UNIVERSITY "POLITECHNICA" OF BUCHAREST

FACULTY OF ENGINEERING IN FOREIGN LANGUAGES

MECHANICAL ENGINEERING

English Stream

Lecture/Tutorial/Laboratory/Project **14 Weeks/semester**

I Year, 1st semester

CALCULUS I

The course introduces the theory of series which are basic for understanding elementary functions and for approximations, differential calculus of functions with several variables and develops what is needed for the optimization problems. The students are supposed to learn these topics, be aware of the basic principles of analysis and develop new computational skills. They are also supposed to search for computer methods and numerical analysis of the results.
Topics: *Series of numbers (real and complex). Series of functions, power series and power series expansions, basic elementary functions. Elementary topology of metric spaces. The Euclidean n-dimensional space. Partial derivatives, differentiability for functions of several variables. Implicit function theorem and applications. Extremes of functions of several variables, Lagrange multipliers, applications.*

LINEAR ALGEBRA I

This course serves as an introduction to the abstract concepts based on linearity. The list of topics for course and tutorials provides a host of additional applications, or better, "interpretations" of linear algebra, analytic geometry brought to real-world situations.
Topics: *Vector spaces. Linear transformations. Eigenvalues and eigenvectors. Bilinear and quadratic forms. Free vectors. Equations of straight line and plane. Changing of frames.*

CHEMISTRY

The information provided by this course offers a better understanding of chemical phenomena for technical applications. Students can perform calculations for the basic application in electrochemistry, kinetics and thermodynamics to develop understanding of basic concepts of chemistry and materials.
Topics*: Chemical bonds. Correlation between chemical structure and properties of materials. Chemical thermodynamics. Chemical kinetics (Chemical reaction rate ; Kinetic-molecular theory ; Catalysis). Electrochemistry (Electrolytes; Electrodes). Corrosion (Forms of corrosion of metals and alloys; Methods of corrosion protection).*

MATERIALS SCIENCE I

The course gives general information on the properties of metallic materials required for selection in an application and predicts their behavior during service. To this purpose the lectures give a deep insight in the structure (or internal architecture) of the material considered as a link between chemical composition, fabrication technology and properties of the metallic materials.
Topics: *Properties of materials. Structure of materials. Crystallographic systems. Imperfection in real crystals. Phase equilibrium diagrams. Structural transformations. Heat treatments of steels.. Alloy steels. Carbides formation. Non-ferrous alloys. Al-alloys, Cu-alloys, Ni and Ti-based alloys.*

INTRODUCTION TO INFORMATION TECHNOLOGY

The course gives the knowledge and qualification to work with computers, computer networks, operating systems, files and databases, internet technologies, the use of some general application packages, and the necessary knowledge for ECDL qualification (European Computer Driving License).
Topics: *Definitions (data, information, knowledge, processing, organization, architecture, structure/functions of the computer, evolution and classification). Central Processing Unit, Computer Memory System (as hierarchy), Input/output Unit, Interconnection Structure, File Organization and Database Systems. System Software and Application Software. Data communication and Computer Networks. Trends and issues in ICT (Information and Communication Technologies).*

ENGINEEING GRAPHICS I

The course introduces the special and very precise language of graphical science needed to build up and to develop 3D representations, technical thinking, understanding and interpretation of an engineering part and assembly drawing.
Topics: *The graphic representation of the fundamental geometric elements of the three-dimensional space, using the orthographic projection. Basics of the Technical Drawing; the six principal views. Views and sections of a solid. Threads and threaded fasteners. Springs. Crankshafts.*

PROFESSIONAL COMMUNICATION I

The practical course deals with the development of the four fundamental skills: listening, speaking, reading and writing. The main objective lies on the development of communicative competence, capacity to recognize and understand another culture and civilization, the ability to use them in context, incorporating cultural and civilization connotations, capacity to decode the iconic and cultural character of gestures during conversation.
Topics: *Working together. Cross cultural communication. Telephoning in English. Functions of academic written English. Writing short documents: memo and e-mail. Writing formal letters.*

EUROPEAN CULTURE AND CIVILISATION I

The course is designed as an introduction to some major issues of European history and philosophy which may give an account of what does it mean to be European. The focus will be set on theoretical and historical roots of individualism, liberalism and rights versus collectivism, traditionalism and beliefs.
Topics: *I. Nature and Convention in Greek philosophy; Plato's ideal State; II. Early Christian philosophy; Iconoclasm vs. iconolatry; III. Martin Luther and the Catholic Church; IV. From the divine cosmos to the modern secular thought; Kant; V. Experimental science and philosophy; From Copernican revolution to Newton and then to Einstein; VI. British empiricism; French rationalism; Anglo-Saxon cultural model*

PHYSICAL EDUCATION

The activity is intended for maintaining an optimal health condition of the students who practice physical training, in order to increase the work potential required by everyday activities; developing of the basic physical capacities and the specific capacities of the different sport branches; forming the habit of permanent and continuous practice of physical exercises and training in their spare time; educating the fair-play spirit, to form an efficient behaviour and a positive attitude, as well as a disciplined manner of life.

I Year, 2nd semester

CALCULUS II

The course introduces the integration of functions of several variables with applications to areas and volumes computation. The basic integral formulas used in the field theory are also studied.
Topics: *Improper integrals and functions defined by integrals. Line integrals , total differentials. Double and triple integrals, areas and volumes computation. Surface integrals and applications. Integral formulas (Stokes, Gauss etc) and applications. Euler functions.*

PHYSICS I

The main objective is to learn the concepts, principles and technical vocabulary associated with areas of fundamental optics of very wide-ranging application and to lay the foundations for further studies in applied sciences and engineering. The course will describe the nature of light, its propagation, light – matter interactions and numerous applications of these phenomena. The students will be introduced to some modern equipment and techniques using optical phenomena.
Topics: *Fundamental concepts in optics (Light; Superposition of electromagnetic waves; Doppler effect; Reflection and refraction of light ; Optical fibers). Polarization (absorption, reflection, birefringence, scattering). Interference (Young's device, Fizeau's wedge; Newton's rings; Holography). Diffraction (Fraunhofer, Fresnel, Rayleigh).*

MECHANICS I

This course gives students basic and advanced concepts in statics and kinematics.
Topics: *Sliding vectors; Statics of the particle; Centers of mass ;Statics of the rigid body ; Kinematics of the particle; Kinematics of the rigid body; Particular motions of the rigid body; Kinematics of relative motion.*

ENGINEERING GRAPHICS II

The course is intended to learn the rules and conventions used in views and sections, to learn how to use tolerances of size form and position, to realize permanent and separable fasteners, gearings and packing.
Topics: *Sectional views. Production dimensioning. The achievement of the execution drawing. Assembly drawing. Representation of the component parts of permanent and separable joints, gear and gearings, bearings, seals.*

PROGRAMMING LANGUAGES

The students learn to use a programming medium such as Matlab and to apply the acquired programming skills to solve engineering problems.
Topics: *Computers, Operating systems, Programs; Computer solving Problems. Algorithms , Introduction in Octave, Writing Programs, Getting Help. Variables, Matrices, Operations, Plots. Strings, I/O Functions, Flow Control. Functions, File I/O Functions, Recursive Functions. Simple Algorithms: Max/Min, Sorting. Exhaustive Search, Simulation.*

MATERIALS SCIENCE II

The course presents the important classes of nonmetallic materials that will be put in intuitive relations with the properties awaited by the engineers (i.e. elasticity, hardness, ductility, tenacity, refractoriness, transparency, thermal conductivity, electric conductivity, etc). These characteristics will be discovered through close relations that exist between the microstructure and the macroscopic characteristics.
Topics*: Introduction to the science of materials nonmetal. The chemical liaison. Various states of the matter. Real crystal, defects. Polymers. Ceramics. Glasses and vitroceramics. Biomaterials. Composites. Composite binder systems. Cements and concretes. Thin layers.*

PROFESSIONAL COMMUNICATION II

The practical course continues the development of the four fundamental skills: listening, speaking, reading and writing. The main objective lies on the development of the student communicative competence in a professional environment.
Topics*: Company description. Activities within the company. Applying for a job. Job interviews. Typical grammatical structures in technical English.*

EUROPEAN CULTURE AND CIVILISATION II

The course is designed as an introduction to some major issues of European history and philosophy which may give an account of what does it mean to be European. The focus will be on the theoretical and historical roots of individualism, liberalism and rights versus collectivism, traditionalism and beliefs.
Topics: *VII. State of nature in Hobbes' view, in Locke's view; David Hume; Jean-Jacques Rousseau; VIII. Natural Rights Doctrine; IX. Classical liberalism; Individualism and liberty; X. Industrial Revolution; Herder; XI. Plato against democracy; Social utopia and human nature; XII. Ethical Socialism; Marxism; Nazism; Collectivism and elitism; XIII. The Idea of Europe.*

II Year, 1st semester

ADVANCED MATHEMATICS I

Attending this course, students assimilate theoretical knowledge, basic formulas and algorithms for solving problems of mathematical physics, fluid mechanics, electrical engineering, heat engineering and control engineering. This course improves abilities in using specialized software packages as: Matlab, Mathematica and Maple.
Topics*: Higher-Order Differential Equations. Systems of Differential Equations. Stability. Routh-Hurwitz criterion. Lyapunov functions. Complex Functions. Residues theory. Conformal mappings. Bilinear Transform. Operational Calculus. Laplace Transform. Z Transform.*

PROBABILITIES AND STATISTICS

The objectives of this course are: the formation of the capacities of handling the concepts of the probability and statistics by presenting them in direct relation with other sciences; the completion of the students knowledge with theoretical and applicative notions; the students will be able to understand applied models from reliability, queuing theory, random walk, data transmission, numerical simulation, physics and much more.
Topics*: The notion of probability. Geometric probability. Conditional probability. Applications to reliability. Sequence of independent trials. Limit theorem. Random variables. Distribution functions. Random vectors.*

Numerical characteristics. Correlation. Regressions. Characteristic functions. Classical laws via characteristic functions. Data representation and analysis. Estimation of parameters. Confidence intervals. Approximation theory in statistics. Least squares methods.

PHYSICS II

The course provides students with the basic knowledge of the modern (Quantum) Physics, as well as with the main applications of the specific mechanical, thermal, electrical, magnetic and optical properties of solid bodies. Also provides the necessary elements for the basic physical measurements and for the design of some devices and installations in the field of electrical, mechanical and chemical engineering.
Topics*: Foundations of quantum physics (origins, postulates, angular momentum, lasers and masers). The physics of condensed matter (dynamics of electrons, metals, semiconductors, dielectrics, superconductivity). Elements of the nuclear physics and elementary particles (structure, radioactivity, nuclear reactions).*

INTRODUCTION TO MECHANICAL ENGINEERING

The course develops a basic understanding of mechanical engineering design process and shows how engineers "communicate" (sketches, 2D drafting, 3D solid models, technical writing and presentations). It will also develop an understanding of engineering problem solving techniques. During laboratory activities students become familiar with basic 3D-solid modeling techniques in a project oriented environment (CATIA V5 software).
Topics*: An overview of Mechanical Engineering (machine, apparatus, mechanism, device, machine parts). Introduction to the Design Process (Materials and Manufacturing Processes. Fits and Tolerances). Engineering communication.3D-Solid Modeling.*

STRENGTH OF MATERIALS I

The course intends to familiarize the students with the modern methods used for the strength calculus of the mechanical structures. In tutorials the students become familiar with the methods intended to establish the necessary dimensions, verification and the strength capacity, together with the calculus of the displacements of bars for different loadings.
Topics*: Stresses, displacements, strains. Traction and compression. Torsion of straight bars. State of stress on inclined surfaces. Bending of straight beams. Deformation of beams loaded in bending. Shearing. Theories of resistance. Compound loadings. Buckling of compressed straight bars.*

MECHANICS II

The course provides the student with the capacity of understanding and modeling real world mechanical phenomena, giving students basic and advanced concepts in dynamics.
Topics: *Dynamics of the Particle, Theorems of Dynamics, Dynamics of the Constrained Particle, Dynamics of Relative Motion, Dynamics of a System of Particles, Moments of Inertia, Theorems of Dynamics for Rigid Body, Dynamics of the Rigid Body*.

ELECTRICAL ENGINEERING I

The contents is structured as to include the main theoretical aspects needed for the proper understanding of electromagnetic phenomena and their principal technical applications, particularly those of interest for a mechanical, material science or chemical engineer.
Topics: *Fundamentals of Electromagnetics and Electrical Circuits including: The theory of electromagnetic phenomena; Electromagnetic quantities; Laws and theorems of electromagnetic phenomena; Units of electromagnetic quantities; Direct current circuits; Alternating current circuits; Capacitor circuits; Coils and magnetic circuits.*

MANUFACTURING PROCESSES I

It presents the main groups of engineering materials, their use, properties, obtaining and manufacturing methods. It treats mainly about the form giving processes: casting, forming, powder metallurgy, joining. It presents both traditional methods and also state of the art processes (space manufacturing and composites manufacturing).
Topics*: Introduction (Manufacturing. Production. Business. Industry). Classification of the primary manufacturing processes. Metals (Metallurgy processes. Foundry. Forging. Joining). Ceramics. Plastics. Composites (Obtaining processes. Product design). Trends (space manufacturing).*

MICROECONOMICS

The students are instructed so as to have a critical view and identify both the virtues of the market mechanism and its potential failures. The main course is devoted to the study of basic concepts in microeconomics and it focuses on the three main economic partners (consumers, business firms and governments) and their respective behaviour in the market place.
Topics**:** *Basic Economic Concepts. The Founations of Microeconomics (The Consumer. Spending Choices. The Law of Diminishing Marginal Utility. The Consumer's Surplus. The Business Firm. Forms of Business Organization. Functions, objectives of a Business Firm. Input Decisions and the Cost of Production. Output-Price Decision. Profit Maximization. Total Profit. Total Revenue. Average Revenue. Marginal Revenue.). The Market Structure*.

PROFESSIONAL COMMUNICATION III

The practical course continues the development of the four fundamental skills: listening, speaking, reading and writing, started in the first two parts of the course. The main objective lies on the development of the student communicative competence of presenting visuals (tables, graphs, diagrams, charts) and their interpretation.
Topics**:** *Description of technological processes and operations. Reading and presenting visuals (diagrams, graphs...)*
Professional presentations. Setting up a company – project.

II Year, 2nd semester

ADVANCED MATHEMATICS II

The students can employ several methods which are based on Fourier analysis of signals and on some classes of special functions. Students obtain abilities to solve these problems by using specialized software such as MATLAB and Mathematica.
Topics**:** *Theory of distributions. Fourier and Laplace transforms of distributions. Orthogonality. Real and complex Fourier series. Orthogonal polynomials. Bessel's functions. Second-order partial differential equations. Reduction to the canonical form. Wave equation, heat equation. Initial value problems and boundary value problems. Dirichlet and Neumann problems. Variational Calculus. Functionals, Euler Equation, Euler-Lagrange system., Hamiltonian. Extrema. Optimal control.*

MECHANICS III

The course provides the student with the capacity to understand and model real world mechanical phenomena using Analytical Mechanics methods. The main steps start from the initial hypothesis, to the mathematical model, its solution and back to the understanding of the phenomena.
Topics: *Principles of Analytical Mechanics. Principles of Virtual Work. Toricelli's Principles. D'Alembert Principles Lagrange Equations for Holonomic Systems. Prime Integrals. Lagrange Equations for Non-Holonomic Systems. Lagrange Equations for Holonomic Systems with Dependent Variables. Hamilton Canonical Equations.*

STRENGTH OF MATERIALS II

The objective is to study the behaviour of solid bodies under load and also to carry out strength and displacement analyses for a variety of engineering components and structures. It introduces the major techniques of experimental stress and strain measurement, calculation of the stresses and strains which occur in several mechanical structures.
Topics: *Statically indeterminate systems. Introduction in Theory of Elasticity. Theories of elastic failure. Complex stresses and strains. Struts. Impact loads. Fatigue. Plates , thin-walled cylinders, thick cylinders. Experimental stress analysis.*

NUMERICAL METHODS

Students will be able to enlarge their calculus possibilities in various fields of engineering by using numerical modelling. Simplification of general representations by using function approximations, processing of experimental data, optimization, dynamical behaviour of various phenomena etc., is easier achieved via numerical computation.
Topics*: Introduction to Numerical Methods. Numerical approximation of functions (interpolation, mini-max approximation, least square approximation). Numerical solution of algebraic equations. Numerical solution of differential equations.*

MANUFACTURING PROCESSES II

The course objectives are to achieve knowledge concerning the integration of fabrication with product design from machining to quality control and the practical abilities with basic machine tools such as lathes, mills, drills.
Topics: *General introduction. Process engineering. Basics of machining processes (cutting, machinability). Conventional machining processes (drilling, reaming, sawing, broaching, planning, shaping, slotting, milling; threading; gear production). Finishing and coating processes. Non-traditional machining processes. Quality control. Manufacturing management (cost estimating and control).*

ELECTRICAL ENGINEERING II

The aim of the course is to understand the electromagnetic phenomena and their principal technical applications, particularly those of interest for a mechanical, material science or chemical engineering, to present a fairly sufficient part of electrical engineering topics that will enable the student to feel at ease with electromagnetic applications, such as electric machines and apparatus.
Topics: *Simulation of electromagnetic field applications; Measurements of electromagnetic quantities; Measuring instruments; Electric machines and apparatus (her electric transformer, direct current machines, asynchronous machines, synchronous machines, electric apparatus, electric drives).*

MACHINE ELEMENTS AND MECHANISMS I

Being the first in a series of three courses which can be considered the "spinal column" of mechanical engineering education this course is focused on general purpose linkages and cam mechanisms and on general purpose rigid or elastic joints.
Topics*: Design principles. Introduction to Mechanisms (Planar linkages. Cam mechanisms). Threaded fasteners and power screws. Hub-on-shaft joints. Springs (Helical Springs. Torsion Bar. Leaf Springs. Friction Ring Springs Elastomeric Springs).*

MACROECONOMICS

The Macroeconomic Model is explained and analysed from the two perspectives: the Classical and the Keynesian Approach. The main course is devoted to the study of basic Macroeconomic Outcomes (economy's output, fluctuations in economic activity, economic instability with its two evils – unemployment and inflation - and the main outlines for the policies for economic stability and growth).
Topics*: The Realm of Macroeconomics (Economic Aggregates; Classical Approach; Keynesian Approach). Economy's Output (National Product; National Income; Economic Welfare). Economic Instability. Major Problems of Economic Instability (Unemployment, Inflation, Phillips Curve, Wage-Price Spiral).*

PROFESSIONAL COMMUNICATION IV

The practical course continues the development of the four fundamental skills: listening, speaking, reading and writing, started in the first three parts of the course. The main objective lies on the development of the student reading skills and academic writing (essays, technical reports, graduation theses).
Topics*: The decision making process. Debates. Professional meetings. Academic writing – technical reports.*

III Year, 1st semester

FINITE ELEMENT ANALYSIS

The course objectives are to ensure that students have achieved a familiarity in working with matrix methods and developing stiffness matrices, an understanding of global versus local coordinate systems, the ability to use virtual work equations, mapping from isoparametric space to real geometrics and the use of equilibrium, compatibility, stress/strain relations and boundary conditions.
Topics*: Introduction. Fundamental structural analysis. Stiffness and inertia matrices for slender beams. Elementary elasticity of a continuum. Finite elements based on displacement fields. Isoparametric elements. Two dimensional field problems. Concluding remarks on F.E.A.*

ENGINEERING THERMODYNAMICS

The course presents the theoretical bases of Thermodynamics and some of its applications, Thermal Machines. It applies the fundamentals of Thermodynamics to real-world applications of Energy Conversion. The presentation is focused on the application of the most general laws of science, the First and Second Law of Thermodynamics, to various areas of engineering.
Topics: *Basic Concepts of Thermodynamics. Properties and Laws of Ideal and Perfect Gas. Gas Mixtures. First Law of Thermodynamics. Thermodynamic Processes. Second Law of Thermodynamics. Vapor and Steam Power Plants. Thermodynamics of High-Speed Fluid Flow*.

FLUID MECHANICS

The course gives a general overview of the principal chapters of fluid mechanics and introduces the specific methodology for solving some of the most common problems in applied hydrodynamics. The course is focused in obtaining solutions for laminar flows of viscous and viscoelastic incompressible fluids, with applications to hydrodynamics of hydraulics devices and circuits. A special attention is giving to the correlation between analytical and numerical solutions in fluid mechanics (numerical codes: FEMLAB, FLUENT, Mathematica).
Topics: *Continuum media; rheological properties of fluids; diffusion. Boundary conditions. Forces and stresses in fluids. Fluid Kinematics; Stream functions and stream tubes. Conservation of mass, momentum and energy; particular solutions. Bernoulli equation. Navier-Stokes equation. Stokes 2D solutions; Hele-Shaw flow; Thin films hydrodynamics (Reynolds equation). Laminar and turbulent motions.*

CONTROL THEORY

The course contains general knowledge about the role, structure, operation, design and proper use of the control systems; modelling, simulation and dynamic identification of the control systems are also presented. It presents a comprehensive treatment of the analysis and design of the continuous – time control systems. All computational problems are solved with Matlab and Simulink. The technical applications are solved by Automation Studio and AMESim.
Topics: *Structure of Control Systems. The Laplace Transform. Mathematical Modelling of Control Systems. Transient-Response Analysis. Root-Locus Analysis. Control Systems Design. Frequency-Response Analysis. PID Controls and Introduction to Robust Control. Analysis of Control Systems in State Space. Liapunov Stability Analysis and Quadratic Optimal Control.*

APPLIED MECHANICS OF MATERIALS

The course aims to develop the understanding of elastic behaviour, by a more general matrix formulation and, on this basis, extend it to anisotropic materials. Further on, the course aims to introduce basic formulations for material nonlinear problems, focusing on yielding criteria applied during plastic deformation, as a milestone in the description of various types of failure for materials.
Topics: *Basic equation in theory of elasticity in matrix formulation. Isotropic materials; Extension to anisotropic materials. Main failure modes for materials and structures: under static and dynamic loading, under simple and combined loads, buckling and creep. Structural imperfections. Dislocations and voids, hardening mechanisms. Theoretical limits of strength. Fracture mechanics (crack; brittle fracture; Griffith's criterion; linear elastic fracture mechanics; ductile fracture; J-integrals). Toughening mechanisms. Fatigue of materials. Elements of smart design. Structural optimization.*

MACHINE ELEMENTS AND MECHANISMS II

The course is intended to provide the student with a clear and thorough understanding for both the theory and application of the fundamentals of general-purpose machine elements. The second in a series of three courses which can be considered the "spinal column" of mechanical engineering education this course is dedicated to rotating machine elements.
Topics: *Basics of Tribology (friction and wear). Shafts and Axles. Sliding bearings. Rolling-element bearings. Seals. Couplings (rigid, compensating couplings, clutches, brakes).*

MANUFACTURING PROCESSES III

The course presents the basic notions of cutting processes, parameters involved in cutting speed and feed calculation, correlation between different types of cutting tools and processed materials in connection with the indications of some important producers and their catalogues; understanding of the CNC machine tool structures, flexible manufacturing and fabrication lines. The course presents also the fundamentals of computer aided manufacturing – CAM applied in programs such as EasyCAM, Catia.
Topics*: Material Properties. Metal Cutting (Sawing, Shaping, Broaching, Drilling, Reaming, Boring, Tapping, Grinding and other Abrasive machining processes, Honing, Lapping, Turning, Milling). CNC machines and systems. CNC programming. Mill parts programming*.

MONEY AND BANKING

After an introductory chapter that makes reference to economic fluctuations, the main policy levers used by government to restore equilibrium and growth are described; a chapter is devoted to World Economics, where international trade and finance and international comparisons bring more evidence about money and banking in the global market.

Topics: *The macroeconomic model. Policies for Economic Stability and Growth: Fiscal Policy, Monetary Policy, Global Macroeconomics. World Economics: International Trade, International Finance, Sustained Economic Development.*

III Year, 2nd semester

HEAT AND MASS TRANSFER

This course acquaints students with the underlying principles of conduction, convection and radiation heat transfer, as well as of mass diffusion and convection. Analytical and numerical methodologies are presented for solving steady and transient problems with one or more spatial dimensions. Related topics of contemporary interest to industry will also be considered in terms of homework problems, design problems, and worked examples.

Topics*: Course Description and Introduction to Heat Transfer. Conduction Heat Transfer. 1-D Steady Heat Conduction. 2-D Steady Heat Conduction. Transient Conduction. Convection Heat Transfer. Forced External Convection. Forced Internal Convection. Free Convection. Heat Exchangers. Radiation Heat Transfer. Phase Change. Mass Transfer.*

DYNAMICS OF MACHINERY

The objective is to ensure a basic understanding of vibration principles in order to guide the diagnosis and elimination of vibration problems and also to present dynamic phenomena in rotating and reciprocating machinery.

Topics: *Natural frequencies. Vibration isolation. Damping. Frequency response. Natural modes of vibration. Torsional vibrations. Geared systems. Vibration dynamic absorber. Stiffness and inertia matrices for bars and beams. Assembly. Modal analysis of vibrating systems. Matrix iteration method. Damping matrices. Finite element analysis of vibrating systems. Vibration limits. Precession of rotors. Critical speed map. Campbell and stability diagrams. Calculation of unbalance response. Finite element modelling of actual rotor-stator systems. Vibration in machines with hydrodynamic bearings, with rolling bearings. Diagnosis. Vibration measurement. Specific faults. Computer assisted vibrodiagnosis.*

MECHANICAL TRANSMISSIONS

The course is intended to provide the student with a clear and thorough understanding for both the theory and application of the fundamentals of mechanical transmissions. The presentation points out static and fatigue failure theory and analysis as well as the synthesis and design aspects of a wide variety machine elements. The course offers the basic knowledge for the design of mechanical components.

Topics: *Basics of power transmissions (functional characteristics of driving and driven machines). Gears and gear reducers (fundamental law of meshing, spur, helical, bevel, worm gears). Belt drives (flat belts, V-belts). Friction transmissions (modes of failures and strength calculation). Speed variators. Chain transmissions.*

MECHANICAL MEASUREMENTS

The course gives the capability of an engineer to make judicial choice and to be able to balance (often hyped-up) manufacturer info and the reality of the measurements chains, instruments and transducers limitations, to get familiar with different types of measurement systems/devices for engineering measurements, to handle different types of measurement signals and utilize this capability to obtain reliable measurement results, to make a simple uncertainty analysis. Knowledge of the computerized data acquisition systems, virtual instruments, and of the DAQ software LabView is presented.

Topics: *Introduction to measurement. Measurement systems. Signals and data transmission. Transducers. Conditioning systems signals. Processing experimental data. Presentation of scientific experimental results. Force and torque measurement. Pressure measurement. Strain measurement. Displacement & velocity measurements. Temperature measurements.*

APPLIED FLUID DYNAMICS

The course introduces various applications of fluid mechanics in engineering science, presents general principles which govern fluid mechanics. The laboratories are dedicated to the representation of the flows, especially in relation to the flow visualizations techniques and corresponding numerical solutions.

Topics: *General principles of fluid mechanics. Numerical solutions of Navier-Stokes. Laminar-turbulent transition. Boundary layer concept. Introduction in turbulence; k-ε model. Analysis of 2D and 3D flows in finite and infinite domains. Relative motions. Jets hydrodynamics. Unsteady flows. Micro-fluidics. Complex fluids.*

COMPUTATIONAL STRUCTURAL MECHANICS

The course introduces the basic equations describing the behaviour of the particular material or structure under a certain loading, to mention the basic requirements needed to get a robust model and to present some well-known tools to solve a certain load case. The student will achieve basic knowledge in the calculus of advanced structures.
Topics: *Thin walled beams; Shear bending; Free torsion; Specific failure modes. Composite materials and structures. Macromechanics of a lamina. Stress-strain relations. Stiffness and compliance matrices. Strength of a lamina. Micromechanics of failure. Failure mechanisms. Elastic behaviour of layered composites. Strain-displacement relations. General load-deformation relations. Laminate stiffness and compliance coefficients. Nonlinear mechanics of structures. Failure under nonlinear and anisotropic assumptions.*

MACHINE DESIGN PROJECT

This project, which is in strong relationship with the courses "Machine Elements and Mechanisms" and "Mechanical Transmissions" introduces students to the design of mechanical components and provides the base for professional practice for the design of machines. The main goal is to provide students the ability to utilize specific design tools needed to execute a design. This activity, with a thorough individual character, gives the opportunity to solve a real technical problem, i.e. a complex mechanical transmission including a gear reducer box, a belt transmission and couplings. The final form of the project that includes a Technical Report, 2D assembly drawing, detail drawings and a 3D solid model, allows the materialization all the past knowledge acquired during the first 3 academic years.

BUSINESS ADMINISTRATION

Students are instructed how to approach the business environment, to come down to market research and product development, to develop the marketing mix and finally to communicate with all stakeholders of a company. The students are instructed to take a proactive attitude so that their economic efforts should be rewarded.
Topics: *Marketing and its Environment. The Company and its Environment. The Buyer Behaviour and Target Market Selection. Distribution Decisions. Pricing Decisions. Promotion Decisions*.

INDUSTRIAL INTERNSHIP

IV Year, 1st semester

SOFTWARE TOOLS FOR MECHANICAL ENGINEERING

The course presents lessons and applications of software tools from math calculus and representation (MathCAD) to drawing and design machine elements (CADdy++ Mechanical Engineering with feature modelling). Based on a core of CAD activities students learn the concept of total design and structural analysis by Finite Element Analysis (Cosmos). The main part of activities is dedicated to learn and deal with advanced CAE/CAD/CAM concepts to create innovative products into integrated systems using I-DEAS software, to exchange CAD information and to create synchronized databases as a result of collaborative and parallel task.
Topics: *Design Process. Calculus elements and soft packages for design projects (MathSoft -MathCad). Concurrent Engineering Principles and Environment. Integrated manufacturing systems. CAE analysis- Finite Element Analysis. Product Life Cycle. Data Exchange Procedures. Supplier Interaction.*

HEAT ENGINES I (Internal Combustion Engines)

The course provides the concepts on knowledge about structure, operating, design and practice of the internal combustion engines. In this sense, fundamental bases for engine design are discussed as well as development and manufacturing. In the same time the main parameters which characterize performance are emphasized, efficiency and emissions which are produced by spark ignition and diesel engines. There is discussed in detail the influence of different parameters on engine's characteristics, the reliability and manufacturing and service costs. The engine's operating processes are analysed from point of view of thermodynamics, combustion development, fluid flow, heat and mass transfer and effects of fuel's chemical and physical properties.
Topics*: Introduction. Gas exchange processes. Combustion in Spark – Ignition Engines. Combustion in Compression – Ignition Engines. Heat transfer. Engine mechanism.*

TRIBOLOGY

Cross-disciplinary course intended to provide the student with a clear and thorough understanding of friction and wear phenomena caused by the relative motion between interacting elements, basic principles of lubrication, and tribological designs of machine elements and systems.
Topics*: Introduction. Surface topography. Lubricants properties. Fluid friction (Constant gaps. Parallel step sliders. Reynolds equation. Plane inclined slider. Journal bearings. Squeeze films. Hydrostatic lubrication.*

Mechanical seals. EHD/ EHS lubrication). Dry friction (adhesion theory, ploughing effect). Rolling friction. Boundary friction. Wear (abrasive and fatigue wear).

ADVANCED MANUFACTURING PROCESSES AND QUALITY ASSURANCE

The course provides the students with basic knowledge concerning concepts, principles and standards related to quality, in compliance to the ISO 9000 series standard. An in-depth understanding of quality philosophy and quality culture in organization will be pointed out. Case studies from different sectors and tools to be applied in order to improve the processes are envisaged for better understanding and quality principles implementation towards quality certification and finally, quality awards.
Topics*: Quality. Quality assurance. Certification. Quality costs. Quality audit. Quality control. Quality management.*

MECHANICAL ENGINEERING PROJECT

The main objective of the course is to teach the fundamentals of finite element method with emphasis on the underlying theory, assumptions, and modelling issues and complementing this with providing experience in using finite element software to model, analyse and design simple mechanical structural systems. Most of finite element calculations are backed up with initial estimates from simple closed form analysis. Matrix theory is used to show the basic unity in finite element analysis. The course also focuses on CAD Product Data Exchange using both Direct Database conversion and International Standards based conversion methods between major CAD/CAE systems.
Topics*: Introduction to MSC Patran/Nastran element types. MSC Patran geometric modeling. Working with importing CAD models (Catia, Pro/Engineer, IGES, etc). Load and boundary condition application. Checking the geometry and finite element model. Results post processing.*

FLUID CONTROL SYSTEMS

General knowledge about the role, structure, operation and proper use of the fluid control systems as general purpose power transmissions; modelling, simulation and dynamic identification of the systems controlled by the aid of fluids.
Topics*: Structure of fluid control systems. Hydraulic fluids properties and selection. Fluid flow fundamentals. Hydraulic pumps and motors. Hydraulic control valves. Hydraulic power elements. Electro hydraulic servo valves. Electro hydraulic servomechanisms. Hydro mechanical servomechanisms. Nonlinearities in control systems. Pressure and flow control valves. Hydraulic power supplies. Pneumatic drives.*

ELECTRONICS

The course is focused to various aspects of electronic devices and circuits, being oriented to applied and technological electronics issues necessary to be known for design and manufacturing of electronic modules and systems.
Topics: *An introduction in electronics, electronic products development stages and main emerging electronic technologies. The passive electronic components and circuits. Printed circuit boards. Active discrete components and semiconductor and p-n junction properties Analogue electronic circuits: amplifiers, negative and positive feedback, integrated analogue components and circuits, operational amplifiers. Digital electronic circuits.*

FOUNDAMENTALS OF MANAGEMENT

The course objectives are to understand the role and importance of management in the future activity of graduates and to understand the basic technical and economic notions.
Topics: *Management – art or science? Managers. Foreseeing in management. Activity organization. Directing employees. Coordination and control.*

IV Year, 2nd semester

REFRIGERATION AND AIR CONDITIONNING (HVAC)

The objectives of the course are to teach students about choosing the refrigerating flowchart depending on the temperature level of the cold chamber, on location of the refrigerating system and on the input supply; optimizing the refrigerating flowchart depending on the chosen refrigerating agent; calculating of the refrigerating system; calculating of the air conditioning system for summer and winter seasons.
Topics: *Refrigeration systems. Classification of refrigerating units. Vapour-compression refrigeration system (One stage, Conventional regimes, Two stages, Cascade). Absorption refrigeration systems. Air conditioning systems.*

ENVIRONMENTAL ENGINEERING

The course focuses on the complex process of natural and artificial pollutant gaseous emissions and the main types of installations used to reduce the pollutant emissions at an industrial scale. A special chapter is dedicated to pollutant monitoring devices and their selection criteria.
Topics: *Introduction to air quality. Industrial air pollution sources. Pollutant emissions from chemical process industry. Pollutant emissions from iron and steel industry. Pollutant emissions from aluminium industry. Pollutant emissions from mobile sources. General theoretical aspects concerning formation of gaseous pollutant emissions. Particulate emissions. Human health visible effects. Gaseous pollutant emissions. Gas analysers.*

HEAT ENGINES II (Turbines & Steam Generators)

This course is dedicated to the complex process of classic and alternative fuels sustainable utilization to produce heat, to transfer it to a pressurized cooling agent and to produce steam to run a power system. Alternative fuels and their use are treated together with adequate technical solutions. Applications of steam boilers include local heating of the buildings, heat storage, industrial power installations and great scale power systems, solar fed steam boilers and nuclear installations. The objectives include: to choose the optimized technical solution for local/industrial heating installation; to optimize the burning process of the classic/alternative fuel; to calculate the heat transfer process inside the boiler system; to assess the stress capability of the pressure parts of the steam generator; to calculate the thermal and the cost efficiency of a heating installation.
Topics: *Fuels' characteristics determination. Gas burners characteristics. Coal burners characteristics. Thermal analysis by Fluent.*

INDUSTRIAL MANAGEMENT

The course objectives are to understand the role and importance of management in the future activity of graduates; to understand the basic technical and economic notions, to familiarise with the specific scientific vocabulary and with the basic tools used in industrial management; to acquire skills in approaching the decision process through information and calculus.
Topics : *Introduction in industrial management. The conception and erection of an industrial company. The management of production activities. The management of human resources activities. The management of commercial activities. The management of finance and accounting activities.*

DIPLOMA PROJECT