UNIVERSITY "POLITEHNICA" OF BUCHAREST
FACULTY OF ENGINEERING IN FOREIGN LANGUAGES
MECHANICAL ENGINEERING in ENGLISH LANGUAGE, 2025-2026

CONTENT OF THE LECTURES FROM THE STUDY PLAN
14 Weeks/semester

Legend: "**Ver**" = evaluation form (**E**=exam in exam session, **C** or **V** = semester evaluation)
"**C**" = Lectures (hours/week); "**S**" = Tutorial; "**L**" = Labwork; "**P**"=Project

From the *optional subjects*, only one of the two will be taught, depending on students' choice.
The *facultative subjects* will be taught only if a sufficient number of students choose them, to form the group.

I Year, 1st semester

Nr. crt.	Denumirea disciplinei	Nr. ECTS	Ore/săptămână				Forma de evaluare
			C	S	L	P	
Discipline Obligatorii (Ob)							
1	Analiză matematică 1 /Calculus 1	4	2	2			E
2	Algebră liniara , geometrie analitica si diferentiala /Linear Algebra Analytic and Differential Geometry	4	2	1			E
3	Desen tehnic si infografica 1 /Engineering Graphics and Infographics 1	3	1		2		V
4	Chimie /Chemistry	3	1		1		E
5	Stiinta si ingineria materialelor 1 /Materials Science	4	2		1		E
6	Comunicare profesionala (in lb. engleza) /Professional Communication	2		2			V
7	Educatie fizica si sport 1 /Physical Education 1	3		2			V
8	Informatica aplicata /Applied Informatics	4	2		2		V
9	Mecanica 1 /Mechanics 1	3	2	1			E
Discipline facultative (F)							
10	Limba franceza pentru ingineri 1 /Langue francaise pour ingenieurs 1	2		2			V
11	Limba si cultura romana pentru studenti straini 1 /Romanian language and culture for foreign students	2		2			V
12	Psihologia educației	5	2	2			E
13	Voluntariat 1	3					V

CALCULUS I

Calculus 1 continues the theory of functions of one single variable (from the college); in the first part it contains: real and complex numbers, sequences and series of numbers, sequences and series of functions. In the second part, the differential calculus of functions of several variables is presented: partial derivatives, the differential, extrema and conditional extrema, implicit functions.

Topics: *Real numbers. Complex numbers. Series of real and complex numbers. Sequences of functions. Series of functions. Taylor Polynomials. Power Series. Elementary functions. Euclidian Spaces. Partial Derivatives. The Differential. Extrema of functions of several variables. Implicit functions. Conditional Extrema.*

LINEAR ALGEBRA

The course aims to enable good understanding and handling of the main linear and affine quadratic - based algebraic and geometric objects, and present them in direct relation with other sciences.

It provides basic knowledge of linear (vector) spaces and linear mappings, orthogonality (including the Gram Schmidt process, norming, orthonormal bases), spectral theory of linear operators (including eigenvalues, eigenvectors, the diagonal and the Jordan forms), orthogonal curvilinear coordinates, quadratic forms, free vectors and their main operations (including scalar, cross, mixed and double cross products), quadratic objects in 2D (conics), and linear & quadratic objects in 3D (including straight line, plane, and quadrics). It emphasizes the relevance and consequences of the linear/quadratic character of the specific objects towards their efficient use in real-life models.

Topics: *Vector spaces. Linear transformations. Eigenvalues and eigenvectors. Bilinear and quadratic forms. Free vectors. Equations of straight line and plane. Changing of frames; conics. Quadrics.*

ENGINEEING GRAPHICS AND INFOGRAPHICS I

Engineering Graphics and Infographics 1, on which designing, project making and manufacturing are based, is one of the most important study disciplines in superior technical education. Engineering Graphics is a science and a language too; it's a tool of knowledge, communication and social interaction. The components of this science are: Descriptive geometry, Technical drawing, and Computer graphics. Descriptive Geometry establishes laws which are to enable the representation of spatial objects and of spatial situations. These laws (rules) are coming directly from the elementary geometry. Technical drawing relies on orthogonal (orthographic) projection, which supplies the best conditions for describing shape of an object, and it is best fitted to make dimensioning, which is the second function of a technical drawing.

Topics: *The representation of the basic geometrical elements of the three-dimensional space by the double and three orthogonal projection. The box of projections, graphic elements of dimensioning. The surfaces generation. Sectioning and intersecting of surfaces. Threads' and flanges' representation, threaded fasteners.*

CHEMISTRY

Nowadays an important accent is on the interdisciplinary character of the researchers. Chemistry is involved in all technical activities, not only at the level of materials, environmental protection, but also directly, through processes of chemical nature. The basic knowledge about chemical reactions and systems involved in chemistry is the key condition for understanding particular chemical aspects of different non-chemical engineering fields. The modern devices are based on new materials and a future engineer needs to possess knowledge about chemical structure and physic-chemical properties in order to be able to design new intelligent materials. This discipline insists on the structure and the properties of the most important materials in the nanomaterials era, on the possibility of spontaneous evolution of processes and insists also, on the electrode processes study, to understand the phenomena that govern device performance. The knowledge obtained during the course allows a better understanding of chemical processes in which engineers specialized in mechanics can be involved and the possibility to collaborate with specialists in the field of chemistry.

Chemistry is one of the fundamental sciences that studies the structure of substances and their properties, looking at the same time on the effect of chemical reactions on substances. The progress in engineering registered in the last decades is due to the development of technology to obtain materials with reliability, longevity, precision, reduced weight and special properties. In order to achieve these performances, the knowledge about the structure and properties of materials, the possibility of spontaneous evolution of chemical or physical-chemical processes, the thermal effects that accompany these processes and their progress rate, as well as the possibility of obtaining renewable energies are essential.

The Chemistry course provides an introduction to the main concepts necessary to train an engineer capable of adapting to the requirements of the market economy and new technologies.

In this way, the graduates are provided with adequate competences with the needs of the current qualifications and a modern, quality and competitive scientific and technical training, which will allow them to be employed quickly after graduation, being perfectly framed in the policy of the National University of Science and Technology POLITEHNICA from Bucharest, both from the point of view from the point of view of content and structure, as well as from the point of view of the skills and international openness offered to students.

Topics*: Correlation between chemical structure and properties of materials (1.1. Ionic, covalent and metallic bonds formation. Examples of chemical substances used in electronics (in crystalline, amorphous, liquid, liquid crystal state); 1.2. Surface phenomena. Adsorption. Colloids. Sol-gel processes. Micro and nano-dispersions. Membrane processes; 1.3. The influence of chemical structure on electrical, magnetic and optical properties of the substances. Applications on chemical and biochemical sensors; 1.4. Organic macromolecular compounds with applications in electronic*

industry; 1.5. Organic/inorganic Semiconductors). Thermodynamics of chemical processes (2.1. Intensive and extensive state parameters; 2.2. Thermal effects of chemical processes at constant pressure and volume. Hess Law. Kirchhoff Law; 2.3. Thermodynamic functions: entropy, free energy, free enthalpy, correlated with chemical affinity. Chemical potential; 2.4. Phase Equilibriums, Phases Rule. Phase diagram for a pure compound. Vapor pressure. Using of Phase Diagrams in substances separation and purification; 2.5. Chemical equilibrium. Principle of chemical equilibrium evolution. Relationship between thermodynamic functions and equilibrium constant). Kinetics of chemical reactions (3.1. Kinetic parameters: chemical reaction rate, rate constant, reaction order, molecularity, activation energy. Simple and complex reactions; 3.2. Homogeneous chemical reactions. Reactions of 1st and 2nd order; 3.3. Heterogeneous reactions. Corrosion of metals and semiconductors in dry gases. Catalytic reactions; 3.4. Chain reactions. Photochemical reactions; 3.5. Molecular theories in chemical kinetics. Molecular collisions. Theory of activated complex). Electrochemistry (4.1. Subject matter. Electrochemical cells. Electrical double layer; 4.2. Electrolytes. Ionic equilibrium. Electrical conductivity of electrolytes; 4.3. Electrochemical reactions. Electromotive force and thermodynamic functions of the reactions. Electrode potential. Electrodes types. Activity series of the elements. Polarization and over-potential;4.4. Electrochemical power sources. Primary, storage and fuel cells; 4.5. Electrolytic processes in electronic devices technologies). Corrosion (5.1 Definition and classification; 5.2. Chemical and electrochemical; 5.3. Electrochemical corrosion. Thermodynamics and kinetics of corrosion process; 5.4. Anticorrosive protection methods).

MATERIALS SCIENCE I

The main objective of the lectures is to give a general information on the metallic materials required for the mechanical engineer as well as for the metallurgist engineer to select materials and predict their behavior during service. To accomplish its task in using and selecting materials the engineer has to possess a solid knowledge on the physical and chemical bases of the properties of metallic materials. 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. Fundamental knowledge is provided on the influence of structure considered at various levels (macroscopic, microscopic, crystallographic, inter-atomic and subatomic level) for a better use of traditional metallic materials and to an opening to the use of advanced materials. Reliability in the service of metallic products would be thus secured.

Topics: *Nature, structure and properties of metallic materials. Mechanical properties. Classification of engineering materials. Microscopic and crystallographic structure of metallic materials.*

Crystallographic planes and directions. Polymorphism and allotropy. Imperfections in real crystals. Lattice defects (point defects, line defects, plane defects). Elastic distorsions of the crystal lattice. Atomic vibrations in the crystal lattice. Nature of phases in engineering materials and their thermodynamic stability. Solid solutions. Intermetallic compounds, definite compounds, intermediate phases. Phase equilibrium diagrams of alloy systems. Structural transformations associated to solidification of metals and alloys. Structure of the melt. Solidification mechanism: homogeneous nucleation, heterogeneous nucleation, crystal growth. Defects found on metallic castings. Structural transformations associated with plastic deformation of metals and alloys. Strengthening mechanisms of metallic materials. Solid state transformations and heat treatments in steels and cast irons (Fe-C phase equilibrium diagrams, TTT diagrams, diffusionless martensitic transformation, type of heat treatments). Solid state transformations and heat treatments in alloy steels (influence of alloying elements, classification and representative groups of alloy steels). Solid state transformations and heat treatments in non-ferrous metals and alloys (precipitation hardening in Al, Mg, Ni, Ti, Cu alloys).

PROFESSIONAL COMMUNICATION

The practical course (seminar) English language – Professional Communication 1 is addressed to Romanian and foreign students in year I, of the FILS and it has as its general objective the development of the communicative competence of the students in English which is used as a medium of instruction in FILS. Stress is placed on the four fundamental components: listening, writing, reading and oral communication, developed on the basis of the adequate grammatical and lexical support corresponding to the required level. The teaching of this subject has the following secondary objectives: the capacity to use in real contexts communication situations adequate to simple/phraseological units incorporating cultural and civilization connotations, adequately using the necessary lexical and grammatical structures, with a focus on those structures encountered in the academic technical study in English.

Topics: *Grammar: Verb revision: Particularities in using the following tenses: Simple present, present perfect. Oral communication activities/ listening on various topics of general interest, acc to thematic units chosen / Grammar: Verb revision: Particularities in using the following tenses: Simple past, past perfect. Reading activities and testing understanding of certain texts and exercises of vocabulary enrichment on various general interest topics, acc to thematic units chosen/ Grammar: Revision of passive voice. Oral communication activities/ listening on various topics of general interest, acc to thematic units chosen / Grammar: Revision of indirect speech. Reading activities and testing understanding of certain texts and exercises of vocabulary enrichment on various general interest topics, acc to thematic units chosen. / Grammar: Revision of conditional mood. Reading*

activities and testing understanding of certain texts and exercises of vocabulary enrichment on various general interest topics, acc to thematic units chosen. Exercises of word formation by affixation. / Revision /Final written test.

PHYSICAL EDUCATION I

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.

Topics: *Athletics: Elements of the running school, Jumping. Gymnastics: front and band exercises. Aerobic Gymnastics: exercise complexes. Applicative trails combined with running, balance, escalation, crawling, climbing, transport. Sports games: basketball, football, volleyball. The global practice of playing on small fields.*

APPLIED INFORMATICS

The course has as main objective to provide an overview of the computer operating systems. This course aims to introduce basic concepts and mechanisms of modern operating systems and virtualization. The emphasis is on principles and organization of operating systems, but also on practice, so as to illustrate key concepts in a practical context. At the end of the course, the students will understand some of the basic concepts concerning computers operating systems. At the end of the course, the students will be able to configure basic computer operating systems, interconnect two or more computers, and to apply basic security and protection to operating systems.

Topics: *As introduction/background, a brief reminder about computers organization and structures of computer systems. OS viewed as a service; OS as a resources manager; general organization of an OS. Process management, threads and multithreading, inter-processes communications. Memory management, allocation strategies, virtual memory. Input and Output devices; principles of I/O hardware; principles of I/O software; interfacing; devices management. Data storage management, file system structure; editing and file systems management, file system implementation, protection mechanisms, network-based file systems. Virtualization systems. Networking and interconnection. Security issues.*

MECHANICS I

This course gives students basic and advanced concepts in statics and kinematics. The course presents the most important notions, principles and study methods of the statics and of the kinematics of absolute motion. Students are familiarized with:

– interaction and mechanical constraints between bodies;
– equilibrium conditions of bodies and systems of bodies;
– kinematic characteristics of the motion of a material point and of a rigid body, respectively.

Applications are conceived so that students should:

– learn how to model mechanical systems ;
– develop the ability to apply the studied theoretical principles and methods, in order to analyze the mechanical systems;
– know and compare the applicability conditions, the advantages and the limits of various methods.

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.*

LANGUE FRANCAISE POUR INGENIEURS 1

This discipline aims to facilitate the development of students' skills to use specific grammar and vocabulary elements of the French language, in a professional/technical-scientific context, as well as their ability to work individually and in a team.

The discipline addresses as a specific subject the basic notions of grammar, lexicon and professional communication, all of which contribute to the training of students in professional communication skills in French. The study of this discipline facilitates the acquisition of skills to present and interpret concepts, facts and opinions, in oral and written form (listening, speaking, reading and writing) and the development of skills of mediation and intercultural understanding, so that the future engineer can interact appropriately in social, professional and culturally diverse contexts outside of school.

ROMANIAN LANGUAGE AND CULTURE (FOR FOREIGN STUDENTS) I

The practical course (seminar) of Romanian Language, Culture and Civilization is addressed to the foreign students in the first year, enrolled at the Faculty pf Engineering in Foreign Languages and has the following general objective: the development of students' communication competence with a focus on the four fundamental skills: listening, writing, reading and speaking. Moreover, it is important to mention the following secondary teaching objectives: the capacity to use in real communication contexts simple and complex vocabulary structures with reference to cultural and civilization conotations, as well as the capacity to adequately use the grammar structures.

Topics: *Teaching pronunciation patterns. Greetings and introdction dialogues. Talking about you. The time, seasons and months of the year. Teaching basic grammar notions: the article, the plural of the nouns, the numeral, the gender of the nouns, prepositions, the present indicative of the verb. Teaching basic vocabulary in context and language functions.*

PSIHOLOGIA EDUCAȚIEI

Course objectives:

- Understanding Psychological Principles: Equip students with a foundational understanding of key psychological theories and principles as they apply to educational contexts.
- Development of Communication Skills: Enhance students' abilities in listening, writing, reading, and speaking, focusing on how these skills are developed and can be improved in educational settings.
- Application of Psychological Concepts: Enable students to apply psychological concepts and theories in real-world educational scenarios, understanding how psychological principles can inform teaching strategies and student learning.
- Critical Thinking and Analysis: Foster critical thinking and analytical skills by engaging with research and case studies in educational psychology, encouraging students to critically evaluate different educational practices and their psychological underpinnings.
- Classroom Management Techniques: Provide students with strategies and techniques for effective classroom management based on psychological principles, helping them to create a positive and conducive learning environment.
- Assessment and Evaluation: Teach students how to design, administer, and interpret various forms of educational assessments, using psychological principles to inform their understanding of student performance and learning needs.
- Cultural and Contextual Sensitivity: Develop students' awareness of cultural and contextual factors that influence education, emphasizing the importance of considering these factors in psychological assessment and intervention.
- Professional and Ethical Practices: Instill a strong sense of professional ethics and practices in the field of educational psychology, ensuring that students are prepared to handle ethical dilemmas and maintain professional standards in their work.

This course aims to blend theoretical knowledge with practical application, preparing students to effectively integrate psychological insights into their educational practice.

VOLUNTEERING 1

Effectively engage with communities, understanding their needs, and working collaboratively to address those needs through volunteer activities.

I Year, 2nd semester

Nr. crt.	Denumirea disciplinei	Nr. ECTS	Ore/săptămână				Forma de evaluare
			C	S	L	P	
Discipline Obligatorii (Ob)							
1	Analiza matematica 2 /Calculus 2	5	2	2			E
2	Fizica 1 /Physics 1	4	2	1	1		E
3	Desen tehnic si infografica 2 /Engineering Graphics and Infographics 2	3	1		2		V
4	Mecanica 2 /Mechanics 2	4	2	2	1		E
5	Stiinta si ingineria materialelor 2 /Materials Science 2	4	2		1		E
6	Programarea calculatoarelor si limbaje de programare /Computer programming and Programming Langages	4	1		2		E
7	Limba straina 1 (Franceza) /Foreign Language 1	2		2			V
8	Educatie fizica si sport 2 /Physical Education 2	2		1			V
9	Comunicare în echipă 1 /Collaborative Work 1	2		1			V
Discipline facultative (F)							
10	Limba franceza pentru ingineri 2 /Langue francaise pour ingenieurs 2	2		2			V
11	Limba engleză pentru studii academice inginerești 1 /English for Engineering Academic Study 1	2		2			V
12	Limba si cultura romana pentru studenti straini 2 /Romanian language and culture for foreign students 2	2		2			V
13	Pedagogie I: - Fundamentele Pedagogiei - Teoria și metodologia curriculumului	5	2	2			E
14	Voluntariat 2	3					V

CALCULUS II

The lecture is a presentation of the theory of the integral of functions of several variables. The main topics are: the Riemann integral, improper Riemann integral, functions defined by integrals, double and triple integrals, line and surface integrals. The integral formulae (Green-Riemann, Gauss-Ostrogradski and Stokes) and an introduction to the field theory are presented too. The course contains also a brief introduction to the metric spaces theory and applications of the fixed point principle.

Topics: *Metric Spaces. Fixed Points and Contraction Principle. Discrete Dynamical Systems, Newton's Method, Fractals. Riemann Integral and Improper Riemann Integral. Functions defined by Integrals. Double and Triple Integrals. Vector Fields, gradient, divergence, curl. Parameterized Paths, Length of paths. Line Integrals, Poincare's Theorem. Parameterized surfaces, area of a surface. Surface Integral, Flux of a vector field. Green-Riemann Formula. Gauss-Ostrogradski Formula. Stoke's Formula.*

PHYSICS I

The *Physics I* discipline aims to offer students the opportunity to develop their knowledge of physics through the study of electromagnetic waves and wave optics, domain. Students will learn the concepts, principles and technical vocabulary associated with the fields of electromagnetism and wave optics, which have numerous applications in their field of specialization. The course will briefly present the basic notions of the theory of electromagnetic waves, their propagation, the nature and properties of light as an electromagnetic wave, light-matter interactions, the main optical wave phenomena and their applications. Students will acquire theoretical and practical knowledge about some modern equipment and techniques that use optical phenomena, such as, for example, optical fibers and lasers, interferometric techniques of measurement, defectoscopy, etc.

Topics: *Fundamental concepts in optics: nature of light; light - matter interaction; Doppler effect of light; dispersion of light; ray model; optical path; reflexion and refraction; total internal reflexion; optical fibers, evanescent waves; Huygens-Fresnel Principle; Fermat's Principle. / Polarization of light: states of polarization, (linear, circular, elliptical); polarization by reflexion, applications: Brewster window, Brewster polarizer, polarization by absorption, Malus law: polaroid films; polarization by double refraction (birefringence): retarders; polarization by scattering; optical activity: polarimeter, liquid crystal displays. / Interference of light: principle of superposition, methods to superpose waves, light standing waves; interference of coherent waves propagating in arbitrary directions, Young's device, multiple beam interference; thin film interference, optical wedge, Newton's rings; spatial and temporal coherence of light. / Diffraction of light: Fraunhofer and Fresnel diffraction regimes; diffraction of light by a long, narrow slit, the halwave zone technique, light intensity distribution in the diffraction pattern (the phasor method); diffraction by a circular slit, the Airy disc, the Rayleigh criterion, the diffraction limit of optical systems; diffraction gratings, modern spectrometers; Fresnel diffraction by a circular slit./ Introduction to laser physics: the working principle of a laser, the main components of a laser and their roles, the working of a 3-level laser, example: the ruby laser, the working of a 4-level laser, example: the He-Ne laser.*

ENGINEERING GRAPHICS AND INFOGRAPHICS 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 and packing.*

MECHANICS II

This discipline is studied in the domain of mechanical engineering and it is indented to acquaint students with the principal approaches, models and explanatory theories of the domain, used in solving of practical applications and problems, relevant for the stimulation of the students learning process.

The scope of the discipline consists in achieving the following base notions, concepts and specific principles:

- dependence of the motion characteristics on the reference frame;
- the way interactions determine the motions of bodies;
- conditions, physical significances and practical consequences of conservation of certain mechanical quantities.

All these contribute to the formation of an overall vision of the students upon the methodological and procedural framework of the domain.

Topics: *1. Dynamics of the Particle. Theorems of Dynamics. Dynamics of the Constrained Particle. 2. Dynamics of Relative Motion. 3. Dynamics of a System of Particles. 4. Theorems of Dynamics. Theorem of Linear Momentum. 5. Theorems of Dynamics. Theorem of Angular Momentum. 6. General Theorems of Dynamics. Theorem of Variation of Kinetic Energy and Work. 7. Moments of Inertia. Definitions. Moments of Inertia with Respect to Parallel Axes. 8. Moments of Inertia with Respect to Concurrent Axes. Principal Moments of Inertia 9. Theorem of Linear Momentum in Dynamics of the Rigid Body. 10. Theorem of Angular Momentum. Theorem of Variation of Kinetic Energy and Work. 11. Dynamics of the Rigid Body with Fixed Axes. 12. Dynamics of the Rigid Body with Fixed Point. 13. Gyroscope. 14. General Motion of the Rigid Body.*

MATERIALS SCIENCE II

The multidisciplinary field of materials science and engineering outlines approaches to enhance the manipulation of existing materials and the synthesis of new materials. Further, the study of materials science and engineering provides the basis for understanding material properties concerning chemistry and atomic structure and, specifically, the ability to tailor chemistry and structure to bring about specific properties. This course presents the basic principles for understanding structure-property relations in engineering materials. The course assumes a basic knowledge of general physics, general chemistry, and mathematics. With these tools and the subject matter outlined in this course, students will understand modern challenges to applying modern materials. When appropriate, state-of-the-art problems will be discussed to illustrate the structure-property relationship in materials. The student will grasp structure concepts from bonding to microstructure and then learn to consider the

interrelationships between structure and property. Properties ranging from mechanical, thermal, electrical, optical, magnetic, and chemical in nature will all be considered. Further, examples will discuss manipulating these structure-property relationships in engineering materials such as ceramics, glasses, composite materials, and nanomaterials.

Topics*: Introduction to the science of materials nonmetal. The chemical liason. Various states of the matter. Real crystal, defects. Polymers. Ceramics. Glasses and vitroceramics. Biomaterials. Composites. Composite binder systems. Cements and concretes. Thin layers.*

COMPUTER PROGRAMMING AND PROGRAMMING LANGUAGES II

This introductory course focuses on several programming languages, with a special emphasis on MATLAB. It describes the most well-known and popular programming environments such as: MATLAB, C#, C++, Java, JavaScript, PERL, PHP, Python, Ruby, and Visual Basic (VB) or Visual Basic for Applications (VBA). Therefore, the main objective of this course is to provide code examples reflected in these ten computer languages. Students can easily understand the connection and universality between the syntax of different environments and be adept at translating code with applications to chemistry and mechanics. This learning experience is ideal for students charged in the future with implementing data analysis in their respective fields. Graphical illustrations are used for technical details about the computation examples to aid in an in-depth understanding of their inner workings. Moreover, the course contains original material and numerous cases are examined. Students will also benefit from the inclusion of: 1) Historical and philosophical perspectives on the past, present and future of computer languages. 2) A total of 448 additional files freely available online, from which a total of 44 files are poster presentations. 3) A total of 404 code examples reflected in ten computer languages, namely: MATLAB, C#, C++, Java, JavaScript, PERL, PHP, Python, Ruby and VB. 4) a total of 220 novel examples in MATLAB covering all stages of learning from simple to advanced. Moreover, this course first begins with a general introduction to history and presents the natural inevitable pathway from mechanical automations to present electronic computers. Following this historical introduction, an in-detail look is made on philosophical questions, implementations, entropy and life. Moreover, a basic knowledge of software implementation in several computer languages, especially MATLAB, even in an introductory way, helps the versatility and adaptability of the student to new situations that may arise in industry, education, or research. Thus, this course is meant to bring a more concrete understanding of applications in chemistry.

Topics: *1. Programming Languages. 1.1. Basics. Classifications. 1.2. The execution of a program by the computer 1.3. The syntax of programming languages. 2.Design programs 2.1. Algorithm: construction, structure 2.2. Description of algorithms. Pseudocode: basic operations, control structures, data structures, subroutines 3. Introduction to programming in Matlab 3.1. MATLAB*

language features 3.2. Program structure in MATLAB / Octave 4. Basic Programming in MATLAB / Octave 4.1. Variables, constants; data types, assignment instructions 4.2. Operators and expressions; order of precedence 5. Flow control statements 5.1. Conditional expressions 5.2. Iterations. Definite loops. Indefinite loops 6. Functions 6.1. Declaration and definition of functions and procedures 6.2. User defined functions 6.3. Function handle

FOREIGN LANGUAGE 1 (FRENCH)

This discipline aims to facilitate the development of knowledge of the French language (grammar, lexicon, written expression, oral expression), to form ordinary and professional communication skills. Develop written and oral comprehension skills allowing students to correctly decode various authentic documents (specialty articles, press articles, conferences), to identify their purpose and style. Enrichment of the technical vocabulary specific to the different situations of professional conversation. Ability to use grammatical structures in situational contexts.

PHYSICAL EDUCATION II

The Department of Physical Education and Sport – Kinetotherapy through the specificity of the activity promotes the acquisition of a biological potential capable of ensuring a good health state and the increase of the quality of life of the individual in society, the formation of a system of theoretical and practical knowledge that would correspond to the general tasks of university education, integrated in the requirements of modern society, learning, strengthening, improving the skills and motor skills in certain branches sports and the formation of the habit of independent and systematic practice of sports activities with a recreational and compensatory purpose, the development of the ability to work in a team, to respond promptly, correctly and efficiently to requests, to make decisions quickly and with presence of mind, to optimize physical and mental health necessary to support professional activities, the ability to communicate interactively in the processes of evaluating complex problems for activities that require work in a team, interdisciplinary cooperation, creativity – innovation and to communicate and demonstrate the solutions proposed to be adopted by the working team.

Topics: *Athletics: Elements of the running school, Jumping. Gymnastics: front and band exercises. Aerobic Gymnastics: exercise complexes. Applicative trails combined with running, balance, escalation, crawling, climbing, transport. Sports games: basketball, football, volleyball. The global practice of playing on small fields.*

COLLABORATIVE WORK I

The general objective of the practical course (seminar) **Collaborative Work** is twofold: the development of the students' communicative competence in English, as well as the acquisition of strategies and functional language needed to perform tasks in collaboration, through the presentation

of team projects and problem solving. The students perform activities which improve their presentation skills while learning how to best promote their ideas as a team in a professional context. Cross-cultural elements are also incorporated, about audience expectations in different countries. A secondary objective of the course is the acquisition of relevant vocabulary relating to the description of company organization, hierarchy and activities.

Topics*: Intercultural communication. Phone conversations in professional environment. Working environment in the company/ career plan. Functions of academic writing. Writing short documents: e-mail/ memo/professional letters. Revision. Mid-term examination. Final test.*

FOREIGN LANGUAGE FOR ENGINEERS 2

This discipline aims to facilitate the development of oral and written expression skills in French, the ability to use elements of language to describe and explain technical processes, the ability to understand specialist written / oral text, ability to work individually and as a team. Goals:

- The acquisition of skills to receive an orally transmitted message (understand the overall meaning of a message, extract factual information from a message), to produce an oral message (design of oral messaging referring to itself and to other activities / ideas) to receive a message sent in writing (understand the overall meaning of a text read silently, synthesis of the information read), to produce a written message (write sentences / paragraphs / larger text on various subjects of general interest or in particular).
- Develop professional presentation skills.
- Various technical vocabulary conversation work situation.
- The ability to converse on professional/technical topics.

ENGLISH FOR ENGINEERING ACADEMIC STUDY II

The discipline is addressed to all students of bachelor level year I of FILS – English stream; it has as its main objective the development of academic study skills in the context in which English is the medium of instruction in a technical university. The course and seminar aim to: develop the skills and level of proficiency in English for academic study of the engineering type, particularly reading with reflection on the structures and senses of different kinds of texts and other study materials, efficient note taking at courses and preparation for written/oral examinations. A range of specific objectives cover: optimizing note-taking skills; identifying key ideas of courses and making the difference between essential points and details; improving scientific reasoning and data presentation in accordance with the envisaged academic format; providing support to the students in developing their independent study skills within the academic context, by creating their reflective attitude, open to optimization, and by acquiring modes of transferring already existing skills. Goals:

- successful effective communication in the university and in the working environment,

- the optimal efficient model of accessing different types of texts of the technical academic kind, text, paragraph and sentence structure with a view to developing writing skills in the academic environment,
- the development of specific academic lexis in the engineering context, as well as the appropriate grammatical support.

Topics: *Module 1- Development of listening abilities Module 2 – Development of oral communication abilities necessary for the active and efficient participation in seminaries as well as for making oral presentations Module 3 – Creating autonomous study abilities*

ROMANIAN LANGUAGE (FOR FOREIGN STUDENTS) II

The practical course (seminar) of Romanian Language, Culture and Civilization is addressed to the foreign students in the first year, enrolled at the Faculty pf Engineering in Foreign Languages and has the following general objective: the development of students' communication competence with a focus on the four fundamental skills: listening, writing, reading and speaking. Moreover, it is important to mention the following secondary teaching objectives: the capacity to use in real communication contexts simple and complex vocabulary structures with reference to cultural and civilization conotations, as well as the capacity to adequately use the grammar structures.

Topics: *Socialising in Romanian. Teaching grammar notions: the the past tense, the verbal , the verbal voices, the future, elements of syntax. Expressing the cause, the aim, and the result. Teaching basic vocabulary in context and language functions.*

PEDAGOGY 1

This course provides a foundational understanding of pedagogy, focusing on the core principles and theories that underpin effective teaching and learning practices. Students will explore the fundamentals of pedagogy, gaining insights into educational philosophies, teaching strategies, and classroom management techniques. Additionally, the course covers the theory and methodology of curriculum development, equipping students with the skills to design, implement, and evaluate curricula that meet diverse educational needs. By the end of the course, students will be prepared to apply pedagogical theories and curriculum methodologies in real-world educational settings, fostering a supportive and effective learning environment.

VOLUNTEERING 2

Effectively engage with communities, understanding their needs, and working collaboratively to address those needs through volunteer activities.

II Year, 1st semester

Nr. crt.	Denumirea disciplinei	Nr. ECTS	Ore/săptămână				Forma de evaluare
			C	S	L	P	
Discipline Obligatorii (Ob)							
1	Matematici speciale/Special Mathematics	4	2	1			E
2	Fizica 2 /Physics 2	4	2		1		E
3	Teoria probabilitatilor si statistica matematica /Probabilities & Statistics	3	2	1			E
4	Tehnologia materialelor /Material Technology	4	2		1		E
5	Rezistenta materialelor 1 /Strenght of Materials 1	4	2	1	1		E
6	Introducere in ingineria mecanica /Introduction to Mechanical Engineering	4	1		2		V
7	Electrotehnica /Electrical engineering	3	2	1			V
8	Microeconomie /Microeconomics	2	1	1			V
Discipline opționale (Op)							
9	Limba straina (Franceza) 2 /Foreign Language (French) 2	2		2			V
10	Comunicare în echipă 2 /Collaborative Work 2						
Discipline facultative (F)							
11	Limba si cultura romana pentru studenti straini 3 /Romanian language and culture for foreign students 3	2		2			V
12	Limba engleză pentru studii academice inginerești 2 /English for Engineering Academic Study 2	2	1	1			V
13	Pedagogie II: - Teoria și metodologia instruirii - Teoria și metodologia evaluării	5	2	2			E
14	Voluntariat 3	3					V

SPECIAL MATHEMATICS

This discipline is studied in the field of Mechanical Engineering (English) and aims to familiarize students with the main approaches, models and theories of the field. The discipline is used in solving practical applications and problems and is relevant to stimulating the learning process in students.

The discipline covers the following chapters of Mathematics with application in engineering and their basic / advanced notions: Systems of Differential Equations, Functions of a Complex Variable, Fourier Analysis, Fourier and Laplace Transforms, as well as specific concepts and principles, all of them contributing to the transmission to the students of an overview of the methodological and procedural principles related to the field and to the use of the mathematical models in the study and solution of the engineering problems.

Topics*: Higher-order differential equations. Variation of parameters method. Linear equations with constant coefficients. Euler's equations. Systems of differential equations. Variation of parameters*

formula. Systems of differential equations with constant coefficients. Stability of the systems of differential equations. Routh-Hurwitz Criterion. Lyapunov equation. Lyapunov functions. Complex functions. Analytic functions. Cauchy-Riemann conditions. Complex Integrals. Cauchy's fundamental theorem and Cauchy's integral formulas. Taylor and Laurent series. Singularities. Residues theorem and its applications. Fourier transform. Inversion formula. Sine and cosine Fourier transform. Fourier integral. Applications of Fourier transforms and integrals in engineering. Discrete Fourier transform. Fast Fourier transform.

PHYSICS II

The Physics II course is designed to provide the student with the basic notions of physics on the atomic and subatomic scale both theoretically and through applications. The presentation of the fundamental concepts begins with the experimental results in contradiction with classical physics (the motion of matter described by Newtonian mechanics and the electromagnetic field described by Maxwell's equations) and the evolution of the ideas that led to the creation of quantum mechanics. The presentation of the postulates of quantum mechanics is carried out gradually, the examples contributing to the assimilation of new notions. The concepts presented allow the understanding of the structure of matter (atom, molecule, condensed matter), the methods of investigation at the atomic scale, or some devices that use phenomena controlled at the atomic scale (for example, the laser). The material presented is a first step towards advanced technologies such as the production of materials with special properties (see nanotechnology), or the realization of quantum computers.

Topics*: The experimental foundations of quantum physics: thermal radiation; photoelectric effect; Compton effect; atomic spectra; X-rays, Bohr's model of the hydrogen atom; correspondence principle; Einstein's theory of radiative processes; wave-particle duality; Heisenberg's uncertainty principle. Applications: the optical pyrometer; the photoelectric cell; the photomultiplier; X-rays in medicine; the electron microscope. The formalism of quantum mechanics (I): wavefunction postulate; time-dependent Schrödinger equation; probability conservation; wavefunction constraints; time-independent Schrödinger equation (TISE); 1-D infinitely deep potential well; 1-D finite potential well; potential potential barriers and tunnel effect; quantum harmonic oscillator; TISE in 3-D. Applications: nanotechnology, quantum wells with semiconductors; tunnel diode; scanning tunneling microscopy; vibration spectrum of a molecule. The formalism of quantum mechanics (II): state vectors; Hermitian operators; position and linear momentum operators; the link between the quantum state of a system and measurement results; Heisenberg's uncertainty principle. Applications: quantum computer; quantum cryptography. Angular momentum in quantum mechanics: orbital angular momentum (definitions of orbital angular momentum operators, properties, eigenfunctions and eigenvalues); spin angular momentum (Stern-Gerlach experiment,*

electron spin hypothesis) Hydrogen atom and multielectron atoms. The periodic table of elements. Condensed matter physics: crystalline structure of a solid; electron dynamics in solids; energy bands; metals, semiconductors and dielectrics.

PROBABILITIES AND STATISTICS

The acquisition of knowledge in the field of Probability and Mathematical Statistics as well as the ability to correctly use statistical models in theoretical and practical problems. Objectives: correctly determine the factors that appear in the statistical modeling of phenomena; understand the theoretical and practical context of the use of the applications studied; adapt models and methods of statistical calculation to specific problems of engineering sciences. Topics*: The notion of probability. Axiomatic definition. The classical concept of probability. Geometric probability. Conditional probability. Applications to reliability Sequence of independent trials. Limit theorem. Random variables. Distribution functions. Random vectors. Functions of random variables. Numerical characteristics of random variables. Correlation. Regressions. Characteristic functions. Classical laws. via characteristic functions. Data representation and data analysis. Estimation of parameters. Confidence intervals. Approximation theory in statistics. Best approximation. Least squares methods.*

MATERIAL TECHNOLOGY

Topics**:** *1. Introduction (Definitions. Manufacturing. Production. Business. Industry. The post-industrial society. Fabric. Management. Manufacturing properties of engineering materials). 2. Classification of the primary manufacturing processes (Summary of manufacturing processes for obtaining metals, ceramics, plastics, composites). 3. Metals (Definitions and properties of metals and alloys. Metallurgy processes. Powder metallurgy. Foundry. Forging. Joining. Product design. Processes selection and design. Specific flaws). 4. Ceramics (Definitions and properties. Classification of ceramics. Obtaining processes. Product design. Processes selection and design. Specific flaws). 5. Plastics (Definitions and properties. Classification of plastics. Obtaining processes. Product design. Processes selection and design. Specific flaws). 6. Composites (Definitions and properties. Classification of composites. Obtaining processes. Product design. Processes selection and design. Specific flaws). 7. Trends (Space manufacturing).*

STRENGTH OF MATERIALS I

Strength calculus of components loaded statically and dynamically. Within this discipline are presented the methodology for calculating stresses, deformations and displacements for straight bars in simple loadings. It is aimed to familiarize students with the modern methods used for the strength calculus of bars structures. Through applications the students acquire methods for dimensioning,

verification, establishing the resistance capacity and calculus of the deformations of bars at different loadings.

Topics*: Cap. 1+2 Stresses, displacements, deformations Cap. 3 Traction and compression Cap. 4 Torsion of circular bars Cap. 5 States of stress on inclined planes Cap. 6 Bending of straight bars (calculus of stresses) Cap. 7 Shearing, Cap. 8 Deformations of bars loaded in bending.*

INTRODUCTION TO MECHANICAL ENGINEERING

The course presents lectures and applications of software tools from math calculus and representation (OCTAVE. MathCAD) to drawing and design machine elements (CATIA-Mechanical Engineering with feature modelling). Based on a core of CAD activities students learn the concept of total design. The main part of activities is dedicated to learn and deal with advanced CAE/CAD/CAM concepts to create innovative products. • Understand the criteria for selecting component and mechanical system variants based on concepts, theories and methods of technical and economical analysis. • Interpretation of technological and functional problems of mechanical systems by applying basic knowledge and using new ones • Select design solutions (CAD/CAE solutions) for mechanical transmissions given the inter-relationships of design, material selection and nature of product design, manufacturing process • Explain the concepts of concurrent engineering and team work in CAD/CAE projects • Product development and lifecycle product management in mechanical engineering field.

Topics*: What is Mechanical Engineering. What a Mechanical Engineer does. Definitions: Machine, Apparatus, Mechanism, Device. A brief description (types and functions) of general purpose machine parts; (fasteners, springs, shafts, bearings, couplings, gear drives, belt, drives). Main steps of the Design Process. Materials and Manufacturing Processes. Fits and Tolerances. Sketches. 2D-Drawings – advanced features. Complex assembly drawings. Dimensioning and Tolerancing. Reports and Presentations. General rules. Basic Principles. Main modules. Profiles. 3D-transformation commands.*

ELECTRICAL ENGINEERING

The ***Electrical Engineering*** course aims at an applied approach to electromagnetic field theory as a fundamental part of the vast field of electrotechnics. The course is designed to provide the student with the basics of electrical engineering, both theoretically and through applications.

It starts from the coherent construction of a scientific theory, physical model, physical quantities and attached mathematical relationships, then presenting the physical quantities that characterize the electromagnetic field. The course continues with the presentation of the laws of the macroscopic theory of electromagnetism, with an emphasis on their consequences and applications. The second part of the course focuses on the study of electrical circuits. In this sense, the assumptions with which the macroscopic theory of electromagnetism works, the limits of the circuit models, the main

quantities with which the theory of electric circuits works, and Kirchhoff's theorems are presented, for two operating regimes (direct current, alternating current). The applications are solved using systematic methods, and the correctness of the electrical circuits is checked by the power balance method.

Topics: *I. Electromagnetism I.1 Introduction. Overview of the subject. The coherent construction of a scientific theory. Physical model, physical quantities and attached mathematical relationships. I.2 Electromagnetic quantities. Primary electromagnetic quantities. Derived electromagnetic quantities. I.3 Laws and theorems of electromagnetic phenomena. Electric flux law (Gauss law). Magnetic flux law. The magnetic field constitutive law. Temporary magnetization law. The electric field constitutive law. The law of temporary electric polarization. Electromagnetic induction law (Faraday Law). The magnetic circuit law (Ampère law). The electric charge conservation law. The constitutive law of electric conduction. The law of energy conversion associated to e. The law of energy conversion associated to electric conduction. The electrolysis law. II. Electric circuits. II.1 Introduction and overview. Limits of circuits' models. The main quantities of electrical engineering. Kirchhoff's theorems. II.2 Direct current (D.C.) circuits. Elements of direct current circuits. Branch characteristics. Fundamental theorems for direct current circuits. Kirchhoff equations method. Loop current method. Node potential method. II.3. Alternating current (A.C.) circuits. Circuit equations. Basic circuit elements. Complex form of equations for A.C. circuit. Power in A.C. circuits (active, reactive, apparent). Power factor. Matrix form of circuit equations. Power conservation. RLC series circuit. RLC parallel circuit. Combined circuits: series/parallel branches. Inductive coupling. Coupling removal.*

MICROECONOMICS

Formation and assimilation of the economic way of thinking that helps in the identification and application at microeconomic level of entrepreneurship decisions.

Topics**:** *C1 Introduction to economics, economic principles. C2 Demand, supply and market equilibrium. C3 Elasticity, demand and supply and there application. C4.Maximum/minimum prices-economics of welfare. C5 Production cost. C6 Profit and prices under competition. C7 Market structures.*

FOREIGN LANGUAGE (French) II

This discipline is studied within the field of Mechanical Engineering - modern applied languages and aims to facilitate the Bachelor students' development of the skills to use the grammar and vocabulary elements specific to the English language, at the CEFR – B2 level - competent user, in a professional/technical context scientific as well as their ability to work individually and in a team.

The discipline addresses basic/advanced notions of grammar, lexicon and professional communication as a specific topic, all of which contribute to the training of students in professional communication skills in English. The study of this discipline facilitates the acquisition of skills to present and interpret concepts, facts and opinions, in oral and written form (listening, speaking, reading and writing) and the development of mediation skills and intercultural understanding, so that the future engineer can interact appropriately in contexts social, professional and culturally diverse outside of school.

Topics**:** *Job searching methods, Job application file - CV and cover letter. Company presentation, organizational chart. Job presentation and responsibilities within the company. Expressing intentions and opinions in work situations. Comparing processes.*

COLLABORATIVE WORK II

Developing the four fundamental components of communication: oral and written comprehension, written and oral communication (listening, writing, reading, speaking).

Topics**:** *CV writing. Letter of intent writing. Lexis specific to professional communication: career plan, working schedule, job descriptions/working environments description. Sitting for an interview. Oral presentations – the structura of an oral presentation. Oral presentations (Functions, expressions, structures of lexis specific to an oral presentation). Oral presentations (delivery). Mid term examination. Making oral presentations.*

ROMANIAN LANGUAGE AND CULTURE (FOR FOREIGN STUDENTS) III

1) Enhancing the foreign students' ability to understand written and verbal messages in Romanian by enriching their vocabulary and advancing their grammar knowledge. 2) Developing the students' communicative competence, focusing on fluency and accuracy. Developing their ability to use grammar structures and vocabulary items in their own contexts of communication. 3) Enhancing the students' knowledge of grammar by focusing on academic writing activities and communicative activities such as conversations, presentations, descriptions, negotiations, telephone conversations. 4) Developing the students' ability to understand a series of aspects concerning the Romanian culture and civilization presented within the seminars of Romanian language.

Topics: *1.Presenting our daily activities. • The indicative. The present tense. Verbs whose infinitive ends in ,''-a", ''-e", ''-i", ''-ea", ,''-î". • Verbs with the personal pronoun in the dative. • The indefinite pronoun and adjective. • Reading, speaking, vocabulary and grammar activities. 2. Naming and presenting the objects in a classrooom, in a laboratory, in one's house. • The noun. The masculine, the feminine and the neuter gender. • The plural of nouns in the masculine, feminine,*

neuter gender.• Reading, speaking, vocabulary and grammar activities. 3. Describing places and objects. Describing a friend. • The adjective with two, three and four forms. • The demonstrative pronoun and the demonstrative adjective. • Reading, speaking, vocabulary and grammar activities. 4. How do we ask for information? How do we give information? • Adverb + verb.• Verb + preposition + noun.• Prepositions followed by nouns without an article. • Prepositions followed by nouns with the definite article.• The personal pronouns in Accusative and the reflexive pronouns in Accusative.• Reading, speaking, vocabulary and grammar activities. 5. An introduction to the Romanian culture and civilization. • Presenting the Romanian traditions and customs at Christmas, New Year's Eve and Easter. • Asking the students to talk about their own traditions and customs. • The indicative. The present tense. Reflexive verbs. • Reading, speaking, vocabulary and grammar activities. 6. Describing a city visited in the past. Presenting the activities done in that city in the past. • The indicative. The compound perfect tense. • The dative case. Unstressed forms. • Revision of the adjectives with two, three and four forms.• The comparative of adjectives. • Reading, speaking, vocabulary and grammar activities. 7. Individual project: • Presenting one's home town. Presenting the activities done in that city before coming to study in Romania. 8. Plans for the future. • The indicative. The future tense. • Reading, speaking, vocabulary and grammar activities.

ENGLISH FOR ENGINEERING ACADEMIC STUDY II

It is aimed that the students of FILS – Year I – English stream should acquire the essential oral and written skills necessary to study in English the disciplines within the bachelor level, reaching the level C1 (Competent User) acc. To CEFR _ EU for foreign languages learning.

The main specific courseobjectives are to: identify the necessary skills in academic study in an engineering environment in English; create the necessary linguistic support to develop adequate competences for academic study in the engineering environment in English; develop the accessing/reading abilities of the scientific/technical texts with a view to academic study purposes; develop the writing skills and raising awareness of the trainees as to writing connected issues.

Topics: *Developing listening skills. Developing oral communication skills necessary to the students in order to efficiently and actively participating in seminars and to make oral presentations. Creating autonomous study skills, within the engineering academic study skills program.*

PEDAGOGY 2

Building on the foundations laid in Pedagogy I, this course delves deeper into advanced pedagogical theories and practices. Students will enhance their understanding of contemporary teaching methods, learning theories, and educational research techniques. The course also focuses on the practical application of these theories in diverse educational contexts, emphasizing differentiated instruction,

assessment strategies, and inclusive education. By the end of the course, students will be able to critically analyze and apply advanced pedagogical concepts, design effective instructional strategies, and contribute to the development of innovative educational practices.

VOLUNTEERING 3

Effectively engage with communities, understanding their needs, and working collaboratively to address those needs through volunteer activities.

II Year, 2nd semester

Nr. crt.	Denumirea disciplinei	Nr. ECTS	Ore/săptămână				Forma de evaluare
			C	S	L	P	
Discipline Obligatorii (Ob)							
1	Organe de masini 1 /Machines Elements 1	4	2		1		E
2	Tehnologie de fabricatie 1 /Manufacturing Processes 1	3	2		1		E
3	Termotehnica 1/Engineering Thermodynamics 1	5	2	1	1		E
4	Rezistenta materialelor 2 /Strenght of Materials 2	3	2	1			E
5	Metode numerice /Numerical Methods	5	2		1		V
6	Comunicare tehnică /Technical writing	2		1			V
7	Instrumente software in ingineria mecanica 1 (design corp solid) /Software Tools for Mechanical Engineering 1 (solid body design)	3	1		2		V
8	Macroeconomie /Macroeconomics	2	1	1			V
Discipline opționale (Op)							
9	Masini si actionari electrice /Electrical machines	3	2		2		E
10	Masurari si traductoare /Measurements & Transducers						
Discipline facultative (F)							
11	Limba si cultura romana pentru studenti straini 4 /Romanian language and culture for foreign students 4	2		2			V
12	Didactica specializării	5	2	2			E
13	Voluntariat 4	3					V

MACHINE ELEMENTS AND MECHANISMS I

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. 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 fasteners or elastic joints (springs).

Topics*: 1. Modern design principles. Product development. Functional analysis. 2. Planar mechanisms. General considerations. Classification. Basis of kinematics (Degree of freedom, joints (pairs), links, chains, mobility). Linkages. Analysis and synthesis of simple linkages. Practical design considerations. Cam mechanisms. Classification. Analysis of cam and flat follower. Design considerations. Kinetostatic and dynamics of linkages. Driving systems of mechanisms. 3. Contact of elastic mechanical components. Extended surface contacts (conformal contacts); contact pressure for various configurations. Concentrated (Hertzian) contacts (Counterformal contacts); stresses and*

deformations. 4. Threaded fasteners and power screws. General considerations (functions, design solutions, materials and technologies, standardization) Forces and moments in a threaded pair. Efficiency of power screws. Ball screws. Planetary roller screws. Threaded fasteners calculation. Power screws calculation. Design methods of threaded fasteners. Locking nuts and washers. 5. Springs. General considerations (Functions, characteristics, materials and technologies, applications). Torsion bar. Helical springs. Leaf springs. Ring springs. Elastomeric springs. Special, novel springs. 6. Permanent joints (welded, bonded, riveted).

MANUFACTURING PROCESSES I

A major goal of engineers is to determine the properties and characteristics of the materials for their rational use and expected performances. This module will allow achieving knowledge concerning the integration of fabrication using different materials with product design from machining to quality control.

Topics: *1. Generalities; Basic definitions for manufacturing systems; Design activities for manufacturing systems; Planning and control activities for manufacturing systems; 2. Design for fabrication and plan based on computer-assisted technique; 3. The fundamentals of cutting through traditional methods and modern methods. Cutting and cutting power using lasers and plasma guillotines;4. Processing processes used to produce round shapes. Machining, rounding and finishing processes using power laser technology and plasma guillotines;5. Thermal, chemical and electrochemical finishes; Coating methods using the thin film deposition techniques; 6. Synthesis and processing of materials on micro- and nanoscale scale; 7. Methods for characterization of pre- and post-processed micro- and nanoscale materials; 8. Dimensional metrology, metrology inspection equipment and techniques.*

ENGINEERING THERMODYNAMICS I

Engineering Thermodynamics I is a basic science that deals with energy. The course presents the basic concepts of Thermodynamics, some of them reviewed and new ones introduced (Energy, System, Thermal Motion, Molecular Speed, Interactions, State Parameter, Process and Cycle). Then the perfect gas approximation is introduced, together with other equations of state. After the introduction of heat and work interaction, the First Law gives an overview of energy conservation and transformation as a quantitative principle. The development of the Second Law relations adds qualitative aspects of heat transfer, with special emphasis on irreversibility and entropy generation. A practical example of thermodynamics laws application is developed in the high-speed gas dynamic flow chapter, with special attention given to flow through nozzles, as important process in steam and gas turbines.

Keywords: state parameter; thermodynamic processes and cycles; energy; entropy; First Law; Second Law; high speed gas dynamics

Topics: *Basic Concepts of Thermodynamics. Working Fluids in Thermal Machines. First Law of Thermodynamics. Thermodynamic Processes. Second Law of Thermodynamics. Vapor and Steam Power Plants. Basic of High Speed Gas Dynamics*.

STRENGTH OF MATERIALS II

The objective is to study the behavior 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: *Chapter 1 Statically Indeterminate Systems. Chapter 2 Introduction to Theory of Elasticity Chapter 3 Theories of Elastic Failure. Chapter 4 Complex Stresses and Strains. Chapter 5 Struts Chapter 6 Impact Loads. Chapter 7 Fatigue. Chapter 8 Plates, Thin-Walled Cylinders, Thick Cylinders. Chapter 9 Experimental Stress Analysis.*

NUMERICAL METHODS

The course entitled Numerical methods is designed to present students in a unitary manner the problems related to the main numerical methods for solving the various types of problems encountered in engineering, being structured in 7 chapters. They are presented and explained the path taken to solve a problem in any field with the help of the computer and consists of: establishing a mathematical model of the concrete problem (a model that can fit into a category such as: a non-linear equation, a system of linear or non-linear equations), which is often continuous in nature must be discretized; the solution of the discretized problem must be consistent and stable; the discretized model must be translated into a realizable and efficient algorithm, usually described in an evolved programming language.

In the first part of the course, fundamental notions and results related to the approximation of real numbers, the representation of information in calculation systems and floating point arithmetic, the sources of errors, types of errors and the propagation of errors are presented and explained. Next, the numerical solution of linear systems (through direct and iterative methods) and the numerical solution of equations and nonlinear systems are explained. Next comes the approximation of functions (through interpolation polynomials and the method of least squares), numerical derivation and integration, but also the numerical solution of differential equations.

The most used numerical methods are described, brought to an algorithmic form. In each case, procedures in MATLAB/OCTAVE are presented and comparisons are made between the output data

of the respective procedures and the results displayed by the MATLAB/OCTAVE commands designed to solve the same problems.

Topics*: 1. Introduction - Scope discipline. Link to programming and technical subjects. Steps to solving a given problem. 2. Methods for approximate solving of algebraic equations 2.1. Graphical method 2.2. The bisection method 2.3. The secant method 2.4. Newton method 3. Numerical methods for solving systems of equations 3.1. Systems of linear equations. Criteria for the existence and uniqueness of the solution of a system of linear equations. 3.2. Direct methods for solving linear algebraic equations. Gauss elimination method. 3.3. Iterative methods for solving linear algebraic systems of equations 3.4. The method of successive approximations. Gauss-Seidel method. 4. Function Approximation 4.1. Interpolation. 4.1.1. Lagrange interpolation polynomial 4.1.2. First and second order Newton interpolation polynomials 4.1.3. The method of divided differences. 4.1.4. Spline interpolation 4.1.5. Interpolation of function of two variables 4.2. Regression 4.2.1. The least squares method 4.2.2. Linear regression 4.2.3. Quadratic regression 4.2.4. Exponential regression 4.2.5. Bilinear regression 5. Numerical differentiation. Forward finite differences. Backward finite differences. Centered finite differences 6. Numerical integration. 6.1. Midpoint method 6.2. Trapezoidal method 6.3. Simpson's method. 6.4. Gauss quadrature 6.5. Numerical integration of improper integrals. 7. Solving differential equations and systems of differential equations 7.1. Euler's method 7.2. Predictor – corrector methods (Heun) 7.3. Taylor series method 7.4. Second order Runge-Kutta methods 7.5. Fourth order Runge-Kutta methods 7.6. Numerical integration of systems of differential equations 7.7. The finite difference method 7.8. The finite element method.*

TECHNICAL WRITTING

Developing the four fundamental components of communication: oral and written comprehension, written and oral communication (listening, writing, reading, speaking) in professional communication contexts.

Topics*: Debates. Professional meetings. Academic writing – technical reports. Approaching the teaching of writing skills within the process paradigm. Collaborative and/or individual writing. Communicative methods (interactive lecturing, explanation, conversation, group discussion). Brainstorming, problem solving, audio techniques and written ones (reading, working with course book/working cards).*

SOFTWARE TOOLS FOR MECHANICAL ENGINEERING I (SOLID BODY DESIGN)

This subject is studied within the Mechanical Engineering field and aims to familiarize students with the main approaches, models and explanatory theories of the field, used in solving practical applications and problems, with relevance for stimulating the learning process in students.

The discipline addresses as a specific topic the following basic notions of designing mechanical systems, from the simplest to complex mechanical systems, using up-to-date software, specific concepts and principles, all of which contribute to the transmission/formation to/of students of an overview of the methodological and procedural landmarks related to the field.

This discipline aims to familiarize students with the principles of design activity, to use theoretical knowledge of material resistance, technology, study of metals in dimensioning, verification and realization of the 3D model of the proposed equipment.

The course presents lectures and applications of software tools from math calculus and representation (OCTAVE. MathCAD) to drawing and design machine elements (CATIA-Mechanical Engineering with feature modelling). Based on a core of CAD activities students learn the concept of total design.The main part of activities is dedicated to learn and deal with advanced CAE/CAD/CAM concepts to create innovative products.

Topics: *C1.Concept and calculus using various software. Designing- master model. Relattion to manufacturing. Original soft; The commercial codes of software C2.Life cycle design principles, CAD / CAE design life cycle design, product development C3.Mechanical assembly. Realization of the parts and their integration as an aassembly. The concept of "master modeling". Soft to compute and graphical representation. CAD / CAE design software C4. Using OCTAVE - description, use C5.Developing the design of mechanical components using the MathCAD software C6.Product database, Interactive database utilization within a design team, information exchange and CAD files. Design, testing, manufacturing, quality. Teamwork and manufacturing preparation.*

MACROECONOMICS

Formation and assimilation of the economic way of thinking that helps in the identification and application at macroeconomic level of entrepreneurship decisions

Topics*: C1. Measuring a nation's income. C2. The Wealth of Nation's and economic growth. C3. Macroeconomic equilibrium. AD-AS model C4. Growth. Money growth and inflation. C5. Unemployment. C6. International finance. C7. Stock market and personal finance.*

ELECTRICAL MACHINES

The **Electrical machines** course aims at an applied approach to electromagnetic field theory as a fundamental part of the vast field of electrotechnics. The course is designed to provide the student with the basics of electrical engineering, both theoretically and through applications with a focus on electrical machines.

It starts from the coherent construction of a scientific theory, physical model, physical quantities and attached mathematical relationships, then presenting the physical quantities that characterize the

electromagnetic field. The course continues with the presentation of the laws of the macroscopic theory of electromagnetism, with an emphasis on their consequences and applications.

The second part of the course focuses on the study of electrical machines (transformers, special transformers, induction machine, three-phase induction motor, single phase induction motor, synchronous machine, synchronous generator, DC Machine, DC generator, DC motor).

The course ends with a special chapter dedicated to Drives and Electric Motor Selection (introduction to drive systems, mechanical requirements. electric machines heating and cooling, the power calculus of the drive motor that is working under invariable load or variable load, motor drives controller).

In conclusion, the course covers a wide range of topics, including the fundamental principles governing electric machines, their diverse applications, and the underlying physics that govern their operation. Key concepts like electromagnetic induction, magnetic fields, and the principles of conversion between electrical and mechanical energy are discussed in relation to practical aspects, such as machine design, efficiency considerations, and the latest advancements in the field. Through these lectures, the students gain valuable insights into the practical applications of electrical machines across industries like power generation, transportation, and manufacturing.

.Topics: *1. Review of basic knowledge of units, laws and regimes of electromagnetic field Gauss's law. Coulomb's law. Joule-Lentz's law. 2. Review of basic knowledge of Direct current (DC) electric circuits. Nodes, Branches and Loops. Direct currents devices. Law of Current. Law of Voltage. Superposition theorem. Node Voltage Method. 3. Review of basic knowledge of Electrodynamics. Magnetic field. Electromagnetic induction. Lorentz force law. Electromotive force. Ampere's law. Faraday-Lenz law. Classification of magnetic materials. Ferromagnetism. Magnetic circuits. Inductivity. Energy and forces in magnetic field. 4. Review of basic knowledge of Alternating current (AC) electric circuits. Sinusoidal steady-state regime. CompMlex representation. Complex impedance. Sinusoidal power 5. Electrical transformers. Construction. Operation principle. Circuit equations. The secondary side values referred to the primary side. Electric equivalent circuit. No load and short circuit regimes. Efficiency and power diagram. Characteristics. Three-phase transformer. Special transformers. 6. Induction machine. Three-phase induction motor. Construction. Operation principle. Efficiency and power diagram. Torque. The characteristics of the three-phase induction motor. Starting of the three-phase induction motor. Single phase induction motor. 7. Synchronous machine. Construction. Synchronous generator. Operation principle. Efficiency and power diagram. Equation and voltage diagram. Electromagnetic torque and electromagnetic power. Characteristics of the synchronous generator. 8. DC Machine. Construction. Operation principle. DC machine torque. DC generator. DC generator equations. Efficiency and power diagram. Characteristics. DC motor. DC motor equations. Efficiency and power diagram. Starting of the DC motor. Variable speed. Characteristics. 9. Drives and Electric Motor Selection.*

Introduction to Drive Systems. Mechanical Requirements. Electric machines heating and cooling. The power calculus of the drive motor that is working under invariable load. The power calculus of drive motor, that is working under variable load. Motor Drives Controller.

ELECTRIC MEASUREMENTS AND TRANSDUCERS

Measurement is a fundamental skill for engineers, including software engineers. This course will provide students with basic knowledge on measurements techniques, analog and digital instruments architecture and use, methods and transducers to measure principal physical variables. All automatic systems demand measurements in one stage or another. For this reason, all electric engineers with software or electronics formation should be acquainted with measurements. Lectures are sustained by a workshop for the practical formation of students in the field of electrical measurements.

Key words: Electric measurements, sensors and transducers, analog to digital conversion, data acquisition systems

ROMANIAN LANGUAGE AND CULTURE (FOR FOREIGN STUDENTS) IV

The practical course of Romanian for foreign students focuses on the development of the four fundamental skills: listening, speaking, reading and writing.

Topics: *Telephone conversations. Writing a letter. Talking about Romania. Reading about Romania. Individual project - Presenting your country. Talking about your future career. Presenting your future career and your plans for the future. Talking about our free time.*

DIDACTICS OF SPECIALIZATION

This course is designed to equip students with specialized teaching methodologies and pedagogical strategies tailored to their specific subject area. By focusing on the unique aspects of their specialization, students will learn to effectively convey complex concepts and foster an engaging learning environment. Goals:

- Understand and apply teaching methods specific to the subject area, ensuring that instructional strategies align with subject-specific content and learning outcomes.
- Develop skills in designing and implementing a curriculum that meets educational standards and addresses the needs of diverse learners, incorporating relevant and up-to-date resources.
- Utilize innovative instructional strategies, including the integration of technology and interactive tools, to enhance student learning and engagement.

- Master various assessment techniques to measure student understanding and progress and learn how to provide constructive feedback that supports student growth.
- Explore effective classroom management practices tailored to the subject area, promoting a positive and productive learning environment.
- Learn to differentiate instruction to cater to diverse learning styles and abilities, ensuring that all students have equitable access to educational opportunities.
- Engage in reflective teaching practices to continually assess and improve instructional methods, fostering a mindset of continuous professional development.

By the end of the course, students will have a deep understanding of how to teach their specialized subject effectively, using targeted didactic approaches to create impactful and meaningful learning experiences for their students.

VOLUNTEERING 4

Effectively engage with communities, understanding their needs, and working collaboratively to address those needs through volunteer activities.

III Year, 1st semester

Nr. crt.	Denumirea disciplinei	Nr. ECTS	Ore/săptămână				Forma de evaluare
			C	S	L	P	
Discipline Obligatorii (Ob)							
1	Organe de masini 2 /Machines Elements 2	5	2		1	2	E
2	Tehnologie de fabricatie 2 /Manufacturing Processes 2	3	2		1		V
3	Metoda elementului finit /Finite Element Analysis	4	2		2		E
4	Termotehnica /Engineering Thermodynamics	5	2	1	1		E
5	Rezistenta materialelor 3 /Strenght of Materials 3	4	2	1			E
6	Mecanica fluidelor /Fluid Mechanics	4	2	1			E
7	Proiectare pentru reciclare /Design for recycling	3	2			2	V
8	Moneda si sistem bancar /Money & Banking	2	1	1			V
Discipline facultative (F)							
9	Instruire asistată de calculator/ Computer-assisted instruction	2	1	1			V
10	Practică pedagogică de specialitate în învățământul preuniversitar 1	3	42 ore (14 săpt * 3 ore/săpt)				V
11	Voluntariat 5	3				4	V

MACHINE ELEMENTS AND MECHANISMS II

The course is intended to provide the student with a clear and thorough understanding of both the theory and application of the fundamentals of general-purpose machine elements. Being the second in a series of three courses which can be considered the “spinal column” of mechanical engineering education, this course is focused on machine components for rotational motion (shafts, bearings, seals).

Specific objectives: Learning and correct usage of the terminology and technical language specific to mechanical components. Learning of the design solutions and operating characteristics of the main components studied through theory and experiment. Define the specifications and methods to calculate and design (including their selection from catalogues) of the components studied. Identification of the main mechanical load acting on the studied components and calculation of the corresponding stresses and deformations. Apply of the failure theories for static and variable (fatigue) conditions. Critical analysis (expertise) of alternative design solutions for a given mechanical system.

Topics: *Introduction into mechanical design (Design steps. priciples of mechanical design. Engineering specifications. Design considerations). Basics of Tribology (Classification of friction pairs. Elastic and plastic contacts. Friction regimes and modes of wear. Fluid film generation). Shafts, axles and associated parts: (Generalities: definitions, classifications, materials and technology, modes of failure. Shaft design. Hub-on-shaft assemblies by positive means: keys, splines, pins, polygonal profiles.Hub-on-shaft assemblies by friction means: tapered shaft, taper rings,*

interference fit). Rolling-element bearings (Generalities: design solutions, classification symbols. Design of rolling-element bearings: modes of failure, force repartition, bearing arrangements and calculation. Bearing lubrication). Sliding bearings (General characteristics: principles of operation, classification, constructive solutions, materials for sleeves. Sliding bearings - radial and thrust - operating in boundary lubrication conditions. Fluid film – HD – bearings: principle of operation, design solutions, calculation. Lubricant supply systems. Hydrostatic bearings. Optimum bearing selection - Neale Chart). Seals (Overview. Static seals - gaskets, "O"-rings etc. Dynamic seals – lip seals, mechanical face seals, compliant seals - brush seals, finger seals. Design solutions).

MANUFACTURING PROCESSES II

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.

The discipline addresses the following basic/advanced notions, specific concepts and principles as a specific topic, all of which contribute to the transmission/formation of students with an overview of the methodological and procedural milestones related to the field:

- The objective of the course is to get familiar with the basic notions of cutting processes on machine tools.
- The next part of the course focuses on understanding the structures of CNC machine tools.
- A separate part is dedicated to flexible manufacturing cell structures, flexible manufacturing systems and manufacturing lines.
- The most developed part is dedicated to acquiring the skills of manual generation of NC numerical control programs.
- The course also presents an introduction to Computer Aided Manufacturing - CAM.
- The course has the following specific objectives:
- Getting to know the basics of the parameters involved in machining, such as cutting speed, spindle speed and feedrate calculation;
- Correlation of different types of cutting tools and processed materials;
- Understanding the structures of CNC machine tools, their specific components and control systems, types of cutting tools and their characteristics related to these types of machine tools;

- Knowledge of basic structures along with the flow of materials, energy and information through these systems;
- Obtaining skills in manual CNC programming, starting from the configuration and axis systems of various CNC machine tools and their use;
- Knowledge of CNC codes, types of tool movements (speed, feed, linear interpolation, circular interpolation, etc.);
- Understanding of certain program structures specific to different types of processes (turning, drilling and milling) accompanied by applications for representative types of parts processed on CNC machine tools in the laboratory.

Topics*: Introduction. Material Properties. Metal Cutting. CNC machines and systems. CNC programming.*

FINITE ELEMENT ANALYSIS

The objective of the course is introducing finite element method for approximate numerical solutions of engineering problems. The course concentrates mainly on solution of structural problems. The displacement method of finite element analysis is developed with emphasis on the isoparametric formulation. The objective of the applications is to teach the fundamentals of finite element method with emphasize on the underlying theory, assumption, and modelling issues as well as providing hands on experience using finite element software (in house MATLAB/OCTAVE finite element codes and commercial ANSYS - Classic code) to model, analyze and design systems of relevance to mechanical engineers. The outline of the labs is as follows: 1. Approximate solution of boundary values problem; 2.Introduction to continuous/discrete problems 3.Linear elasticity for 2D models; 4.Specialized elements (Truss, Spring and Beam elements); 5.Mesh generation and modelling concerns; 6.Linear static analyses.

method. Direct stiffness method – trusses. Slender beams, planar frames, grids. Linear elasticity. Energy methods. Finite elements based on displacement fields. Isoparametric elements. Plate bending.

ENGINEERING THERMODYNAMICS A student who has chosen the discipline Engineering Thermodynamics (2nd year, 2nd semester), cannot also choose the discipline. The curriculum is identical.

Engineering Thermodynamics is a basic science that deals with energy. The course presents the basic concepts of Thermodynamics, some of them reviewed and new ones introduced (Energy, System, Thermal Motion, Molecular Speed, Interactions, State Parameter, Process and Cycle). Then the perfect gas approximation is introduced, together with other equations of state. After the introduction

of heat and work interaction, the First Law gives an overview of energy conservation and transformation as a quantitative principle. The development of the Second Law relations adds qualitative aspects of heat transfer, with special emphasis on irreversibility and entropy generation. A practical example of thermodynamics laws application is developed in the high-speed gas dynamic flow chapter, with special attention given to flow through nozzles, as important process in steam and gas turbines.

Keywords: state parameter; thermodynamic processes and cycles; energy; entropy; First Law; Second Law; high speed gas dynamics

Topics: *Basic Concepts of Thermodynamics. Working Fluids in Thermal Machines. First Law of Thermodynamics. Thermodynamic Processes. Second Law of Thermodynamics. Vapor and Steam Power Plants. Basic of High Speed Gas Dynamics*.

STRENGTH OF MATERIALS 3

The course builds upon the knowledge accumulated by students in previous years in disciplines such as Strength of Materials 1 and 2, Mechanics, Technical Drawing, Materials Science, and Mathematical Analysis.

The course is designed in a way that allows students to become familiar with the main approaches, models, and explanatory theories of mechanical engineering, used in solving practical applications and problems, relevant for stimulating the learning process in students.

The main elements related to the behavior of materials are covered, including their classification based on mechanical properties and their influence on how designed structures respond to various demands.

By incorporating concepts from Fracture Mechanics and Materials Fatigue, an overview is provided on how materials used in structural design influence the behavior of structures.

Various case studies are analyzed to understand the applicability of Strength of Materials in the design of mechanical structures and how the material modifies their characteristics according to design requirements.

FLUID MECHANICS

The course is designed to provide students with the basics of incompressible fluid mechanics, including the concept of fluid particle and the continuum fluid hypothesis, physical properties, fundamentals of perfect and real fluid statics and dynamics in laminar and turbulent regimes, elements of dimensional analysis and similarity theory and fluid flows through pipes. A balance is sought between introducing concepts, presenting the physics of phenomena, discussing qualitative aspects, writing equations and solving problems.

The focus of the lectures is to teach the students how the theoretical models are applied to obtain solutions with relevance for practical cases. The focus of the lectures is to obtain laminar solutions of the Navier-Stokes equation, with application in lubrication, dynamics of thin films and the study of biofluids. One main aim of the courses/seminars, in the second part of the course, is to investigate the hydrodynamics instability, in relation to laminar – turbulence transition.

Topics: *Definition of continuous media, rheological fluids properties, diffusion process. Boundary conditions, surface tension, capillarity. Forces and stresses; Cauchy stress tensor. Kinematics; velocity gradient, stretching and spin tensor, vorticity; stream lines and stream tube. General principles and their mathematical formulations: conservation of mass and momentum; Bernoulli solution. Navier-Stokes equation (general presentation). Exact and numerical solutions of Navier-Stokes equation. 2D Stokes solutions; Hele-Shaw flow; Thin films approximation (Reynolds equation for lubrication). Laminar and turbulent flows; hydrodynamic stability (introduction). Boundary layer theory; hydrodynamic forces against immersed bodies.*

DESIGN FOR RECYCLING

Design for recycling considers how the product can be recycled from the moment it is designed, to allow easy reuse of both its components and constituent materials. Design for recycling has no formal rules but involves a series of general guidelines regarding hazardous materials, connections and fasteners, construction and accessibility to subassemblies. Designing a product for recycling aims at the same characteristics as designing for disassembly. It addresses more precisely the selection of materials and determines their recycling rate. In addition, it emphasizes the need to transform recycled materials into new products. A special focus is placed on the fact that fewer different materials in assemblies or subassemblies of products designed for disassembly will improve the possibilities of extending the life of the product.

Topics: Selection of materials for recycling; Materials used in product design; Considerations on recycling materials and technologies; Considerations on nonmetal recycling; Methods and equipment for waste separation; Strategies for recycling; Economic and policy aspects of recycling.

MONEY AND BANKING

Specific objectives: Identify types of banks and financial systems. Applying concepts like, money, interest rates, fees, real annual interest rate, fiat money, official interest rate, reference interest rate. Interpretation of the market signals and identification of cyclically economic tendencies compared to national and European monetary policy.

Topics: *Introduction to banking system, role of money. Money supply, money demand, monetary equilibrium, monetary injection. Fiscal and monetary policy linkages: government debt and inflation risks. General notions about banks, role and functionality. Interest rate, types of interest, price of*

debts instruments, fluctuations in the interest rate. International finance. Short history regarding economic crisis, possible solutions.

COMPUTER-ASSISTED INSTRUCTION

The **Computer-Assisted Instruction** subject is studied within the Psychopedagogical Training Program for the Certification of Competencies for the Teaching Profession, Level I, having an applicative character. Thus, the theoretical knowledge acquired by students in the previously studied disciplines is used: Educational Psychology, Pedagogy I, Pedagogy II, Specialization Didactics.

The discipline addresses the following specific notions, concepts and principles as specific topics, all of which contribute to the formation of competencies for the use of new technologies in the organization, design, implementation of teaching activities and the evaluation of results: Theoretical foundations of the integration of technology in teaching activity, creation of digital resources for teaching activity, use of new technologies in teaching activity, Technology-mediated communication, New technologies for creating Blended learning contexts, Selection and evaluation of educational software, Norms of conduct regarding the ethical and legal use of new technologies in education.

PEDAGOGY INTERNSHIP IN PRE-UNIVERSITY EDUCATION 1

This course provides hands-on experience in pre-university education through a structured pedagogy internship. Students will engage in practical teaching activities within pre-university educational settings, applying pedagogical theories and techniques learned in the classroom. The internship focuses on developing instructional skills, classroom management, and lesson planning. Students will gain real-world insights into educational practices, interact with students and educators, and reflect on their teaching experiences. By the end of the course, students will have acquired practical teaching competencies and a deeper understanding of the dynamics of pre-university education.

VOLUNTEERING 5

Effectively engage with communities, understanding their needs, and working collaboratively to address those needs through volunteer activities.

III Year, 2nd semester

Nr. Crt.	Denumirea disciplinei	Nr. ECTS	Ore/săptămână				Forma de evaluare
			C	S	L	P	
Discipline Obligatorii (Ob)							
1	Organe de masini 3 /Machines Elements 3	3	3		1		E
2	Schimb de caldura si masa /Heat and Mass Transfer	4	3	1	1		E
3	Dinamica masinilor /Dynamics of Machinery	3	2		2		E
4	Calculul structurilor mecanice /Computational Structural Mechanics	3	2	1	1		E
5	Organe de masini 3 - Proiect /Machines Elements 3 - Project	2				2	V
6	Administrarea afacerilor /Bussiness Administration	2	1	1			V
7	Tehnici de analiza si control aplicate in inginerie /Engineering analysis and control technics	3	2		2		V
8	Practică/ Internship	8	360 de ore				V
Discipline opționale (Op)							
9	Masurari mecanice /Mechanical Measurements	2	2		1		E
10	Sisteme de achizitie și interfete /Data Acquisition Systems and Interfaces						
Discipline facultative (F)							
11	Managementul clasei de elevi	3	1	1			E
12	Practică pedagogică de specialitate în învățământul preuniversitar 2	2	36 ore (12 săpt * 3 ore/săpt)				V
13	Examen de absolvire: Nivelul I	5					E
14	Voluntariat 6	3				4	V

MACHINES ELEMENTS III

The lecture is intended to provide the student with a clear and thorough understanding of both the theory and application of the fundamentals of mechanical transmissions. The third in a series of courses dedicated to the "anatomy" of machines, the course is focused on the components used to transmit power by rotation with constant or variable transmission ratio (gears, CVT-s, belt or chain drives, friction drives, couplings, and clutches).

HEAT AND MASS TRANSFER

This course acquaints students with the underlying principles of heat and mass transfer modes. 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.

Heat and mass transfer is a basic science that deals with the rate of transfer of thermal energy. It has a broad application area ranging from biological systems to common household appliances, residential and commercial buildings, industrial processes, electronic devices, and food processing.

Students are assumed to have an adequate background in calculus and physics. The completion of first courses in thermodynamics, fluid mechanics, differential equations, and numerical methods prior to taking heat transfer is desirable. However, relevant concepts from these topics are introduced needed.

This course is intended for engineering students in their third year, and as a reference text for practicing engineers. The objectives of this text are: to cover the basic principles of heat transfer, to present a wealth of real-world engineering examples to give students a feel for how heat transfer is applied in engineering practice and to develop an intuitive understanding of heat transfer by emphasizing the physics and physical arguments.

In engineering practice, an understanding of the mechanisms of heat transfer is becoming increasingly important since heat transfer plays a crucial role in the design of vehicles, power plants, refrigerators, electronic devices, among other things. The lectures cover the standard topics of heat transfer with an emphasis on physics and real-world applications. This approach is more in line with students' intuition and makes learning the subject matter enjoyable. Special effort has been made to appeal to students' natural curiosity and to help them explore the various facets of the exciting subject area of heat transfer. Yesterday's engineer spent a major portion of his or her time substituting values into the formulas and obtaining numerical results. However, now formula manipulations and number crunching are being left mainly to the computers. Tomorrow's engineer will have to have a clear understanding and a firm grasp of the basic principles so that he or she can understand even the most complex problems, formulate them, and interpret the results. A conscious effort is made to emphasize these basic principles while also providing students with a perspective at how computational tools are used in engineering practice.

Chapter I includes an expanded discussion of the relevance of heat transfer. The richness and pertinence of the topic are conveyed by discussion of energy conversion devices including fuel cells, applications in information technology and biological as well as biomedical engineering. The presentation of the conservation of energy requirement is largely emphasized.

Chapter II describes the heat diffusion mode or mechanism, known as thermal or heat conduction, quantified by the rate equation formulated by Fourier. General equation is derived from first principles and Fourier's Law and then simplified for a multitude of cases often seen in engineering applications.

Chapter III details engineering applications where steady one-dimensional conduction is relevant. Thermal resistance concept is defined and its easy use in analogy with electrical circuits is described. A selection of interesting problems is solved as examples of how this technique may be used. The study is then extended to 2-D problems that are solved sometimes analytically but mostly numerically.

With this occasion, numerical methods are succinctly covered to introduce students to practical approach of solving problems.

Chapter IV introduces the dimension of time for transient heat conduction. Analytical approach, as well as numerical approaches are presented for 1-D or 2-D engineering systems where dynamic behaviour is most likely to occur. Few relevant problems are solved as examples for the presented theory.

Chapters V-VI defines a complex heat and mass transfer that uses moving fluids over surfaces to enhance transport phenomena of thermal energy and/or species. In such situations, boundary layers are developed, and their properties use in engineering applications is overwhelming. Few relevant problems are solved as examples for the presented theory.

Chapter VII addresses flows through pipes and channels, known as internal flows, for which rating laws are specific and help quantification of processes in numerous industrial or building installations. Empirical equations are listed together with validity conditions to help students address experimental results in their approach to engineering. Few problems are solved to illustrate specific concepts.

Chapter VIII describes and analyses a wide range of heat exchangers which represents the largest engineering application of heat transfer. Analytical, graphical, and empirical approaches are presented to design or assess the real performance of such equipment. Problems are solved together with students from displayed diagrams and tables.

Chapter IX introduces the radiation of thermal energy, a mechanism with a high specificity and complex modelling equations. The course time allows for a brief approach of this subject, mostly its co-existence with conduction and convection in energy balances over systems contours.

Chapter X presents the particularity of phase-change phenomena and their multiple application in engineering. The work with diagrams and tables is illustrated for few numerical examples to provide students with the use of diagrams and/or numerical programs that are available on webs.

Chapter XI provides more examples for mass transfer, from water evaporation in buildings or nature to mass diffusion of various species in industrial equipment or installations.

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

DYNAMICS OF MACHINERY

The main objectives of the course are: (i) to ensure a basic understanding of vibration principles, basic rotordynamics phenomena and specific machinery faults, to guide the diagnosis and cure of vibration problems; (ii) expand the professional judgment about proposed solutions and the ability to critically

examine alternative solutions. The objectives of the applications are to: (a) identify suitable analytical models for predicting system response; (b) develop models of built-up structures using matrix methods and finite element models; (c) get an insight into the numerical techniques for the solution of eigenvalue problems; (d) use simple finite element programs (in house MATLAB/OCTAVE codes and commercial ANSYS - Classic code), to determine natural frequencies and mode shapes for structural systems, as well as critical speeds and unbalance response orbits of rotors; (e) understand the effect of bearings and seals on rotor precession. At the end of the course the students should be able to explain the major effects of altering mass, stiffness and damping of a system; understand and describe the various forms of energy dissipation mechanisms in structures; describe the dynamic behavior of continuous systems such as beams, plates, and the whirling rotating shafts; realistically model the rotor-bearing systems for vibration analysis and diagnose specific faults based on vibration measurement data.

Topics: *Degrees of freedom; Stiffness, mass, damping and gyroscopic matrix; Mode Shapes; Modal and harmonic analyses; Campbell diagrams, Natural frequencies. Resonance. Damping. Logarithmic decrement. Natural modes of vibration. Torsional vibrations. Geared systems. Lumped parameter vibrating systems. Modal analysis of vibrating systems. Finite element analysis of vibrating systems. Vibration limits. Standards and recommendations. Precession of rotors with rigid discs. Critical speed maps. Campbell and stability diagrams. Finite element modeling of rotor-bearing systems. Vibration in machines with hydrodynamic bearings. Vibration in machines with rolling bearings. Diagnosis of rolling element bearings. Vibration measurement for machinery monitoring. Specific faults of machines and their detection. Monitoring machinery operation condition. Computer assisted vibrodiagnosis. Computer programs.*

COMPUTATIONAL STRUCTURAL MECHANICS

The course objectives are: to learn the principles of calculus for mechanical structures using high-performance finite element codes; to apply methods for calculation of lifetime of cracked structures; to calculate structures made of composite materials.

Topics: *Review of main parameters in fracture mechanics. Review of Finite element concepts: fundamental equation; triangular and quadrilateral finite elements. Finite element modeling of stress singularity at the crack tip. Computational methods for determination of the stress intensity factor. The compounding method – theoretical background, applications. Fatigue and fracture: Paris law, crack propagation rate, fatigue lifetime. Classification and properties of composites. Laminated composites: Strength of a lamina. Strain-displacement relations. Laminate stiffness and compliance coefficients. Finite element modelling of composites.*

MACHINE ELEMENTS III- PROJECT

This project, which is in strong relationship with the courses “Machines Elements 2” and " Machines Elements 3" 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 with the ability to utilize specific design tools needed to execute a design. The tools are presented as examples of the general types of approaches that designers employ (empirical, semi-empirical and analytical methods).

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 draft for assembly drawing and for detail drawings and a 3D solid model allows to materialize all the previous knowledge acquired during the first 3 academic years.

Topics: *Power and speed calculation. Estimation of transmission efficiency. Selection of the electric motor. Optimization of the transmission ratio and calculation of torque and speed of each transmission stage. Selection of the motor mount from catalogues. Design and optimization of the V-belt drive. Design of the transmission. Selection of the gearbox and the elastic coupling from vendors catalogues. 3D-model of the transmission. Design of an one stage gear set (helical, bevel or worm). Gear sizing. Geometry of the gears. Forces in the gear-set. Strength calculation of the gears. Design of the other components of the gearbox. Shafts sizing. Bearing reactions and diagrams of moments. Bearings selection and calculation. Seals selections. Selection and calculation of shaft associated parts. Gearbox lubrication. 3D-model/3-views assembly drawing of the gearbox. 3D-model. Detail drawings for both shafts and the gear. Technical Report.*

BUSINESS ADMINISTRATION

The purpose of the course is to completely integrate the area of economic subjects thought to engineering students with an applied project in the area of business administration and entrepreneurship. Three major components comprise the course: initial analysis (marketing environment, promotion, price, distribution, product) for an organization/product, the development of future strategies with ethical, competitive and environment considerations and the implementation plan. Students are asked to complete a business plan on a new product or a new business in the market and all the mandatory steps are followed to launch the idea in the market. Another objective of the course is to encourage teamwork, most of the projects are completed in teams and if it’s possible in a multicultural team.

Topics: *C1. Marketing introduction. The marketing environment C2.Consumers behavior and target market C3.Product decisions C4.Distribution decisions C5.Promotion decisions C6.Price decisions C7.Social media marketing.*

ENGINEERING ANALYSIS AND CONTROL TECHNICS

The entire range of equipment and devices appearing on the market today, whether for defense or health or industrial or personal use, all contain within them various forms of increasingly advanced technologies with very well-defined capabilities and demonstrated, so made at a very advanced engineering level. All these engineering products involve in the production chain dedicated analysis and control techniques and of course require highly trained engineering personnel, able to understand these advanced measurement and control techniques and able to control them and therefore use them in the production process in who is involved. This is the objective necessity of this course.

This course provides a broad introduction to a variety of analysis and control techniques and equipment useful in engineering in general and mechanical engineering in particular. This course is mainly based on the introduction of non-destructive testing and analysis techniques of materials and components used in engineering. The course offers students the opportunity to learn the most advanced techniques existing today in science and technology, in engineering, such as FTIR, RAMAN, UV-vis, AFM, SEM, XRD, Optical Microscopy, TEM techniques.

The topics covered in this course will include:

- Properties of materials used in the mechanical industry in manufacturing processes.
- The methods of characterizing various materials and the rational selection of analysis and control methods.
- Qualitative and quantitative analysis by micro-Raman spectroscopy, FTIR spectroscopy and UV-vis.
- Qualitative and quantitative phase analysis by X-ray diffraction.
- Scanning electron microscopy, SEM and EDAX compositional analyses.
- Real-space and 3D visualization techniques of atoms and nano-materials, e.g., AFM, MFM, PCM, etc.

During lab hours, students will improve their self-learning, hands-on skills on various equipment, and teamwork.

PRACTICAL WORKSHOP

This internship course is designed to bridge the gap between academic training and the labor market by providing students with hands-on experience in real-world settings. The primary objective is to enhance students' skills and facilitate their swift transition into professional roles. Through practical training in companies, organizations, and research units, students will engage with software

engineering, systems engineering, and application development in a dynamic work environment.

The course emphasizes the development of key professional competencies, including conducting bibliographic research on specific topics, strengthening communication skills, and improving teamwork and project planning abilities. Students will also focus on effective time management and apply theoretical knowledge to practical problems.

The internship is structured as a comprehensive design experience, allowing students to integrate and apply their learning in a real-world context. By participating in this practical training, students will gain valuable industry insights, enhance their professional skills, and prepare for successful careers in their chosen fields.

MECHANICAL MEASUREMENTS

The objective of the course is to provide students with the knowledge and working methods necessary to initiate an experimental research program, design a measurement chain or computerized data acquisition system and measure the main types of physical quantities (forces, pressures, temperatures, speeds, etc.)

Topics: *1. Introduction to measurements 2. Measuring standards. Calibration 3. Measurement characteristics 4. Measuring systems 5. Analog and digital sizes 6. Data transmission 7. Parametric transducers 8. Generators transducers 9. Wheatstone Bridge 10. Forces and moments measurement 11. Pressure measurement 12. Position and speed measurement 13. Vibration measurement 14. Temperature measurement*

DATA ACQUISITION SYSTEMS AND INTERFACES

Instrumentation, measurements and data acquisition are essential technologies in all areas of engineering. This course is designed to provide an active learning environment for students who are learning the basics skills of engineering measurement and data acquisition.

The course aims to provide students with an understanding of the properties of transducers and electronic circuits (signal conditioning and filtering) needed to interface transducers to a data acquisition system This course covers topics about the fundamentals of engineering measurements, transducer selection, signal conditioning, measurement system design, test design, and data analysis. It also addresses the interface of transducers with the use of different digital data buses. Students who take this module also receive programming skills with LabVIEW from the National Instrument for Data Acquisition and Processing.

The learning process will be co.mpleted through regular lectures, group discussions, laboratory exercises and a team project.

Topics: *Software solutions for a data acquisition system – LABVIEW, Analog and digital signals. Sampling, Conversions. Transmission, Active / passive transducers, Measurement with Data Acquisition Systems, Communication interfaces, Modern trends in data acquisition (Industry 4 and 5).*

STUDENT CLASS MANAGEMENT

The course offers a comprehensive approach to managing student classes effectively, focusing on strategies and techniques for creating a positive and productive learning environment. Students will gain practical skills and theoretical knowledge essential for successful classroom management and student engagement.

Goals:

- Learn to organize and structure the classroom environment to support learning, including physical layout, resources, and materials management.
- Develop techniques for managing student behavior, including setting clear expectations, implementing disciplinary procedures, and fostering a respectful classroom culture.
- Acquire skills in planning and delivering lessons that are engaging and effective, including setting objectives, designing activities, and adapting instruction to meet diverse student needs.
- Explore methods to enhance student motivation and engagement, using strategies to inspire participation and maintain interest in the subject matter.
- Learn to assess student performance and provide constructive feedback that supports learning and development.
- Gain techniques for resolving conflicts and improving communication between students, parents, and colleagues to create a harmonious learning environment.
- Understand how to integrate technology effectively into classroom management, including the use of educational software and online tools to enhance instruction and engagement.

By the end of the course, students will be well-prepared to manage classroom dynamics effectively, apply best practices in teaching and behavior management, and create an optimal learning environment for all students.

PEDAGOGY INTERNSHIP IN PRE-UNIVERSITY EDUCATION 2

This course builds on the foundational experiences gained in the initial pedagogy internship, providing advanced, hands-on experience in pre-university educational settings. The focus is on refining teaching skills and applying pedagogical theories in real-world classrooms to enhance educational practices.

Goals:

- Further develop and implement advanced instructional strategies, including differentiated instruction, formative assessment, and interactive teaching methods tailored to diverse learning needs.
- Enhance skills in managing classroom dynamics, addressing complex behavioral issues, and creating a positive and inclusive learning environment.
- Design and execute detailed lesson plans that incorporate innovative teaching practices, integrate technology, and engage students effectively.
- Refine techniques for assessing student progress, providing feedback, and using assessment data to inform instructional decisions and support student development.
- Engage in reflective practice by analyzing teaching experiences, receiving and incorporating feedback, and continuously improving instructional approaches.
- Collaborate with mentor teachers, engage in professional development activities, and contribute to school or educational community projects.
- Develop skills in documenting teaching practices, preparing detailed reports, and presenting findings or reflections on the internship experience.

The course emphasizes practical application, encouraging students to integrate theoretical knowledge with classroom practice while addressing real-world challenges in pre-university education. By the end of the course, students will have deepened their teaching expertise, refined their pedagogical techniques, and prepared for a successful career in education.

STUDY FINALS EXAM: LEVEL 1

This course is designed to prepare students for the Level 1 Study Finals Exam in Pedagogy, serving as a comprehensive review and assessment of pedagogical knowledge and practices acquired throughout their studies. The course focuses on consolidating theoretical understanding and practical skills essential for success in the final examination and professional teaching roles.

Goals:

- Revisit core pedagogical theories and frameworks, including constructivism, behaviorism, and instructional design principles, ensuring a deep understanding of their application in educational settings.
- Critically analyze and evaluate various teaching practices and methodologies, including lesson planning, classroom management, and assessment strategies.
- Engage in targeted review sessions covering key topics that will be examined, including

curriculum design, educational psychology, and effective instructional techniques.

- Apply theoretical knowledge to practical scenarios through case studies, simulations, and problem-solving exercises that mirror potential exam questions.
- Enhance critical thinking and problem-solving skills necessary for the exam, focusing on interpreting and analyzing educational problems and solutions.
- Participate in mock exams to simulate the test environment, receive feedback, and refine exam techniques and strategies.
- Learn effective study and time management strategies to optimize preparation and performance during the finals.

The course provides a structured approach to revising key content areas and practicing exam skills, preparing students to demonstrate their pedagogical competence and achieve success in the Level 1 Study Finals Exam for Pedagogy.

VOLUNTEERING VI

Effectively engage with communities, understanding their needs, and working collaboratively to address those needs through volunteer activities.

IV Year, 1st semester

Nr. crt.	Denumirea disciplinei	Nr. ECTS	Ore/săptămână				Forma de evaluare
			C	S	L	P	
Discipline Obligatorii (Ob)							
1	Instrumente software in ingineria mecanica II /Software Tools for Mechanical Engineering II	4	2		2		V
2	Tribologie /Tribology	5	2		2		E
3	Dezvoltarea de produse inovante /Design of Innovative Products	3	1			2	V
4	Aplicatiile nanotehnologiei in ingineria mecanica /Nanotechnology applications in mechanical engineering	3	1			2	E
5	Masini termice I (Motoare cu ardere interna) /Heat Engines I (Internal Combustion Engines)	6	2		1	2	E
6	Management /Management Fundamentals	2	1	1			V
Discipline optionale (Op)							
7	Electronica Aplicata /Applied Electronics	4	2		1		E
8	Mecanica fluidelor si Masini hidraulice /Applied Fluid Dynamics (Pumps)						
9	Automatica /Control Theory						
10	Managementul calitatii in industrie /Quality Assurance	3	2		1		E
11	Optimizari in inginerie mecanica /Optimisations in Mechanical Engineering						
Discipline facultative (F)							

SOFTWARE TOOLS FOR MECHANICAL ENGINEERING II (THERMAL DESIGN)

This course aims to familiarize students with the main approaches and mathematical models in the field of thermal systems, implemented in one of the most used specialized software, namely Equation Engineering Solver (EES). As a specific topic, the discipline approaches the advanced notions regarding the concepts and principles specific to the field of thermal design, all of which contribute to the transmission/formation to/of students of an overview of the methodological and procedural milestones related to the field. For the successful completion of the discipline, knowledge in the field of computer programming, numerical methods, engineering thermodynamics and heat and mass transfer is required. During the course, the EES specific programming techniques are presented and applied to numerically simulate the behavior and performances of some thermal systems, such as heat engines, the fuel combustors, heat exchangers, systems of cogeneration, combined gas-steam cycles and solar conversion energy systems.

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 design solutions of elements and systems.

Topics*: Introduction. Subject definition. Historical background. Economic consideration. Lubrification issues. Friction and wear issues. Contact of mechanical components. Classification and characterization of friction pairs. Contact area. Physical and geometrical characterization of metallic surfaces. Roughness. Elastic contacts. Hertz model for stress and strain calculation in linear and elliptic contacts. Lubricanți. Classification. Mineral oils. Additives. Sinthetic lubricants. Properties of liquid lubricants. Viscosity and its dependence on temperature and pressure. Newtonian and non-Newtonian liquids. Greases. Hydrodynamic (HD) Lubrication. Isothermal Reynolds eq. for 1D and 2D configurations. Parallel gap. Step (Rayleigh) slider. Plane-inclined slider (convergent gap). Aplications to HD thurst bearings, seals, viscous pumps etc. Heat balance. Numerical solution for Reynolds eq. Hydrodynamic journal bearings. The mechanism. Geometryof the gap. Narrow journal bearing model. Numerical solutions (2D) to calculate finite length HD journal bearings. Squeeze film effects. Circular and rectangular configurations. Hydrostatic (HS) lubrication. Overview. Thrust bearings in constant flow system (load, flow rate, stiffness, power loss). Multi-recess HS systems. Recess optimization. Application of HS lubrication to aligned mechanical face seals. Elastohydrodynamic (EHD) lubrication. Macro-EHD efects for conformal pairs. EHD lubrication for non-conformal pairs. Mathematical model. Numerical solutions. Aplications to rolling bearings, gears, cams and EHD friction drives. Dry Friction. Laws and theories (simple and extended adhesion theory; ploughing effect) for sliding friction. Methods for friction coefficient measurement. Friction regimes. Striebeck curve. Methods to predict friction regimes. Boundary lubrication. Mixed lubrication. Wear. Definition. Indicators. Wear variation in time. Main mechanisms as wear (adhesive, abrasive, surface fatigue-pitting-, fretting). Methods of calculation. Solutions to reduce wear.*

DESIGN OF INNOVATIVE PRODUCTS

Objective: Developing skills in developing a strategy to create a competitive advantage by innovating, to ensure development and even survival in an aggressive competitive environment; knowing the need for systematic exercise of innovative activity.

Topics: *1. Innovation: definitions and typologies 1.1. The context and importance of innovation. 1.2. Innovation: definition. 1.3. Typologies of innovation. 1.4. Classification of innovations. 1.5. Innovation management. 1.6. The causes of innovation failure and success factors. 1.7. The matrix model of innovation management. 1.8. Techniques of creativity. 1.9 Sources of Innovation. 2.*

Enterprise Strategy and Innovation 2.1. Defensive strategy; offensive strategy. 2.2. Strategy. Decision levels. 2.3. Position targeted on the market. 3. Strategic marketing and its environment 3.1. Marketing: concept, evolution. 3.2. Strategic marketing and operational marketing. 3.3. Analysis of the need and definition of the reference market. Functional analysis of need 3.4. Conceiving a customer-oriented marketing strategy. 3.5. Market segmentation, target marketing. 3.4. Strategic marketing in the enterprise and its environment; analyzing attractiveness in terms of quantity (dynamic) and dynamic (product life cycle). Elaboration of the marketing strategy 4. SWOT analysis 5. Operational marketing. 5.1. The marketing mix. 5.2. The product. 5.3. Price. 5.4. Placement. 5.5. Promotion. 6. Functional technical analysis 7. Production 7.1. Production and manufacture of products. 7.2. Organization of production (spatial, temporal, logistic). 7.3. Production Management. 7.4. Production costs. Executive summary

NANOTECHNOLOGY APPLICATIONS IN MECHANICAL ENGINEERING

The course forms competences, skills and gives students the knowledge necessary to use the methods and techniques of analysis and control of materials used in advanced mechanical engineering. Also, through its content and approach, the course is designed to develop creativity and interest in deep investigating the field, including research activities.

Topics: *1. What is nanotechnology? Motivation for the study of nanotechnology. 2. Investigation and handling of materials at nanometer scale. 3. Micro- and nano-manufacturing/fabrication. 4. Nanoscale mechanical properties of solids and thin film surfaces. 5. Nano-devices. 6. Nano-sensors for biology and medicine. 7. Nano-molecular machines and ethics of nano-materials use. 8. Nano-tribology - Friction and wear at the atomic scale 9. Social implications of nanoscience and nanotechnology. 10. Recapitulation and fixation of acquired notions. Reflections for the future.*

HEAT ENGINES I (Internal Combustion Engines)

The course objective is to provide the corresponding concepts on knowledge concerning structure, operating, design and practice of the internal combustion engines. In this sense, there are discussed fundamental bases for engine design, development and manufacturing. In the same time are emphasized the main parameters which characterize performance, efficiency, and emissions which are produced by spark ignition and diesel engines. There is discussed in details the influence of different parameters on engine's characteristics, the reliability and manufacturing and service costs. The engine's operating processes are analyzed from point of view of thermodynamics, combustion development, fluid flow, heat and mass transfer and effects of fuel's chemical and physical properties.

Methods and instrumentation used for theoretical and experimental investigations to performing engine research, development and optimization are described too.

Topics*: 1 Introduction 2 Gas exchange processes 3 Combustion in Spark – Ignition Engines 4 Combustion in Compression – Ignition Engines 5 Heat transfer 6 Engine mechanism kinematics and friction.*

MANAGEMENT FUNDAMENTALS

The object of the discipline "Management Fundamentals" is to complete the students' education through there familiarization with the fundamental technical, economic and managerial notions.

Some of 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 be familiarized with the basic tools used in management; to acquire skills in approaching the decision process through information and calculus; to understand the role and importance of management in the future activity of graduates and to understand the basic technical and economic notions. The topics covered by the course are: Management – art or science? Managers. Foreseeing in management. Activity organization. Directing employees. Coordination and control.

Topics: *Management – art or science? Managers. Definition and importance of management. Evolution of management thinking. Management function. Role of managers in the contemporary society. Foreseeing in management. Elements of the managerial foreseeing process. Tools of the managerial foreseeing process. Decision-making process. Business planning. Assess the business ideas. Business planning. Organizing the activities. Elements of an organizational structure. Development of an organizational structure. Job design. Leading the people. Process of human resource management. Groups. Managers' traits and managerial behavior. Inter personal and organizational communication. Motivation and performance. Coordination and controlling. Mechanism of activities' coordination. Coordination methods. Result control.*

Prof. Radu STANCIU

APPLIED ELECTRONICS

The course is focused on various aspects of electronic devices and circuits, being oriented to applied and technological electronics topics necessary to be known for the design and manufacturing of electronic modules and systems. The first chapter is allocated to an introduction in electronics, electronic products development stages and main emerging electronics technologies. The second chapter describes the passive electronic components and circuits, with accent on resistors and capacitors, including some fundamental circuits based on passive electronic components. The third

chapter treats printed circuit boards (materials, technologies, fundamental design rules, etc.). The fourth chapter is focused on active discrete components and presents semiconductor and p-n junction properties (intrinsic and extrinsic semiconductors, p and n type), characteristics of junction diode, rectifier diode, Zener diode and voltage regulator circuits, light emitting diode (LED) and display, bipolar junction transistors (structure of pnp and npn transistors, the current flow mechanism, Ebers-Moll model, CE, CC and CB connections, input, output and transfer characteristics, DC bias point, regions of operation), field effect transistors, MOS field effect transistors, thyristors, diacs, triacs, some optoelectronic devices, etc. The fifth chapter presents analog electronic circuits: amplifiers (single and multiple stages, audio amplifiers, design of amplifiers), negative and positive feedback, integrated analog circuits, operational amplifiers (device description, characteristics, equivalent circuits, buffer, inverting amplifier, non-inverting amplifier, algebraic summer, comparator). In the last chapter, the sixth, fundamentals of digital electronic circuits are presented: introduction to digital concepts, numbering systems and codes, logic gates, boolean algebra, implementation of logic equations, memory elements (clock, preset and clear signals, RS latch, D latch, D flip-flop, JK flip-flop, T flip-flop), shift registers, counters, decoders, encoders, multiplexers, demultiplexers, and comparators.

Topics*: 1. Introduction to electronics 1.1 Basics of Design and Manufacturing in the Electronics Industry 1.2 Modern technologies in the electronics industry. 2. Passive electronic components and circuits 2.1 Resistors 2.2 Capacitors 2.3 Inductors and transformers 2.4 RL, RC, RLC circuits 3. Printed Circuits (PCB) 3.1 Introduction to PCB 3.2 Manufacturing technologies 3.3 Providing communication between the designer and the manufacturer 4. Discrete active electronic components 4.1 Properties of semiconductors and of p-n junctions (intrinsic and extrinsic semiconductors of p and n types, diffusion and drift current) 4.2 Junction diode, characteristics, graphical analysis, diode and rectifier circuits, Zener diode and regulation circuits, LED diode and display 4.3 Bipolar transistors (structure of pnp and npn transistors, current flow mechanism, Ebers-Moll model, EC, CC and BC connections, input, output, transfer, static, operation regions), field effect transistors, MOS field effect transistors 4.4 Thyristor, diac, triac, optoelectronic devices 5. Analog electronic circuits 5.1 Amplifiers (single and multiple stages, audio amplifiers, amplifier design) 5.2 Negative and positive feed-back 5.3 Analog components and integrated circuits, operational amplifiers (description, characteristics, equivalent circuits, buffer, inverse amplifier, noninvers amplifier, algebraic summer, comparator) 6. Digital electronic devices and circuits 6.1 Introduction to Digital Concepts, Systems and Numeric Codes, Logical Gates, Boolean Algebra, Implementation of Logic Equations 6.2 Memory elements (clock signals, "preset" and "clear", RS latch, D latch, D type bistable circuit, JK type bistable circuit) 6.3 Shift registers, counters, coders, decoders, multiplexors,*

demultiplexors, comparators 6.4 Advanced digital components (microcontrollers and microprocessors) and advanced digital circuits.

APPLIED FLUID DYNAMICS (PUPMPS)

The course aims to provide students with the basics of Applied fluid Dynamics, including dimensional analysis and similarity theory, fundamental notions of real fluids in laminar and turbulent flows through pipes and turbopumps. A balance is sought between presenting the physics of phenomena, discussing qualitative aspects, writing equations, conducting measurements and solving practical problems.

Nanotechnology applications in mechanical engineering

The entire range of equipment and devices appearing on the market today, whether for defense or health or industrial or personal use, all contain within them various forms of increasingly advanced technologies with very well-defined capabilities and demonstrated, so made at a very advanced engineering level. All these engineering products today involve in the production chain materials, techniques and processes related to what today we call nanotechnology and of course they require a very well trained engineering staff, able to understand the nature of nano-materials, how they are used, including their possible toxicity and in at the same time to know and master advanced measurement and processing techniques in nanotechnology. This is the objective necessity of this course.

This course provides a broad introduction to a variety of techniques useful in nanotechnology, nano-materials investigation and manipulation, micro- and nano-fabrication processes, advanced nano-tribology evaluations, etc. This course is mainly based on the introduction of analytical and metrology techniques used in the field of nanotechnology. The course offers students the opportunity to learn the most advanced techniques existing today in nanotechnology, such as AFM, SEM-EDX, STEM, PLD, XRD techniques.

The topics covered in this course will include:

- Investigation and manipulation of nanoscale materials.
- Micro- and nano-fabrication.
- Nanoscale mechanical properties of solid surfaces and thin films. • Nano-devices.
- Molecular nano-machines and the ethics of using nano-materials.
- Nano-tribology - Friction and wear at the nanoscale and atomic scale. • Social implications of nano-science and nanotechnology.

During lab hours, students will improve their self-learning, hands-on capabilities on various equipment, and teamwork.

CONTROL THEORY

Objectives: to know the main basic components symbols and operation principle, basic rules of connecting, sizing, commissioning and fault detection for the fluid power systems.

Topics: *Structure and operation of fluid control systems; control systems performance; common examples of control systems; practical analysis and design methods for control systems. Mathematical modeling of control systems by transfer functions. Modeling control systems in state-space. Transformation of mathematical models with MATLAB. Mathematical modeling of mechanical, electrical, fluid and thermal control systems. Transient and steady-state response analyses of first, second, and higher order systems. Routh's stability criterion; effect of integral and derivative control on system performance. Control systems analysis and design by the root-locus method. Control system analysis and design by the frequency-response method; Nyquist stability criterion. PID controllers; ZieglerNichols rules for tuning PID controlers; automatic PID tuning using SIMULINK. Controllability and observability; robust control systems. Analysis and synthesis of control systems by Control Toolbox and Identification Toolbox. Control systems optimization by simulation with Hardware-in-the-Loop.*

QUALITY ASSURANCE

In the current context, implementation of quality management systems is mandatory in certain organisations, framed in Regulated field, in other organisations the approach is voluntary, but strongly recommended by the international practices and the global economy.

Irrespective of the regulated framework, understanding and practicing by the students of the specific vocabulary, knowledge of the quality management principles (customer focus, leadership, people engagement, process approach, continuous improvement, evidence-based decision making, partnership management) allows transparency, organisation, performance improvement and competitive market positioning.

The subject offers a broad perspective connecting technical elements (control of non-conforming product) to process / processing mechanical products (methods and tools for quality assurance and control) and the global system where the company performs in a competitive manner.

Students' teamwork is facilitated based on homework, laboratory activities and oral presentation integrating previous students' experiences in companies (internships).

Objective: knowledge acquiring on design, implementation and continuous improvement of quality management systems in industrial organizations and supplier chains – commitment for quality, QMS documentation design, quality management related standards for organizations' performance improvement and sustainable development.

Topics*: General elements and concepts in quality field: concept evolution, quality characteristics, quality control / assurance / management concepts, motivation and commitment for quality, client requirements versus organizational performance, national and international standards and conformity / quality related legislation. Quality management system: concepts, practicality versus bureaucracy, management / staff motivation for QMS, QMS design, quality system documents, requirements and features of the ISO 9001:2015 standard. Quality certification: conformity certification, product and quality management system certification, European Conformity label CE, certification bodies, certification procedures, personel certification, supplier conformity declaration, laboratory accreditation in accordance to ISO 17025, impact of conformity certification on consumer (consumer protection). Monitoring & measurement: measurement uncertainty, processes monitoring, non-conforming product, measurement device monitoring, monitoring and measurement of consumer satisfaction, complaints handling ISO 10001, 2, 3, 4. Continuous improvement: self-assessment (ISO 9004), corrective / preventive actions, internal audit of QMS (ISO 19011), audit role in organizations and link to management analysis. Quality control: control methods classification, statistical techniques, correlation quality assurance / quality control, SPC ISO 10017. Economic aspects related to quality: costs of non-quality, client versus company perspective, ISO 10014, quality added value.*

OPTIMISATIONS IN MECHANICAL ENGINEERING

The course aims to teach the basic principles and fundamental methods for the numerical resolution of optimization problems, as well as the correct formulation of an optimization problem and related notions.

The basic techniques for the numerical resolution of an optimization problem, the theory of the extremity of functions and variational calculus are presented. Participating students learn to program in Matlab to solve optimization problems and solve optimal control problems. Among the topics covered are: the mathematical formulation of an optimization problem, the fundamental notions of optimization, the elements of the calculation of the extremes of functions, the elements of variational calculus, the resolution of optimal control problems, the maximum principle (Pontriaghin), the gradient method, dynamic programming (Bellman method). The applications are oriented towards the optimization of energy systems under certain conditions, with certain restrictions.

IV Year, 2nd semester

Nr. Crt.	Denumirea disciplinei	Nr. ECTS	Ore/săptămână				Forma de evaluare
			C	S	L	P	
Discipline Obligatorii (Ob)							
1	Instalatii frigorifice si de conditionare a aerului /Refrigeration and Air Conditioning	5	2	1	2		V
2	Ingineria mediului /Environmental Engineering	3	2	1			V
3	Compresoare si ventilatoare /Compressors and Fans	3	2			1	V
4	Actionari hidraulice si pneumatice /Fluid Power Systems	3	2		1		V
5	Masini termice II (Turbine & Gen. de abur) /Heat Engines II (Turbines & Steam Generators)	4	2		2		V
6	Elaborarea proiectului de diploma /Diploma Project	4				8	V
7	Practica pentru elaborarea proiectului de diploma /Diploma Project Internship	6	60 ore (2 sapt *30h/s)				V
Discipline optionale (Op)							
8	Proiectarea echipamentelor termice / Design of thermal systems	2	1			1	V
9	Managementul proiectelor industriale /Industrial Project Management						
Discipline facultative (F)							

REFRIGERATION AND AIR CONDITIONNING

The objectives of the lecture are to describe the operating principles at individual components and system levels for refrigeration and air conditioning equipment, to understand and apply design and testing methods, to find the optimum design and operation of refrigeration and air conditioning system based on technico-economic criteria.

Topics: *1. Refrigeration systems. Basic concepts. The throttling effect for real gases (the Joule-Thomson effect) 2. Classification of the refrigeration systems 3. Refrigeration systems with mechanical compression of vapors (MCV) 3.1 One stage MCV 3.2 Conventional regimes for MCV 3.3 Two-stage MCV 3.4 Cascade MCV 4. Absorption refrigeration systems (ARS) 4.1 Diagrams for calculating ARS. Enthalpy – Composition diagram (h - ξ) for the Ammonia-Water solution. lnp – 1/T*

diagram. Representing of basic processes in the h - ξ diagram. 4.2 Thermal calculus of the one-stage ARS. 5. Ejection refrigeration cycles 6. Air conditioning systems. Psyhrometrics - basic concepts. Absolute humidity. Relative humidity. Humidity ratio. The Dew point. Density of the moist air and the mixture constant. Enthalpy of the moist air. The H-x diagram for the moist air. Moist air Conditioning Processe. Dry cooling and heating of the moist air. Mixing of moist air currents. Humidification with water or vapors. Drying.

ENVIRONMENTAL ENGINEERING

The course begins with a brief introduction of general background information regarding environmental issues and the field of environmental engineering. The most common types of harmful gaseous, liquid and solid emissions from industrial processes associated with the main areas responsible for environmental pollution are presented. Discussions about pollutant emissions focus on toxicity, effects on environmental health and limits allowed by national and European regulations. Special attention will be paid to the impact of pollutant emissions on the ecosystems of which the environmental components are part, including the implications on the ability of ecosystem to provide expected services, biodiversity loss, anoxia and eutrophication of water bodies.

With the participation of the students, case studies will be chosen for which the main systems/installations that can be used to reduce and control solid, liquid and gaseous emissions will be presented. In this context, the mechanisms for emission generation will also be presented.

The course will address the issue of waste management as well, ecological storage, solid waste treatment methods and equipment, associated pollutant emission monitoring systems, as well as emerging technologies that integrate the principles of sustainable development in the context of climate change.

Completing this course will allow students to accumulate specific knowledge for the insertion of mechanical engineering in current strategic fields: Circular Economy, Bioeconomy, Integration of unitary operations for sustainable development, Emissions related to renewable energy production facilities, Environmental regulations, Environmental footprint of the activity human.

Topics: *Introduction. Generalities. Effects towards human health and environment. The most frequently noxious flue gas emissions. Power plants as pollutant sources. Phonic pollution. Control of solid matter pollution from fixed sources. Solid maters pollution upon the environment. Special equipment for dust removal. Control of NOx emissions. Formation mechanisms, reducing methods, most frequently used equipment. Control of SOx emissions. Formation mechanisms, reducing methods, most frequently used equipment. Carbon monoxide emission. Other pollutants: nuclear plants, di- oxine emissions, and residual water. Main monitoring systems. Waste sustainable deposits. Treatments methods and equipment. European programmes and norms for sustainable development.*

COMPRESSORS AND FANS

The course aims to present the processes, characteristics and construction elements of the compressors and fans. The purpose of the course is to understand the principles of operation and sizing of various types of compressors used in engineering. Students are required to design a sizing project for these cars working in teams.

Topics: *1.Introduction 1.1 Fundamental notions; 1.2 Classification of compressors; 1.3 Choosing the compressor type 2.Thermodynamic bases of gas compression processes 2.1 The behavior of real fluid; 2.2 Theoretical and actual compression processes. 3. Positive displacement compressors 3.1 Classification 3.2 Components of the piston compressor 3.3 Thermodynamic compressor diagrams 3.4 Multi-stage compressors 3.5 Computation scheme of a multi-stage compressor 3.6 Piston compressor flow control 4. Rotodynamic compressors 4.1 Elements of gas dynamics 4.2 Theorem of Euler 4.3 Rotalpy 5. Centrifugal compressors 5.1 Components of the centrifugal compressor; 5.2 Thermodynamic analysis of the compression process; compression ratio; the mechanical work required for compressing; isentropic efficiency 5.3 Mono-dimensional gas flow through the compressor; triangles velocity; load and flow coefficients. 5.4 Two-dimensional inviscid flow elements. Distribution of the relative velocity and pressure in the rotor channel; 5.5 Losses in centrifugal compressors 5.6 Dimensional analysis. Maps of centrifugal compressors 5.7 Multistage centrifugal compressors 6 Axial compressors 6.1Components of axial compress 6.2 Thermodynamic analysis of compression process; distribution of mechanical work on compressor stages. 6.3Monodimensional inviscid flow through the compressor stage; velocity triangles; number of blade for the stage 6.4 Profiling lows of the blades 6.5 Stage losses 6.6 Dimensional analysis; map of axial compressors. 7 Fans 7.1 Fan definition 7.2 Axial fans 7.3 Radial fans 7.4 Techniques for controlling fans 7.5 Maps of fans.*

FLUID POWER SYSTEMS

General objective: to know the main basic components symbols and operation principle, basic rules of connecting, sizing, commissioning and fault detection for the fluid power systems. According to Mechanical Engineering Subject Area, the student should be able to:

1. Identify, define, and use the knowledge given by fundamental subjects specific to the engineering field of study.
2. Use fundamental laws and graphical tools to describe and design mechanical systems and processes.
3. Select, install, exploit and maintain systems in the field of mechanical engineering.
4. Apply methods of design, analysis and testing of mechanical elements and systems.

5. Read the obtained solutions for mechanical systems based on technological, operating, functional and economic criteria.
6. Implement and coordinate the quality-environment management and marketing system.

The student should be able to:

1. Observe the fundamental laws, principles, norms and codes of professional ethics by applying an appropriate efficient and responsible strategy in problem solving and decision-making.
2. Apply communication and multidisciplinary teamwork techniques, across various levels of hierarchy, depending on the specific project management.
3. Correctly use life long efficient learning techniques; appropriately use information and oral and written communication in a foreign language of international circulation.

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. Simulation of the basic control systems behavior. Hydraulic power supplies. Pneumatic drives.*

HEAT ENGINES II (Turbines & Steam Generators)

The course is included in the category of those aimed at deepening the notions of specialized technical culture, being intended to demonstrate the need to use knowledge of mathematics, physics, chemistry, resistance of materials, thermotechnics, fluid mechanics, material science, heat transfer, etc. in engineering.

The course is close to the field of local, industrial and system energy engineering, addressing two main chapters: 1. Classic and nuclear heat generators; 2. Steam and gas turbines.

The first part of the course deals with the analysis of the construction of a heat generator, passing through the elementary notions of fuels and their use, followed by sub-chapters on installations and combustion chambers, heat transfer to cooling agents, the flow of combustion gases and the formation of polluting compounds, as well as the energy efficiency of this type of installations.

The second part of the course deals with the use of heat obtained from the processing of fuels in combustion chambers or reactors, expanding the obtained fluids in steam or gas turbines.

For each of the facilities presented, certain key aspects related to manufacturing, assembly and operation are detailed. The associated laboratory is composed of two distinct parts:

1. The laboratory for the analysis of heat generators
2. The laboratory for the analysis of steam and gas turbines.

In the laboratory, students will confront the notions acquired during the course and learn to use certain tools needed in the thermal energy industry.

Topics: *Steam boilers. Fossil Fuels and alternative/renewable fuels. Combustion and material balance. Boilers types. Thermal efficiency and heat losses. Pollutant emissions and environment protection. Vapor and combined cycle power plants analysis. Fundamental laws applied to turbines Study. Turbine stage theory and design. Analysis and design of main turbine components. Turbine control system.*

DIPLOMA PROJECT

This course focuses on the application of fundamental and specialized knowledge to solve complex technical problems in mechanical systems. Students will learn to execute their projects by identifying clear objectives, utilizing available resources efficiently, and adhering to timelines. The course also emphasizes the scientific writing skills necessary for composing a professional graduation project.

Goals:

- Apply both fundamental and specialized knowledge to address and solve complex technical issues in the field of mechanical systems.
- Learn to precisely identify project objectives, manage resources effectively, and adhere to project timelines. Develop the skills necessary for successful project planning and execution.
- Acquire the skills needed for scientific writing and documentation. Learn to write a comprehensive and professional graduation project that meets academic and industry standards.
- Enhance problem-solving skills by tackling real-world technical challenges. Learn to apply theoretical concepts to practical scenarios.
- Develop the ability to efficiently utilize available resources, including materials, time, and human resources, to achieve project goals.
- Learn to present your project findings and methodologies clearly and professionally, both in written and oral formats.

By the end of the course, students will be proficient in applying their technical knowledge to solve complex problems, managing projects effectively, and presenting their work in a scientifically rigorous manner. They will be prepared to undertake and complete their diploma projects with a high level of professionalism and competence.

The project is developed under the guidance of a supervisor. The supervisor is chosen by the student among the professors teaching at this division.

For ERASMUS students it is advisable to avoid choosing this subject since they should specify in the learning agreement the subject of the thesis and the coordinating professor (difficult to be set before arrival and also difficult to be set in the first weeks of school without knowing the professors and subjects).

DIPLOMA PROJECT INTERNSHIP

This intensive internship is designed to provide students with hands-on experience in applying their academic knowledge to real-world technical projects. Over the course of two weeks, students will work on their diploma projects within a professional setting, dedicating 60 hours to the execution of their project tasks. This experience aims to bridge the gap between theoretical learning and practical application, enhancing students' technical, project management, and professional skills.

Goals:

- Apply fundamental and specialized knowledge in a real-world environment to solve complex technical problems relevant to the student's diploma project.
- Develop and refine project management skills, including setting clear objectives, managing resources, and adhering to strict timelines.
- Gain firsthand experience in a professional setting, working alongside industry professionals and learning about workplace dynamics and expectations.
- Enhance technical skills through hands-on work, problem-solving, and direct application of theoretical concepts.
- Improve professional communication and collaboration skills by working as part of a team, presenting progress, and receiving feedback.
- Further develop scientific writing and documentation skills by maintaining detailed records of project progress and outcomes.

By the end of this internship, students will have gained significant practical experience, bridging their academic learning with industry practice. They will be better prepared to complete their diploma projects with a high degree of competence and professionalism, having applied their skills in a real-world context.

DESIGN OF THERMAL SYSTEMS

The lecture covers the fundamentals and applications in thermal energy systems and components, including conventional power generation and cooling systems, renewable energy systems, heat recovery systems. Practical examples are used throughout and are drawn from solar energy systems, fuel cell, engine exhaust heat and emissions. Recent research topics such as steady and unsteady state

simulation and optimization methods are also included. During this course students will develop the skills and knowledge required for designing, sizing, and specifying thermal energy systems, and to develop control strategies to optimise their operation, with an emphasis on delivering designs based on understanding context, appropriate design and technology selection, implementation of models, and capacity building for sustainable projects. This course uses project-based learning to develop skills and knowledge for designing and specifying hybrid renewable energy projects, by working with a real target.

Learning outcomes: Understand the technical characteristics of components in hybrid renewable energy systems, including loads, storage, and generation technologies

Topics: *Chapter 1* (Overview of Thermal Systems Design; Importance in various engineering applications; Types of Thermal SystemsKey Components in Thermal Systems: Heat exchangers - Pumps and compressors - Turbines and engines - Thermodynamic cycles), *Chapter 2* (Recall heat transfer laws, modes and equations; Heat Exchangers. Types of Heat Exchangers. Shell-and-tube, plate, finned-tube, etc. Selection criteria and applications), *Chapter 3* (Renewable Energy Systems. Project planning and Storage for HRES. Control and optimisation of HRES), *Chapter 4* (Thermal Storage Systems. Phase-change materials. Sensible and latent heat storage. Case studies of thermal systems in industries.)

INDUSTRIAL PROJECT MANAGEMENT

The course aims to familiarize students with the most important topics related to the initiation, planning, organization and management of projects. The aim is for students to acquire vocabulary specific to the field and to be able to use basic concepts, so that regardless of the position occupied in an organization, they can participate in the design and or implementation of projects. Considering the dynamics of the labor market, businesses are constantly changing, in a fluid environment, in which the state of stability and balance is rarely reached, due to the accentuated dynamics. It is necessary to understand the concept of the project, the role and importance of project management in mechanical engineering, the fundamental technical-economic notions and, respectively, the acquisition of some skills for the development of projects. The themes addressed within this discipline contribute to the formation of an overview of the methodological and procedural benchmarks related to the field.