: types; characteristic curves. Wind energy: wind energy potential; types of turbines; advantages and disadvantages; power coefficient; design of horizontal axis wind turbines. Computational Fluid Dynamics: concepts, steps; simulation of flow machines.

Course: Fluid Mechanics II
Class hours: 80
Syllabus: Eulerian and Lagrangian description of fluid movement. Streamlines, Emissions and Trajectories. Flow visualization. Flow kinematics. Acceleration of a fluid particle. Equation of Conservation of Mass in differential form (Eq. Continuity). Navier-Stokes Differential Equation of Motion. Brief description of turbulence and mathematical closure problem for numerical solution (CFD). Equation of Energy in differential form. Laminar and Turbulent Boundary Layer. Von Kármán integral equation for the boundary layer. Drag on a flat plate in laminar and turbulent flows. Flow over blunt bodies. The drag crisis on cylinders and spheres. Strouhal's number. Flow around airfoils. Compressible flow. Shock. Choking and Blockage. CFD (ANSYS codes) simulations of a mixture box or "T" joint (mass conservation); flow around a cylinder (Fluid-Structure Interaction or FSI), jet propulsion (conservation of momentum) and compressible flow with shock wave). 2D Airfoil Simulations with XFLR5. Experiments: flow around cylinders and airfoils (Wind Tunnel or Leybold blower); compressible flow (F810, Termodynamics Lab).

Course: Processes Control
Class hours: 160
Syllabus: Continuous Processes: Introduction to control systems of continuous processes. Laplace transform. Solutions of differential equations by applying Laplace transform. Systems of first and second order. Characterization of parameters (natural frequency, damping, etc.). Characterization of transient responses. Stability. Closed Loop systems (conceptualization, determination of the transfer function). Root Locus analysis. Specification of the control system. PID controllers: description, design and tuning. Discrete Event Processes: Introduction to control of discrete event processes. Modeling and simulation of the control of discrete event systems. Application in pneumatic circuits (sensors, actuators and pneumatic control valves). Application for hydraulic circuits (sensors, actuators and hydraulic control valves). Application of PLC in Automation Systems. Electro-pneumatic and electro-hydraulic.

Course: Vehicle Propulsion
Class hours: 80
Syllabus: Vehicle propulsion fundamentals: longitudinal vehicle dynamics and main architectures. Internal combustion engines: categories, thermodynamic ideal cycles (air-standard) and real cycles, engine performance curves, combustion in reciprocating engines, air-fuel mixture formation, electronic fuel injection & ignition management systems. Air consumption in 4-stroke engines. Lubrication and cooling systems. Vehicle emissions and after-treatment systems. Supercharging in engines. Hybrid, electric propulsion systems.

Course: Energy Conversion Systems II
Class hours: 80
Syllabus: Renewable and non-renewable energy sources. Environmental impacts of energy production and use. Thermodynamic cycles: power cycles (Brayton, Otto, Diesel, Stirling) and refrigeration cycles (vapor compression, absorption). Gas turbines, applications, combined cycles for power generation. Fuels and combustion. Steam generators. Bioenergy and bioelectricity. Psychrometry. Refrigeration, air conditioning. Thermal accumulation systems. Environmental impact of refrigeration and air conditioning systems (ozone layer, climate change). Energy cogeneration with absorption chillers. Basic clean room installation project.

Course: Projects and Special Activities IV
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.

FIFITH YEAR

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: 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: 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: Manufacturing Processes I
Class hours: 80
Syllabus: Theory: Introduce the student to the concepts of mechanical manufacturing processes enabling him to identify and differentiate the characteristics of each process. Train the future engineer providing the techniques for dimensioning manufacturing operations. Provide the

student concepts and topics related to the mechanical manufacturing processes of material removal processes by machining, turning, milling, drilling, boring and, threading; Flat and cylindrical grinding; Union processes by welding. Laboratory: Allow the student practical contact to machining technology with conventional machines as lathe, milling machine, drilling machine and with CNC, machines, lathe and milling machine. Present to the student concepts related to, the tools geometry, creation of process sheets and choice of operational parameters.

Course: Computer-Assisted Manufacturing
Class hours: 80
Syllabus: Provide the students familiarization with CNC machines, showing its characteristics and applications. introduce to the students the basics of ISO G programming language for CNC machines, lathe and milling machines. Work the integration of CNC machines and computer through machining simulation software. Introduce the student to the computer assisted manufacturing environments CAD/CAM and machine integration on computer aided manufacturing (CAM) programs. Discuss the concepts of manufacturing automation, flexible manufacturing systems, advanced manufacturing and Industry 4.0.

Course: Manufacturing Processes II
Class hours: 80
Syllabus: Theory: Introduce the student to the concepts of mechanical manufacturing processes enabling him to identify and differentiate the characteristics of each process. Train the future engineer providing the techniques for dimensioning manufacturing operations. Provide the student concepts and topics related to process by Sand casting, shell-molding, lost wax and pressure casting; Plastic forming processes, Lamination, Open and closed die forging, Stamping, Drawing and Extrusion. The laboratory activities deal with the concepts of non-linearity of the metal plastic forming processes. Students will work with finite element and finite volume software with nonlinear simulation of constant volume forming processes.

Course: Quality Control
Class hours: 80
Syllabus: Theory: Provide the students contact with the most current techniques and quality control tools in use in the industry. Through the methodology of problem solving expose the student to cases and situations regarding topics of quality, involving the student a complete systems of quality control project. Enable the student to correctly discern and apply the various quality tools appropriately and enable them to interpret the statistical concepts of quality control. Laboratory: Through practical experiments work the student the concepts of metrology and quality control using statistical interpretation with the support of specific software. Provide the student the consolidation of the theoretical discussion of quality control system design with practical applications.

Course: Undergraduate Thesis
Class hours: 160
Syllabus: Development of the graduation research project preliminarly conceived during the EMC702-Methodology of Scientific and Technological Research Course or equivalent activity (PAE). Application of standards and criteria for writing a technical report and monography. The development phase is monitored by both the project advisor and the discipline professor through a set of compliance documents and checkpoints, which include the evaluation of language, form and content of the chapters as well as through periodic group presentations. Many activities in this term are aimed towards supporting the EUREKA exhibit, including but not limited to booth layout definition, utility requirements definition, support hardware and software definition, prototype development, construction and testing.

Course: Supervised Internship

Class Hours: 160

ELECTIVE COURSES

Course: Introduction to Aircraft Design
Class Hours: 80
Syllabus: The history of controlled flight. Aircraft terminology and architecture. Aircraft design approaches. Fundamental relations of energy and geometry for making flight possible. Airfoil and wing aerodynamics. Elements of propulsion, performance, stability, control, loads and structures theory for aircraft design, as applicable to the IMT-Human Powered Aircraft design. The use of software as tools in aircraft design (ANSY CFD, XFLR5, Propdesigner). Guided group advancement of the design of the IMT-HPA aircraft.

Course: Material Selection
Class Hours: 80
Syllabus: Physical properties review: thermal, electrical and optical properties. Mechanical properties review: strength, stiffness, plastic work and hardness. General properties: price, density and availability. Mechanical properties related to durability: fracture toughness, fatigue, creep and corrosion. Standard solutions for elastic problems: material indices for elastic design. Materials selection for stiffness-limited design. Materials selection for plastic problems. Fracture and fracture toughness: material property charts for toughness. Materials selection for fatigue-limited design. Materials selection for fracture-limited design. Material indices for fail-safe design. Materials selection for thermal efficiency. Materials selection for electrical efficiency. Friction and wear: materials selection to manage friction and wear. Materials selection for high temperature applications. Materials, processes and the environment - materials indices for eco-design.

Course: Dynamics and Vehicle Systems
Class Hours: 160
Syllabus: Fundamentals of vehicle dynamics. Vehicle systems: steering, suspension, brakes and transmissions.

Course: Computer Simulation in Mechanical Engineering
Class Hours: 80
Syllabus: Fluid dynamics simulations with and without heat transfer. Static and dynamic structural simulations. The discipline presents concepts and methodology of computational modeling of different phenomena of Solid Mechanics (static and dynamic) and Fluid Mechanics (fluidodynamics and heat transfer) in order to enable students to solve numerically, via finite volume or finite element method, fundamental problems in these areas. Wherever possible, numerical solutions will be mathematically verified and experimentally validated, giving students insight into the advantages and limitations of numerical methods.

Course: Bioengineering Topics
Class Hours: 80
Syllabus: The discipline is divided into blocks, each comprised of two months. The first block is dedicated to biomaterials, the second to biomechanics and the third to biological flows. Biomaterials: history and definition of biomaterials; physical, chemical and biological properties; polymeric, metallic, ceramic and composite materials; biocompatibility, activity and functionality; biodegradable materials; implants: compatibility and healing processes. Biomechanics: introduction to biomechanics, kinematic analysis of the movement of the human body; modeling and simulation of the dynamics of human movement; simulations of biomechanical structural systems; rehabilitation devices; prostheses and orthoses. Biological flows: introduction to

biological flows, types of fluids and classification; circulatory system morphology; blood modeling; diagnostic and therapy equipment; pulsatile flows.

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.