STUDY GUIDE
ACADEMIC YEAR 2019-2020

UNIVERSITY OF WESTERN MACEDONIA
SCHOOL OF ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

http://www.mech.uowm.gr/

KOZANI 2019

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1. BRIEF HISTORICAL OVERVIEW

The Mechanical Engineering Department derives from the Department of Engineering & Management of Energy Resources, which was one of the three new departments that were founded at the Aristotle University of Thessaloniki (AUTH), in 1999, aiming at the enlargement of higher education in Greece. The city of Kozani was selected as the Seat of the Department, on account of its inextricable link to energy production, as in this region about 70% of Greece`s electric power is produced.

The foundation of the Department and its regulations are determined by the Presidential Decree published in the Government Gazette 179/6.1999 t.A.

For the academic year 1999-2000, the Department accepted its first 120 students, and since then it admits about 100 students annually. For the current academic year the number of students has raised again to 120.

It should be noted that the Department which was originally founded at the Aristotle University of Thessaloniki was transferred by Joint Ministerial Decision 134 881 a/ B1/23.12.2003 (Government Gazette 1975/31.12.2003), since 01/01/2004 to the University of Western Macedonia, thus becoming the first Department of the University, which leads to Major in Engineering.

The Department was renamed from DEPARTMENT OF ENGINEERING & MANAGEMENT OF ENERGY RESOURCES to MECHANICAL ENGINEERING DEPARTMENT, according to the Presidential Decree 47 (Government Gazette 61 / 27-04-2009, vol. I).

COURSE CONTENTS

9. COURSE CONTENTS

Detailed Course description of ***available*** *courses*

Abbreviations:

Sm.: Course Semester

C.H.: Weekly Course Lecture hours

ECTS: Course Credits according to European Credit Transfer System (E.C.T.S.)

Semester duration is 13 full weeks

Lecture language is Greek

MATHEMATICS I	
Course code	101
Instructor(s)	A, Petrakis
Semester	1
ECTS	5
URL	-
Hours per week	4
Recommended Prerequisites	-
Course content	Sets, Real numbers, Sequences of real numbers, Series of real numbers, Real functions of a single variables, Limits and continuity, Derivatives, Application of derivatives, Indefinite and definite integrals, improper integrals, Applications of integration, Power series.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • examine the convergence of real sequences, series, as well as power series, • calculate infinite sums, • study real functions of one variable,

	• differentiate parametrically-defined and implicit functions, • determine lines tangent to plane curves that are described in different ways, • calculate indefinite, definite, and improper integrals, • use polar coordinates, • calculate the area between curves, and the length of plane curves, • approximate functions with polynomials.
Teaching methods	Lectures, exercises
Assessment methods	Final written exam (compulsory), Intermediate written exam (optional)

PHYSICS	
Course code	103
Instructor(s)	K. Filippidis
Semester	1
ECTS	5
URL	http://eclass.uowm.gr/courses/MECH201/
Hours per week	4
Recommended Prerequisites	-
Course content	Basic Theory of Mechanics. Newton's Laws. Forces. Principles of Energy Conservation of Momentum and Angular Momentum. Kinematics and Dynamics of Material Point. Rigid Body Kinematics. Relative Motion. Rigid Body Dynamics in the Plane and in Space. Oscillations, Electric charge and Electric Field, Electric Potential, Electric Currents, DC Circuits, Magnetism, Electromagnetic Induction and Faraday’s Law, Electromagnetic Waves.
Expected learning outcomes and competences to be acquired:	The course presents systematically basic knowledge of Mechanics and Electromagnetics. After the completion of the course the students should be able to: • Extract the equations that define the variation of the

	space, speed and acceleration in one, two and three dimensions • Extract the equations of the motion of material point • Apply the law of Conservation of Energy • Calculate the Rolling, Torque, and Angular Momentum • Apply the Coulomb's Law • Calculate the Intensity of Electric Fields • Calculate the electric potential • Apply the Gauss law • Calculate the capacitance • Calculate the resistance • Calculate the intensity of magnetic fields • Apply the Kirckoff laws for the electrical circuits
Teaching methods	Hours of Instruction 52
Assessment methods	Final written exam, Intermediate written exam

CHEMISTRY	
Course code	104
Instructor(s)	G. Marnellos, E. Tolis
Semester	1
ECTS	5
URL	http://eclass.uowm.gr/courses/MECH118/
Hours per week	4
Recommended Prerequisites	-
Course content	Introduction to the basic principles of the structure of atoms, Quantum mechanical approach of atoms, Electronic configuration of atoms, Periodic system of elements, Ionic and co-valent bonds, Molecular geometry, Hybridization, Molecular orbital theory, Metallic bonds, Intermolecular forces, Chemical kinetics, Chemical equilibrium, Chemical

	solutions, Acids – Bases - Salts, Redox processes & electrochemistry, Spectroscopic techniques.
Expected learning outcomes and competences to be acquired:	The course introduces the student to the basic principles of chemistry with particular emphasis on inorganic chemistry and physical chemistry. Through theoretical lectures and by solving related exercises, the students following the chemistry course are introduced to the basic principles and applications of chemistry related to the mechanical engineering field (i.e., Materials, Kinetics, Thermodynamics, Electrochemistry, etc.). Upon successful completion of the chemistry course the student will be able to: • Understand the basic principles of Chemistry and Physical Chemistry. • Understand the structure of the atoms and their properties according to their position on the periodic table. • Understand their electronic configuration and how their orbits are completed. • Understand the types of bonds to which the elements are linked to form the compounds (gases, liquids, solids). • Understand their geometrical configuration. • Understand the concepts of Chemical kinetics and the rate of reactions (activation energy, reaction order). • Explore reaction mechanism and kinetics by the experimental data • Understand how temperature, pressure and concentration affect the collisions of the elements for the evolution of the reaction. • Understand the mechanism of catalysis and its applications. • Understand the concept of chemical equilibrium and its role in selecting the reaction conditions for industrially important reactions. • Be aware that the reaction conditions affect the position of equilibrium. • Understand the chemical solutions, the concept of solubility, the effect of the conditions (temperature, pressure) on the solubility of the compounds in various

	solutions. • Be able to define concentrations in solutions in various ways. • Identify which compounds are considered as acids, bases and salts. • Be able to determine which acids or bases are strong or weak. • Define the pH value of the solutions. • Be aware of the phenomenon of acid rain. • Be aware of the importance of solutions in everyday life. • Define which reactions are oxidation or reduction processes. • Understand the redox mechanism. • Equilibrate redox reactions. • Be able to estimate the open circuit potential in electrochemical cells. • Understand the principles of operation of electrolyzers, fuel cells and batteries.
Teaching methods	Hours of Instruction 52
Assessment methods	Final written exam (compulsory, 70%), Midterm written exam (compulsory, 30%)

INTRODUCTION TO COMPUTING

Course code	105
Instructor(s)	C. Grompanopoulos, M. Politis
Semester	1
ECTS	5
URL	http://eclass.uowm.gr/courses/MECH154/
Hours per week	5
Recommended Prerequisites	-

Course content	General computing literacy, hardware design and operation, basic problem solving techniques. Basic principles of programming using the MATLAB environment and language: the command prompt, scripts, tables, graphics and data visualization, flowcharts, selection and repetition structures, data input-output.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course the students should be able to: • recognize the main parts of a Computer System (processor, memory, peripherals) and understand their operation during the execution of an application, • have adequate knowledge of the basic programming principles (variables, selection, repetition, functions) through a high level programming language (Matlab/Octave), • formulate ways of solving simple algorithmic problems and demonstrate their solution with the creation of the appropriate scripts, • apply mathematical knowledge (arrays, functions) with the use of Matlab/Octave, • collect/store (from/into files) and represent graphically data with the use of Matlab/Octave, • utilize files to collect/store data and create plots with the use of Matlab/Octave, • utilize computing systems and their applications for the solution of problems in the field of Mechanical Engineering, • engage in collaborative problem-solving of complex problems during group projects.
Teaching methods	Lectures (13 weeks x 2 hours theory and 2 hours practice problems in the lab)
Assessment methods	Compulsory mid-term exams plus final oral and programming test in the Computer Lab

MECHANICAL DRAWING I

Course code	113

Instructor(s)	N. Sapidis
Semester	1
ECTS	5.5
URL	http://eclass.uowm.gr/courses/MECH115
Hours per week	4
Recommended Prerequisites	-
Course content	Fundamental ISO rules for drawing (types of technical drawings, drawing tools and sheets, title block, parts list, drawing scales, types of lines and line widths, lettering), introduction to Computer-Aided Design/Drafting (CAD), views and representation of mechanical components (types of views, technical sketch, construction drawing, assembly drawing, rules and basic conventions for views), dimensions (ISO rules and principles for dimensioning, special symbols for dimensioning, basic methods and paradigms for dimensioning), Sections (general principles and rules for drawing sections, special types of sections, sections in multiple cutting planes).
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course the students should be able to • fully comprehend fundamental concepts related to the various kinds of Technical Drawings, • comprehend and apply ISO rules dealing with Technical/Mechanical Drawings, • construct a correct, according to the related ISO rules, Technical Drawing for an object of low or medium complexity, • evaluate correctness of a given Technical Drawing regarding both accuracy of representation (of the corresponding object) as well as agreement with applicable ISO rules, • demonstrate basic knowledge of industrial application of Technical/Mechanical Drawings, • construct a correct Technical Drawing (for an object of low complexity) using appropriate Computer-Aided

	Design software, • demonstrate basic knowledge of difficulties (and research issues) related to applying ISO rules in Mechanical Drawing and in engineering work in general.
Teaching methods	Lectures (13 weeks x 2 hours of Theory and 2 hours of Drawing Exercises)
Assessment methods	Final written exam

LINEAR ALGEBRA	
Course code	144
Instructor(s)	K. Balassas
Semester	1
ECTS	3.5
URL	eclass.uowm.gr/courses/ICTE211/
Hours per week	3
Recommended Prerequisites	-
Course content	Vector Calculus. Straight Lines, Surfaces and Curves in Space. Vector Spaces and Vector Subspaces. Linear independence, Bases and dimension of vector Spaces. Matrices and Determinants. Finite-dimensional linear mappings. Matrices of linear maps. Systems of Linear Equations and Matrices. Solution of Systems of Linear Equations. Eigenvalues-Eigenvectors. Matrix Diagonalization, Quadratic Forms.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • know and manage the general form of curves and surfaces, • understand and use concepts of vector spaces, • use matrices as tools in theoretical and numerical computations, • compute eigenvalues and eigenvectors,

	• compute determinants, • solve systems of linear equations, • manage and use matrix diagonalization.
Teaching methods	Lectures, exercises
Assessment methods	Final written exam (compulsory), Intermediate written exam (optional)

ENGLISH I	
Course code	141
Instructor(s)	A. Altini
Semester	1
ECTS	2
URL	eclass.uowm.gr/courses/ICTE141/
Hours per week	2
Recommended Prerequisites	-
Course content	The Field of Mechanical Engineering, An evolving profession, Some sectors where mechanical engineers work, An introduction to fluid mechanics, Blaise Pascal and his contribution to hydrostatics, Archimedes and the second principle of hydrostatics, Automobile industry materials.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • Expand their vocabulary related to the field of engineering • Be able to read, understand and analyze a series of authentic scientific texts • Develop high-level oral skills • Be able to seek and use online dictionaries in order to become familiar with and practice using the technical language they need • Realize the structure of academic writing

	• Write short essays in English • Cultivate intercultural awareness and competence, focusing on differences between British and American English grammar and vocabulary • Compare their cross-lingual abilities though the comparison of academic skills for English and Greek. • Build self-confidence through the detailed examination of scientific texts in English • Improve the reflective skill of self-evaluation • Cultivate autonomous learning ability • Improve their learning strategies
Teaching methods	2 Hours per week of theory combined with participatory teaching.
Assessment methods	• Assignment and presentation 25%, Active participation 25%, Final exam 50% • Assignment and presentation 25%, Final exam 75% • Active participation 25%, Final exam 75% • Final exam 100%

MATHEMATICS II	
Course code	102
Instructor(s)	A. Petrakis
Semester	2
ECTS	5
URL	-
Hours per week	4
Recommended Prerequisites	-
Course content	The $\mathbb{R}^n$ space, Quadratic surfaces, Real functions of several variables, Partial derivatives, Chain differentiation, Directional derivative, Extreme values, Taylor series, Double integrals, Triple integrals, Vector functions, Curves, Line integrals, Differentiation of scalar and vector fields, Conservative fields, Green's theorem, Surface integrals,

	Gauss και Stokes theorems.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • differentiate variables of several functions, • use cylindrical and spherical coordinates, • find extreme values (free/constraint) and saddle points, • linearize functions and find tangent planes, • perform double and triple integration, • manipulate vectors, • differentiate vector functions, • detect irrotational and solenoidal fields, • determine potentials for conservative fields, • parametrically describe curves and surfaces, • calculate line integrals and fluxes through surfaces of vector fields, • use Green's, Gauss, και Stokes theorems.
Teaching methods	Lectures, exercises
Assessment methods	Final written exam (compulsory), Intermediate written exam (optional)

MATERIALS SCIENCE AND TECHNOLOGY I

Course code	109
Instructor(s)	A. Tsouknidas
Semester	2
ECTS	6
URL	https://eclass.uowm.gr/courses/MECH200/
Hours per week	5
Recommended Prerequisites	• Physics • Chemistry
Course content	Atomic structure, chemical bonds, Crystallography and Crystal Stucture (crystalline systems, Bravais lattices,

	elementary cells, directions, levels, measuring density, single- and poly-crystalline materials), structure verification diffraction X-ray crystal structure imperfections (point, linear, flat, three-dimensional). Granules, grain microstructure limits, microscopy, particle size. Mobility of atoms and Diffusion in solid state (mechanisms, laws of Fick). equilibrium phase diagram (solid solutions, thermodynamic interpretation of Gibbs law, binary diagrams). Physical Properties (Electrical, Thermal, Magnetic, Optical). Oxidation, Corrosion and Protection.
Expected learning outcomes and competences to be acquired:	Introduction to basic concepts of crystal structure, materials properties as a function of the microstructure and processing. Standard materials are metallic materials, but also considered are non-metallic (ceramic, polymer for which are developed the relationships governing the physical properties.
Teaching methods	Lectures and tutorials, Materials and XRD lab
Assessment methods	80% written exam, 20% project

ENGINEERING STATICS

Course code	111
Instructor(s)	I. Ziganitidis
Semester	2
ECTS	6
URL	http://eclass.uowm.gr/courses/MECH151/
Hours per week	5
Recommended Prerequisites	• Mathematics I • Physics • Linear Algebra
Course content	Force and moment. Addition and resolution of forces. Free body diagram. Equilibrium conditions. Elementary structures: rods, beams, cables. Advanced structures: frames, trusses. N-Q-M diagrams. Friction: brakes, clutches, couplings, belts. Center of mass. Moments of Inertia.

Expected learning outcomes and competences to be acquired:	Upon successful completion of this course the students should be able to • have/demonstrate a full understanding of the basic types of structures involved in standard engineering applications, • know about and handle the various types of external loads for all kinds of structures considered in this course, • comprehend issues related to supporting a structure either on the “ground” or on some other structure, • analyze beams and frames of various geometric configurations, • thoroughly analyze a truss of medium complexity regarding both geometric rigidity as well as member forces, • calculate the centroid of a complex planar area, • analyze a flexible chain or cable subjected to loads appearing in standard applications.
Teaching methods	Lectures (13 weeks x 2,5 hours of Theory and 2,5 hours of Exercises)
Assessment methods	Final written exam

MECHANICAL DRAWING II

Course code	146
Instructor(s)	N. Sapidis
Semester	1
ECTS	6
URL	http://eclass.uowm.gr/courses/MECH140
Hours per week	4
Recommended Prerequisites	• Mechanical Drawing I • Mathematics I • Physics

	• English I
Course content	Computer-aided mechanical drawing (CAD), Drawing of connection elements (geometric features and categories of threads, standard threads, drawing of thread holes, dimensions and types of screws, standardization of bolts, nuts and tools, bolted joints and related components, rivets, welding methods and drawing of welds), Manufacturing processes (surface quality, surface roughness, selection criteria for manufacturing processes, symbols and regulations, notations for heat treatments and hardness processes), Tolerances (dimensional tolerances, fits and fittings, standardization according to ISO, tolerances of form/orientation/location), Power transmission elements (shafts, bearings, wedges, splines, gear geometry and notation, types of gears, sprockets), drawing of mechanical assemblies (e.g., gearboxes), three-dimensional (3D) representation (types of 3D representations, oblique projection, axonometric projection, perspective representation).
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course the students should be able to: • comprehend fundamental concepts related to connection elements and construct a correct Mechanical Drawing employing these, • demonstrate knowledge about symbolic representation of welded/brazed/soldered joints in drawings, • comprehend issues related to assembly drawings and construct such a drawing, • demonstrate knowledge and apply drawing techniques related to manufacturing processes, • fully comprehend issues related to tolerances/deviations/fits and apply them in Mechanical Drawing, • construct a correct Mechanical Drawing (for an object of low or medium complexity) using appropriate Computer-Aided Design (CAD) software, • demonstrate basic knowledge of difficulties (and research issues) related to applying ISO rules and mechanical CAD in the manufacturing industry.
Teaching methods	Lectures (13 weeks x 2 hours of Theory and 2 hours of

	Drawing Exercises)
Assessment methods	Final written exam.

TECHNOLOGY AND INNOVATION, INTRODUCTION TO ECONOMICS	
Course code	149
Instructor(s)	To be assigned
Semester	2
ECTS	4
URL	http://elearn.materlab.eu/course/view.php?id=14
Hours per week	3
Recommended Prerequisites	-
Course content	Introduction to Innovation, Technology and Entrepreneurship, Size and business development, Form of business, The overall financial budget of enterprises, Investment and financing, Financing and capital composition Styles, Foreign and Credit Capital, Balance sheet, income statement, cash flow analysis, breakeven analysis, Indicators of profitability on invested capital.
Expected learning outcomes and competences to be acquired:	Upon successful completion of the course, students will be able to: • Prepare a balance sheet. • Prepare a scoreboard and cash flow table. • Calculate the breakeven analysis in a business. • Identify the types of business activity. • Recognize the financial tools needed to start a business. • Use indicators to evaluate an investment. • List the forms of funding and recognize the advantages and disadvantages of each.
Teaching methods	Oral presentations
Assessment methods	Written exam

ENGLISH II	
Course code	142
Instructor(s)	A. Altini
Semester	2
ECTS	2
URL	eclass.uowm.gr/courses/ICTE142/
Hours per week	2
Recommended Prerequisites	• English
Course content	Lubricants and lubrication, Hydrodynamic bearings and seals, Shafting and associated parts, Power transmission, Flat, synchronous and V-belts, Parallel axis gears, Planetary gear trains, Nonparallel coplanar and non-coplanar gears, Gearboxes, Design of power transmission systems.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • Expand their vocabulary related to the field of engineering • Be able to read, understand and analyze a series of authentic scientific texts • Develop high-level oral skills • Be able to seek and use online dictionaries in order to become familiar with and practice using the technical language they need • Realize the structure of academic writing • Write short essays in English • Cultivate intercultural awareness and competence, focusing on differences between British and American English grammar and vocabulary • Compare their cross-lingual abilities though the comparison of academic skills for English and Greek. • Build self-confidence through the detailed examination of scientific texts in English

	• Improve the reflective skill of self-evaluation • Cultivate autonomous learning ability • Improve their learning strategies
Teaching methods	2 **Hours per week** of theory combined with participatory teaching.
Assessment methods	• Assignment and presentation 25%, Active participation 25%, Final exam 50% • Assignment and presentation 25%, Final exam 75% • Active participation 25%, Final exam 75% • Final exam 100%

STRENGTH OF MATERIALS

Course code	110
Instructor(s)	I. Mirisidis
Semester	3
ECTS	6.5
URL	http://eclass.uowm.gr/courses/MECH155/
Hours per week	5
Recommended Prerequisites	• Statics • Science and Technology of Materials I • Science and Technology of Materials II
Course content	Axial loading, shearing stress, bearing stress in connections, stress under general loadings, Safety Factor, Hooke's law, Modulus of Elasticity, elastic vs. plastic behavior, static indeterminacy, thermal stresses, Poisson's ratio, generalized Hooke's law, shearing strain, Saint-Venant's principle. Torsion: Stress, strain, angle of twist in elastic range, statically indeterminate shafts, design of transmission shafts, stress concentrations. Pure Bending: Deformations in symmetric member, strain due to bending, bending of members made of several materials, stress concentrations, asymmetric bending, general case of eccentric axial loading. Design and analysis of beams: N,Q,M diagrams,

	determination of the shearing stress in common or complex types of beams, shear stresses in thin-walled members. Stress–Strain Transformations: Plane stress transformation, principal stresses, maximum shear stress, Mohr's Circle for plane stress and general Three-Dimensional analysis of stress and strain.Deflection of beams: Deformation of a beam under transverse loading, equation of the elastic curve, determination of the elastic curve from the load distribution, method of superposition, moment–area theorems.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • analyse a given problem in a simple and logical manner, • apply in a solution some fundamental and well understood principles, • understand the concepts of deformable solid body by applying the principles of the theory of elasticity, • acquire the knowledge to analyse stresses in particular building blocks, components of machines or devices, with specific support, at constant or anticipated external loads applied in certain ways, • understand the concepts of tension, compression, torsion, bending, eccentric axial loading and deflection, • determine the expected mechanical behaviour of structural elements or components of machines or devices, as the basis of proper design or validation of their safety factor.
Teaching methods	Hours of Instruction 65 (Theory: 26, Exercises: 39)
Assessment methods	Final written exam (compulsory), Intermediate written exam (optional)

STATISTICS

Course code	107
Instructor(s)	S. Panagiotidou
Semester	3
ECTS	6

URL	http://eclass.uowm.gr/courses/MECH164/
Hours per week	5
Recommended Prerequisites	Mathematics I & II
Course content	Descriptive statistics: data summary and presentation, frequency distribution, histogram, characteristic values (mean, median, mode, range, variance, standard deviation). Probability theory: basic concepts, events, conditional probability, addition and multiplication law of probabilities, Bayes theorem. Probability distributions, discrete and continuous random variables, expected value, variance and standard deviation. Important distributions: Bernoulli, binomial, geometric, Poisson, uniform, exponential, gamma, normal distribution and the central limit theorem, Student, X2 and F distributions. Statistical estimation: sampling distributions, point estimation, properties of estimators, confidence intervals. Statistical hypotheses: hypothesis testing, type I and type II errors, required sample size, goodness of fit tests.
Expected learning outcomes and competences to be acquired:	This course is the introductory course in the concepts, techniques and tools of statistics. The aim of the course is to introduce the basic concepts of probabilities and statistics and to present the main tools and scientific methods of both descriptive and inferential statistics. An additional aim of the course is to present alternative applications of statistical methods used in a variety of operational (and not only) problems. The course is the basis for several advanced courses in the industrial management direction of studies, on which specific statistical methodologies and techniques are developed and applied. After successful completion of the course, students will be able to: • process data sets • apply the basic principles of the probability theory • perform Bayesian updating • identify and use the basic probability distributions • calculate probabilities using probability (density) functions • perform statistical estimates

	• calculate confidence intervals • perform and interpret statistical hypothesis testing.
Teaching methods	Hours of Instruction 65 (Theory: 39, Exercises: 26)
Assessment methods	Final written exam (compulsory), Intermediate written exam and/or assignments (optional)

THERMODYNAMICS I

Course code	119
Instructor(s)	G. Skodras - E. Tolis
Semester	3
ECTS	6.5
URL	http://eclass.uowm.gr/courses/MECH105/
Hours per week	5
Recommended Prerequisites	• Physics • Mathematics I • Mathematics II
Course content	Basic principles of Thermodynamics. The First Law of Thermodynamics in closed systems, properties of pure substances, Phase diagrams for gases and liquids, equations of State, the First Law of Thermodynamics for open flowing systems, The Second Law of Thermodynamics, Entropy and the third Law, Power, refridgeratıon and heating cycles, Gas and vapor cycles: Carnot, Otto, Diesel, Brayton, Rankine.
Expected learning outcomes and competences to be acquired:	Course focuses on the understanding of the fundamental concepts and principles in thermodynamics with emphasis on the solution of engineering problems and on the analysis of energy systems and flow processes.
Teaching methods	Oral presentations and exercises
Assessment methods	Written exam, 70% final exam, 30% midterm exam

MATHEMATICS III	
Course code	132
Instructor(s)	K. Balassas
Semester	3
ECTS	5
URL	http://eclass.uowm.gr/courses/ ICTE109/
Hours per week	4
Recommended Prerequisites	• Mathematics I • Mathematics II • Linear Algebra
Course content	Introduction. First-order ordinary differential equations. Separable equations. Exact equations, integrating factors. Linear equations. Solution via substitution. Higher-order ordinary differential equations. Linear equations with constant coefficients. Order reduction. Solution of inhomogeneous differential equations. Laplace transform and its use for solving differential equations. Series solution of differential equations, ordinary and singular points. Systems of differential equations, solution with the matrix method. Complex numbers. Complex functions. Differentiation of complex functions. Integration of complex functions.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • recognize the mathematical models for certain physical problems, • identify the general form of differential equations, • apply appropriate methods for determining partial and general solutions, • solve initial value problems, • determine solutions in the form of power series, • exploit the Laplace transform, • solve systems of differential equations,

	• graphically solve certain types of differential equations, • deal with fundamental problems of complex analysis.
Teaching methods	Lectures, exercises
Assessment methods	Written intermediate exam (25%), written final exam (75%)

MATERIALS SCIENCE AND TECHNOLOGY II

Course code	135
Instructor(s)	A. Tsouknidas
Semester	3
ECTS	6
URL	http://eclass.uowm.gr/courses/MECH199/
Hours per week	5
Recommended Prerequisites	• Statics • Strength of Materials • Mechanical Drawing • Machine Elements I
Course content	Equilibrium phase diagrams in binary systems (complete solid solubility, lever rule, eutectic phase diagrams and peritectic phase diagrams). The Fe-C system. Basic solidification mechanisms. Nucleation and Growth, Casting, Segregation. Phase transformations and thermal processing of steel alloys and cast metals (fabrication processes, precipitation processes, annealing processes, recovery, recrystallization and grain growth). Diffusion phase transformations. TTT and CCT diagram. Hardening and strengthening of steels. Precipitation hardening. Jominy test. Engineering materials (steels, cast irons, copper alloys, light metals, titanium alloys, Zn alloys, Pb alloys, superalloys. Corrosion and surface protection. Ceramics
Expected learning outcomes and competences to be acquired:	To acquire general knowledge about the properties of materials and their significance in various applications To study the materials by using the phase diagram, so as to correlate, to a first approximation, the properties of materials with their structure. To realize the importance of phase

	transformations and thermal processing of materials in mechanical applications. To familiarize with the different industrial alloys.
Teaching methods	Lectures and tutorials
Assessment methods	Final Exam

DYNAMICS

Course code	112
Instructor(s)	D. Giagopoulos
Semester	4
ECTS	6.5
URL	http://eclass.uowm.gr/courses/MECH127/
Hours per week	5
Recommended Prerequisites	• Statics
Course content	Kinematics of particles (position vector, velocity, acceleration, rectangular coordinates, cylindrical coordinates, tangential coordinates, relative motion), Kinetics of particles (Newton's and Euler's laws of motion, principles of impulse and momentum, principles of work and energy), Kinematics of rigid bodies (translation, pure rotation, plane motion, rotation about a fixed point, spatial motion, relative motion), Kinetics of rigid bodies (inertia tensor, Newton's and Euler's laws of motion, principles of impulse and momentum, principles of work and energy, inertia forces), Applications (eccentric impact, balancing of rotating rigid bodies, axisymmetric rigid body rotation).
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • have a full understanding of the basic principles of dynamics. • understand the relationship between the movement of material bodies and the forces that cause motion or

	develop during motion. • classify the equilibrium benefits of material points and solid bodies. • analyze the movement of dynamic systems consisting of material points or solid bodies. • calculate the mass parameters of inertia of solid bodies. • apply the basic principles of dynamic problem solving with emphasis on the analysis and determination of motion and the forces that develop during the motion of the bodies. • solve typical examples using analytical and numerical methods.
Teaching methods	Lectures (13 weeks x 3 hour of Theory and 2 hours of Exercises) and homeworks.
Assessment methods	Final written exam

MACHINE ELEMENTS I

Course code	108
Instructor(s)	I. Mirisidis
Semester	4
ECTS	6.5
URL	-
Hours per week	5
Recommended Prerequisites	• Statics • Strength of Materials • Mechanical Drawing
Course content	Introduction to engineering analysis, Load, stress and strain, Normal, torsional, bending and transverse shear stresses and strains, Failure prediction for static and dynamic loading, Operating stresses, Calculation of static and dynamic strength, Combined stresses and equivalent stresses, Permissible stresses, Strength safety factors, Fasteners and screws. Welded joints.

Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • realize the importance of materials choice used in mechanical construction • perform study calculations and control studies on simple parts of machine components • understand the importance of machine elements design • construct and assembly various machine elements • carry out simple machine components project studies • work as designers or manufacturers at a machinery.
Teaching methods	Hours of Instruction 65 (Theory: 39, Exercises: 26) and 1 semester exercise (optional)
Assessment methods	Final written exam (compulsory), Intermediate written exam and exercise (optional)

FLUID MECHANICS I

Course code	120
Instructor(s)	G. Panaras
Semester	4
ECTS	6
URL	http://eclass.uowm.gr/courses/MECH103/
Hours per week	5
Recommended Prerequisites	• Physics • Thermodynamics I • Mathematics II
Course content	Basic definitions. Properties of fluids. Fluid Statics: Measurement of pressure, hydrostatic forces, buoyancy and Archimedes's law. Introduction to Fluid Dynamics: Bernoulli's equation and its applications. Kinematics of fluids, Eulerian and Lagrancian description of flow. Reynolds transport theorem. Control volume formulation and application in mass, momentum and energy conservation. Differential analysis of flow fields: stream

	function, vorticity and potential; elementary ideal, potential, flows and their combinations, examples and applications. Continuity equation, Euler and Navier Stokes equations of motion, Energy equation and their applications. Viscous flows and their application in simple geometries: Poiseuille flow in a slit channel and a cylinder, Quette flow. Dimensional analysis, similarity and dimensionless numbers. Π- Buckingham's theorem. Flow in tubes: Fully developed flow, introduction to turbulence and the concept of the boundary layer. Dimensional analysis and the use of Moody's charts to determine the pressure drop in smooth and rough tubes.
Expected learning outcomes and competences to be acquired:	This course serves as an introduction to the basic principles of Fluid Mechanics. After completion, the students will have: • acquired knowledge of the application field, laws and basic principles of Fluid Mechanics. • acquired well-established knowledge regarding the principles and methods, as well as the importance of applying them for solving technical problems. • learned how to evaluate the suitability of each method, given the characteristics and particularities related with each specific problem. • acquire knowledge to solve, among others, the following problems: • Measurement/estimation of hydrostatic pressure • application of Bernoulli's equation for ideal flows • implement control volume analysis • application of Poiseuille's equation for viscous flows determination of pressure drop in tubes, etc
Teaching methods	Hours of Instruction 65
Assessment methods	Final written exam (75% of the final grade), optional midterm exam (25% of the final grade)

MATHEMATICS IV

Course code	137

Instructor(s)	K. Balassas
Semester	4
ECTS	5
URL	http://eclass.uowm.gr/courses/ICTE217/
Hours per week	4
Recommended Prerequisites	• Linear Algebra • Mathematics II • Mathematics III
Course content	Introduction to Partial Differential Equations (PDEs). Examples of PDEs. First-order PDEs. Linear, semi-linear, and quasi-linear PDEs. Characteristic curves. The Cauchy problem. Second-order PDEs, classification, standard forms. Eigenvalue problems. The Laplace equation, solution in Cartesian and polar coordinates, cases of homogeneous and inhomogeneous boundary conditions and infinite domains. Orthogonal functions, Fourier series and Fourier integrals. The heat equation, solution in finite and infinite spaces. Special functions. The wave equation, finite and infinite strings.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • identify different types of PDEs, • derive the mathematical models for different problems, • solve PDES with the method of characteristics, • deal with eigenvalue problems, • reduce PDES to their canonical forms, • apply separation of variables and other techniques for the solution of PDEs, • solve problems in different coordinate systems, • solve problems in finite, semi-infinite or infinite spaces, • use orthogonal functions and exploit Fourier series and integrals.
Teaching methods	Lectures, exercises
Assessment methods	Written intermediate exam (25%), written final exam (75%).

FUNDAMENTALS OF MACHINING	
Course code	114
Instructor(s)	I. Mirisidis
Semester	4
ECTS	6
URL	-
Hours per week	5
Recommended Prerequisites	• Science and Technology of Materials I • Science and Technology of Materials II • Strength of Materials
Course content	Introduction to engineering analysis, Load, stress and strain, Normal, torsional, bending and transverse shear stresses and strains, Failure prediction for static and dynamic loading, Operating stresses, Calculation of static and dynamic strength, Combined stresses and equivalent stresses, Permissible stresses, Strength safety factors, Fasteners and screws, Welded joints.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • obtain a first look with the subject of machining processes, • understand the basics of forming methods, • choose the most appropriate machining method of an object considering dimensional precision requirements and general qualities and quantities, • recognize and understand concepts related to the modern systems, • compose and re-design products according to the needs of construction, • select the optimum parameters required at various machining, • have the theoretical background concerning the knowledge of conventional machine tools.

Teaching methods	Hours of Instruction 65
Assessment methods	Final written exam (compulsory)

HEAT TRANSFER	
Course code	118
Instructor(s)	A. Dounavis
Semester	5
ECTS	5.5
URL	http://eclass.uowm.gr/courses/MECH105/
Hours per week	5
Recommended Prerequisites	• Thermodynamics I • Mathematics I • Mathematics II
Course content	Introduction to the mechanisms of heat transfer: conduction, convection and radiation. Conduction: Fourier's law, thermal conductivity, heat diffusion equation in Cartesian, polar and spherical coordinates. Steady-state conduction: heat resistance concept, critical radius of insulation, multi-dimensional configurations (analytical, graphical and numerical solutions), shape factor in common configurations, heat-transfer enhancement via fins. Transient heat conduction: Biot number, lumped-capacitance method, analytical solutions in simple geometries, Heissler charts, semi-infinite media. Forced convection: Newton's law of cooling, local and average heat-transfer coefficient, Nusselt number, Prandtl number, Reynolds number, dimensional analysis, analogy between heat/mass and momentum transport, internal and external flows, laminar and turbulent flow, flow and heat transfer over flat plates, cylinders and tube bundles, flow and heat transfer inside pipes. Natural convection: natural convection currents, Grashof number, Rayleigh number, natural convection over open

	surfaces and enclosed regions, Bernard convection cells, combined natural and forced convection. Boiling and condensation: pool boiling, boiling curve, empirical relationships for nucleate boiling, tube boiling, drop and film condensation, condensation over tubes and tube bundles. Thermal radiation: fundamentals of electromagnetic radiation and waves, Wien's displacement law, black-body radiation, Stefan-Boltzmann equation, interaction between radiation and real surfaces, heat exchange between surfaces, view factor.
Expected learning outcomes and competences to be acquired:	Upon successful completion of the course, the students will be able to: • Understand the mechanisms of heat transfer and their influence on practical problems • Carry out energy balances • Solve the heat diffusion equation for specific cases • Utilize the concept of heat resistance to calculate the rate of heat transfer • Estimate the efficiency and effectiveness of fins • Understand and use different methodologies to estimate the time required for the transfer of specific amount of heat • Identify the dimensionless variables that govern heat convenction problems • Estimate the convection heat transfer coefficients in internal and external flows • Understand the physical mechanisms of boiling and condensation • Estimate heat transfer coefficients associated with phase change • Know the basic types of heat exchangers • Analyse the performance and design heat exchangers
Teaching methods	Lectures and Tutorials
Assessment methods	15% coursework (x3), 85% final written exam

MECHANICAL VIBRATION AND MACHINE DYNAMICS

Course code	140
Instructor(s)	D. Giagopoulos
Semester	5
ECTS	5.5
URL	http://eclass.uowm.gr/courses/MECH107
Hours per week	5
Recommended Prerequisites	• Dynamics
Course content	Free vibration and forced response of single degree of freedom linear oscillators to impulsive, harmonic, periodic and transient excitation (natural frequency, damping ratio, resonance). Response of multiple degree of freedom linear oscillators (formulation of the equations of motion, determination of natural frequencies and mode shapes, modal analysis). Axial, torsional and bending vibration of bars. Applications (measurement and evaluation of vibration characteristics, vibration isolation, vibration absorption, balancing, torsional vibration). The course, beyond the theoretical teaching, introduces the student and into programming, based on application programs in an environment of MATLAB. In the course, three (3) laboratory exercises are conducted from which students are informed about the experimental methods in vibrations of mechanical systems and have the opportunity to see the connection of the theory with the actual constructions.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • have a full understanding of the underlying principles of oscillation. • develop simplified models of mechanical systems. • develop and solve the motion equations of mechanical systems. • predict dynamic and oscillating behavior of systems

	based on model analysis. • understand the basic dynamic characteristics that affect the dynamics of mechanical systems. • apply the methodologies in the design of mechanical vibration isolation devices. • solve typical examples using analytical and numerical methods.
Teaching methods	Lectures (13 weeks x 3 hour of Theory and 2 hours of Exercises) and homeworks.
Assessment methods	Final written exam

OPERATIONS RESEARCH I

Course code	147
Instructor(s)	G.Nenes
Semester	5
ECTS	5.5
URL	http://eclass.uowm.gr/courses/MECH165
Hours per week	5
Recommended Prerequisites	• Statistics
Course content	Introduction to optimization, mathematical programming models, variables, objective function parameters, constraints. Linear programming theory, graphical solution, Simplex method, sensitivity analysis. Linear programming problem solving using computer software (lindo, lingo, EXCEL solver). Integer programming. Branch and Bound algorithm. Binary programming. Applications to real-world problems.
Expected learning outcomes and competences to be acquired:	The course introduces students to the basic knowledge of Quantitative Analysis. Particular emphasis is given to optimization techniques for real production processes and systems. The course also studies case studies to prepare students for modeling real process optimization problems. Upon completion of the course, students will understand the basic functions and the most important decision making

	tools within production systems (such as inventory management, equipment maintenance, quality control, demand forecasting, production planning) as well as their interactions, and they should be able to: • understand the relationship between real problems and mathematical modeling • identify and use basic operations research tools • model real problems using mathematical programming • solve and obtain optimum solutions for various engineering problems • analyze existing solutions of engineering problems.
Teaching methods	Hours of Instruction 65 (Theory: 39, Exercises: 26)
Assessment methods	Final written exam.

ELECTROTECHNICS

Course code	116
Instructor(s)	Th. Theodoulidis
Semester	5
ECTS	5
URL	http://eclass.uowm.gr/courses/ICTE163/
Hours per week	5
Recommended Prerequisites	-
Course content	Electrical charge, current, voltage, power. Kirchhoff laws and Tellegen theorem. Electrical components and their connection. Resistance, impedance, conductivity, complex conductivity. Methods of analysis of circuits in DC and AC (voltage division, current division, Millman theorem). Use of phasors and complex numbers. Systematic methods of analysis of electrical circuits (loop method, node method). Electrical circuit theorems (superposition, maximum power transfer, Thevenin, Norton). Power and energy in sinusoidal excitation circuits. Power triangle, power factor and

	correction. Symmetric three-phase circuits.
Expected learning outcomes and competences to be acquired:	The aim of the course is to introduce the student to the basic knowledge of theory and analysis of electrical circuits. Through this course the student acquires the necessary knowledge in order to be able to understand (in following courses) aspects of electric machines as well as issues of power production, transmission, distribution and use. Upon successful completion of the course, the student will: • Be familiar with the basic laws governing electrical circuits (DC and AC). • Be able to analyze DC and AC electrical circuits and calculate basic current, voltage and power quantities. • In the case of AC circuits convert circuits to the frequency domain and analyze them with phaset using the complex number theory. • Use the theorems of electrical circuits and synthesize equivalent circuits. • Apply general methods of solving and analyze electrical circuits of any complexity. • Recognize the basic circuits of three-phase circuits and make basic calculations using the one-phase equivalent. • Understand the advantages and disadvantages of using DC, AC and AC three-phase current. • Develop problem-solving abilities and evaluate numerical calculations to understand the order of magnitude.
Teaching methods	Hours of Instruction 52 (Theory: 32, Laboratory: 20)
Assessment methods	Final written exam (compulsory)

MACHINE ELEMENTS II

Course code	138
Instructor(s)	E. Varitis
Semester	5

ECTS	5.5
URL	http://eclass.uowm.gr/courses/ MECH121/
Hours per week	5
Recommended Prerequisites	• Statics • Strength of Materials • Mechanical Drawing • Machine Elements I
Course content	Lubricants and lubrication, Hydrodynamic bearings and seals, Shafting and associated parts, Power transmission, Flat, synchronous and V-belts, Parallel axis gears, Planetary gear trains, Nonparallel coplanar and non-coplanar gears, Gearboxes, Design of power transmission systems.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • understand the different methods of support shafts and spindles and the diversity of bearings versus sliding bearings usage, • understand the basic concepts of motion and power transfer from axis to axis, by means of straps, chains and gears, • have the ability to assess and solve complex problems of movement and power transfer, • develop operational provision engines in laboratory spaces, • carry out complex machine components project studies, • work as designers or manufacturers at a machinery.
Teaching methods	Hours of Instruction 65 (Theory: 39, Exercises: 26) and 1 semester exercise (optional)
Assessment methods	Final written exam (compulsory), Intermediate written exam and exercise (optional)

THE MECHANICAL ENGINEERING CAPSTONE PROJECT

Course code	199

Instructor(s)	To be assigned
Semester	5
ECTS	4
URL	-
Hours per week	4
Recommended Prerequisites	-
Course content	The Mechanical Engineering Capstone project is an early requirement for graduation. The course is a multifaceted assignment designed to encourage students to think critically, solve challenging problems, and develop research skills, planning, goal setting, and skills on oral communication, public speaking, teamwork, self-sufficiency, skills that will help prepare them for their thesis research and writing and generally for modern careers. The projects adopted by students should be interdisciplinary ie. requiring students to apply skills or investigate issues across many different subject areas or domains of knowledge, connecting their projects to community issues or problems, and integrating outside-of-school learning experiences, including activities such as scientific observations, interviews, or internships. Specific content of taught crash courses includes: The role and importance of scientific research – The ethics of research – The research process: Basic terminology, choice of problem areas, revision of research – Structure of a research proposal – Systems of bibliographic reference – Plagiarism – Systematic literature review – Reference lists and bibliographic data bases – Debate techniques
Expected learning outcomes and competences to be acquired:	After completion of the course the student should be able to: • Complete a research /review project • Critically think about challenging problems • Address interdisciplinary subjects and teamwork • Recognize the writing techniques of different forms of scientific research • Skillfully communicate his research results to peers • Understand the oral and written rules of scientific reasoning
Teaching methods	Instruction of theory, discussion of applications and

	individual projects, community based learning, project based learning
Assessment methods	30% participation in class, 70% final assignment

ELECTRICAL MACHINES	
Course code	117
Instructor(s)	Th. Theodoulidis
Semester	6
ECTS	5
URL	http://eclass.uowm.gr/courses/MECH170/
Hours per week	5
Recommended Prerequisites	• Electrotechnics
Course content	Fundamental principles of electromagnetism and principles of operation of AC and DC electric motors. Single-phase and three-phase transformers. Equivalent circuit. Synchronous generators. Equivalent circuit and parallel operation. Synchronous motors. Induction motors. Equivalent circuit. Typical torque-speed. Speed regulation, starting and motor selection.
Expected learning outcomes and competences to be acquired:	Upon successful completion of the course, the student will: • Have understood the phenomenon of electromechanical energy. • Be familiar with the basic types of AC electric motors. • Use equivalent electrical circuits to analyze electrical machines and extract their functional characteristics. • Have understood the behavior of generators and engines in changing their loads. • Be able to choose the appropriate type and size of engines for specific applications. • Be able to choose appropriate engine start and engine methods.

	• Have understood the operation of the overall production, transmission, distribution and use of electricity. • Develop problem-solving abilities and evaluate numerical calculations to understand the order of magnitude.
Teaching methods	Hours of Instruction 52 (Theory: 32, Laboratory: 20)
Assessment methods	Final written exam (compulsory)

ALTERNATIVE ENERGY SYSTEMS

Course code	127
Instructor(s)	G. Skodras
Semester	6
ECTS	4.5
URL	http://eclass.uowm.gr/courses/MECH132/
Hours per week	4
Recommended Prerequisites	• Statistics • Thermodynamics • Mathematics
Course content	Introduction to energy policy issues. Energy in the European Union. The EU Green Bible for the security of the energy supply. The EU White Bible for the Renewable Energy Sources. Energy reserves and resources. The Greek energy system. Solar energy-basic principles. Solar collectors and photovoltaics. Wind energy and wind parks. Energy from biomass. Energy utilization of biomass. Hydropower and power plants – Advantages and disadvantages. Geothermal energy and geothermal fields. Tidal and wave energy. Ocean thermal energy. Energy conservation. Thermodynamic analysis of the renewable energy systems. Environmental analysis of the renewable energy systems. Social and economic impacts.
Expected learning outcomes and competences to be	The course presents systematically the renewable energy sources the systems and the cutting edge developments. After the completion the students will be able to approach

acquired:	effectively the issues of RES and to handle design and implementation problems, by means of scientifically rigorous quantitative methods.
Teaching methods	Hours of Instruction 52 (Theory: 26, Exercises: 26) – Home works 3
Assessment methods	Final written exam (compulsory) , Intermediate written exam (optional)

INDUSTRIAL MANAGEMENT	
Course code	123
Instructor(s)	K. Tasias
Semester	6
ECTS	5.5
URL	http://eclass.uowm.gr/courses/MECH177/
Hours per week	5
Recommended Prerequisites	• Statistics • Operations Research
Course content	Introduction to production operations. Forecasting: time series and causal models; constant, linear-trend and seasonal models. Design of Production Systems: product design; process selection and capacity planning; facilities layout. Planning and Control of Production Systems: long, medium and short range production planning; inventory management; quality control; equipment maintenance and replacement.
Expected learning outcomes and competences to be acquired:	The aim of the course is to examine problems related to the design and operation of production units. Appropriate methods for decision making are presented and analyzed both for the design (position selection, organization of production methods, means and administrative structure) and for the operation of production companies (production planning and control, work schedule and procurement strategies). After successful completion of the course, students will be able to:

	• tackle problems related to the design and operation of a production plant • use forecasting techniques • apply specific methods for selecting location • calculate the required capacity and equipment of a production unit • select the appropriate working method apply production planning tools • optimize the job schedule • optimize the allocation of resources for a set of tasks • apply techniques for balancing and smoothing production lines • organize the procurement decisions
Teaching methods	Oral presentations and exercises
Assessment methods	Written exam, 70% final exam, 30% midterm exam

NUMERICAL ANALYSIS AND SIMULATION

Course code	106
Instructor(s)	R. Sotiropoulou, M. Politis
Semester	6
ECTS	5
URL	http://eclass.uowm.gr/courses/MECH172/
Hours per week	5
Recommended Prerequisites	-
Course content	Introduction to numerical analysis methods using MATLAB. Basic concepts of analysis. Representation of numbers and numerical solutions errors. Linear systems. Roots of equations. Nonlinear systems. Optimization. Curve fitting. Numerical interpolation and polynomial approximation. Numerical Differentiation and Integration. Ordinary Differential Equations.

Expected learning outcomes and competences to be acquired:	The aim of the course is to acquire the necessary know-how to study engineering problems with emphasis on fluid flow using computational tools. Emphasis will be given to practical engineering applications. After completing the course the student will have the following skills: • Ability to solve technical problems with computational techniques • Ability to evaluate reasonable solutions and select appropriate levels of processing of these solutions • Understanding the important physical phenomena that need to be integrated into the solution of the system from the formulation of the problem • Development of appropriate equations and computational models for the given system • Ability to solve computational models for various processes / modules and simulation of the processes involved
Teaching methods	Hours of Instruction 65 (Theory: 26, Lab - Exercises: 39)
Assessment methods	Final exam (compulsory), Fifteen minutes tests during the lectures, Weekly exercises (compulsory).

ENVIRONMENTAL TECHNOLOGY

Course code	131
Instructor(s)	G. Marnellos
Semester	6
ECTS	4.5
URL	http://eclass.uowm.gr/courses/MECH132/
Hours per week	4
Recommended Prerequisites	• Chemistry • Fluid Mechanics
Course content	Environmental/Atmospheric pollution, Sources of environmental pollution, Effects of environmental pollution to human health, flora, fauna and materials, Greenhouse

	effect, Depletion of ozone layer, Acid deposition, Photochemical smog, Atmospheric chemistry, Analysis of gaseous pollutants, Pollution control technologies for stationary and mobile sources, Particulate matter, Technologies for particulate matter control (Cyclones, Electrostatic Precipitators, Baghouses), VOCs, SOX and NOX abatement and control.
Expected learning outcomes and competences to be acquired:	The course introduces students to understand the impact of various human activities on the environment. In specific, the causes, trends and technological solutions to address the environmental problems that are related to air pollution (gaseous and particulate pollutants) from stationary and mobile sources, are presented. Emphasis is given to the design (technological and economic) of control pollution technology systems for the control of particulate matter and gaseous pollutants. Upon successful completion of the course the student will be able to: • Understand the meaning and importance of air pollution. • Be aware of sources of pollution and of gaseous / particulate pollutants. • Understand pollution phenomena, such as greenhouse effect, photochemical smog, acid deposition (rain) and ozone layer depletion. • Understand which pollutants and the involved mechanisms are contributing to the greenhouse effect, photochemical smog, acid rain, and depletion of ozone layer. • Be aware of the analytical techniques used to identify and quantify the concentration of gaseous pollutants, such as infrared, chemiluminescent, gas chromatography, LIDAR. • Understand the behavior of particulate matter in fluids • Be aware of the principles of design of control pollution technologies, equipment sizing and costing, fixed and operating costs. • Understand the principles of operation of particulate matter control technologies such as gravity cyclones, centrifugal cyclones, electrostatic precipitators, baghouses and scrubbers.

	• Be aware of the technologies for controlling VOCs, NOX and SOX. • Be able to select, size, design and calculate the cost of control pollution technologies for particulate matter and gaseous pollutants.
Teaching methods	Hours of Instruction 52 (Theory: 26 h, Exercises: 26 h)
Assessment methods	Final written exam (compulsory) , Midterm written exam (optional)

THERMODYNAMICS II	
Course code	133
Instructor(s)	D. Kolokotronis
Semester	6
ECTS	5.5
URL	http://eclass.uowm.gr/courses/MECH129/
Hours per week	5
Recommended Prerequisites	• Mathematics I • Mathematics II • Physics • Thermodynamics I
Course content	Exergy, Ideal gas mixtures, Gibbs and Helmholtz functions. Combustion process. Mass transfer calculations in complete combustion, application of the first law of thermodynamics in combustion processes, heating value, enthalpy of reaction. Application of the second law in combustion processes. Thermodynamic relations, Maxwell’s equations. Thermodynamic properties of systems with variable chemical composition, Equilibrium of thermodynamic systems. Chemical potential and chemical equilibrium. Dissociation. Thermodynamics of special systems.
Expected learning outcomes and competences to be	Upon successful completion of the course, students will be able to: • Calculate exergy and its changes in several

acquired:	thermodynamic systems. • Calculate intensive and extensive properties of mixtures. • Apply the 1st and 2nd thermodynamic laws to reactive systems. • Calculate adiabatic flame temperature and heat of reaction in combustion applications. • Calculate the changes in entropy, enthalpy and internal energy of thermodynamic systems based on measured sizes and the use of Maxwell equations. • Choose the appropriate equation of state for each thermodynamic system. • Calculate concentrations and temperatures in thermodynamic systems where chemical equilibrium has occurred.
Teaching methods	Oral presentations and exercises
Assessment methods	Written exam with optional midterm exam

STEAM GENERATORS I

Course code	204
Instructor(s)	D. Kolokotronis
Semester	7
ECTS	5.5
URL	http://eclass.uowm.gr/courses/MECH162/
Hours per week	5
Recommended Prerequisites	• Heat Transfer • Thermodynamics II
Course content	Preliminary concepts. Optimization of thermodynamic efficiency in steam plants. Energy and exergy efficiency. Evolution of steam power plants. Criteria and classification of modern Steam Generators with natural and forced circulation and once-through flow. Flow of energy. Losses

	and boiler efficiency. Characteristic temperatures. Stoichiometric combustion and fuel-air ratio. Combustion of fuel mixtures. Incomplete combustion. Ash. Slugging and fouling. Combustion of pulverized coal. Drying and grinding of solid fuels. Solid, liquid, and gaseous fuel burners. Combined cycle power plants. Important parameters. Laboratory exercises designed for the understanding of flame geometry, emissions and heat engineering calculations.
Expected learning outcomes and competences to be acquired:	After successful completion of the course students will be able to: • Know different thermoelectric power stations setups. • Calculate the energy efficiency of a thermal power station based on its operational parameters. • Suggest interventions to reduce the various energy losses. • Know the effect of the operating parameters of a thermoelectric power station.on its performance. • Calculate operational parameters and efficiency of combined cycles. • Know the individual characteristics of combustion applications with different fuels. • Be aware of modern clean coal technologies for power generation.
Teaching methods	Oral presentations and exercises
Assessment methods	Written exam

HEATING - VENTILATION - AIR-CONDITIONING

Course code	207
Instructor(s)	G. Panaras
Semester	7
ECTS	5.5
URL	http://eclass.uowm.gr/courses/MECH271/

Hours per week	5
Recommended Prerequisites	• Heat Transfer • Thermodynamics I
Course content	Introduction: Content and objectives of HVAC, historical background, review of the basic principles of thermodynamics and heat transfer. Thermal comfort: definition and influencing parameters. Psychrometrics: The thermodynamic properties of moist air and the processes to control them. Heating: Compliance with legislation requirements for building insulation, computation of building heat losses, description of common heating systems, selection and sizing of heating system components. Principles of solar radiation. Heat gains. Air-conditioning: description of common air-conditioning systems, computation of cooling loads, selection and sizing of main components and air- ducts. Cooling: Cooling cycles with vapor as a working fluid, common refrigerants, heat pumps, evaporative cooling. Absorption cooling cycles.
Expected learning outcomes and competences to be acquired:	Through the course, the student is introduced to the basic principles of heating, ventilation and air-conditioning (HVAC), as well as the design and analysis of HVAC systems. Following the successful completion of the course, the students will have achieved/acquired: • Understanding of the basic principles governing the analytical methods, and linking them to the pre-existing knowledge they have acquired (e.g. topics of Fluid Mechanics, Heat Transfer, etc.) • The ability to appropriately apply the methods (e.g. calculation of thermal / cooling loads, checking of thermal insulation capacity, etc.). • Understanding of the particularities of each method (e.g. differences in heat / cooling load calculation methods) and evaluate its reliability by weighing the causes of possible complexity or the possibility of adopting more simplified approaches. • The ability to apply the methods for designing the respective installations. The student applies the acquired knowledge by performing two case-studies of HVAC system design; one case study refers to a heating problem while the other refers to a

	cooling one.
Teaching methods	Hours of Instruction 65
Assessment methods	Final written exam (80% of the final grade), optional midterm exam (20% of the final grade)

AUTOMATIC CONTROL SYSTEMS

Course code	219
Instructor(s)	K. Rallis
Semester	7
ECTS	5.5
URL	http://eclass.uowm.gr/courses/MECH219/
Hours per week	5
Recommended Prerequisites	• Mathematics Physics • Introduction to Computing • Electrotechnics
Course content	The course introduces students to the basic principles of automatic control systems. Class lectures provide students with fundamental systems analysis skills with particular emphasis on the applications of control. Lectures cover the following topics. Mathematical model of a physical system and differential equations, electrical and mechanical dynamic systems, Open loop & Close loop control systems, Laplace Transform in control systems, Characteristics equation and Transfer Function, Block diagrams of systems, State space representation, time response for 1st order system, transient response specification of 2nd order system, Steady State error of a system, use of Matlab and Simulink in control topics, Stability of systems, Ruth-Hurwitz criterion.
Expected learning outcomes and competences to be acquired:	By the end of the course, students must be able to understand the basic principle of theory, design and applications in all technical areas of control systems. Typical students will have acquired the following skills: • To extract the mathematical model of electrical and

	mechanical dynamic systems • Be able to use the Laplace transform for the calculate the time response • To describe a system by the use of transfer function and state space representation • To become familiar with functional block diagrams of control systems • Determine steady state and transient characteristics of first and second-order systems. • Determine stability by calculating positions of poles and by using Ruth-Hurwitz criterion • Ability to work with Matlab and Simulink for analysis and design of control systems.
Teaching methods	Lectures and tutorials
Assessment methods	100% written exam

NUMERICAL METHODS IN DESIGN OF MECHANICAL STRUCTURES

Course code	372
Instructor(s)	D. Giagopoulos
Semester	7
ECTS	4.5
URL	http://eclass.uowm.gr/courses/MECH128
Hours per week	5
Recommended Prerequisites	• Mechanical Vibrations and Machine Dynamics • Statics • Mechanics of Materials.
Course content	Introduction to FEM, The Total Potential Energy of System. Matrix Algebra, Spring, Bar and Beam elements. Stiffness and Mass matrices, Plane trusses Two dimensional problems (membranes, disks, plates, shells)., Stress and strain relations, Strain and displacement relations, the equilibrium Equations. Equations solving, direct and iterative methods. Linear Static analysis, Structural vibration and dynamics,

	Basic equations, modal equations, damping, transient response analysis. 3D problems. The course, beyond the theoretical teaching, introduces the student and into programming, based on application programs in an environment of MATLAB, and commercial finite element computer software.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • understand and use finite elements to solve mechanical engineering problems and solids engineering with emphasis on the energy method based on the total dynamic energy of the body. • write its own programs for the layout and solving of motion equations, constructions consisting of one-dimensional elements, taking into account the properties of the material and the loads (mechanical and / or thermal) stressing the structure. • understand and use numerical integration methods. • solve mechanical systems and constructions in eigen analysis, static analysis, dynamic analysis in the time and frequency domain, using all types of finite elements (one-dimensional, two-dimensional and three-dimensional elements). • understand and evaluate the numerical results with respect to the unknown nodal displacements of the finite elements of a structure and be able to make a design optimization.
Teaching methods	Lectures (13 weeks x 3 hours of Theory and 2 hours of Exercises) and homeworks.
Assessment methods	Final written exam

INTERNAL COMBUSTION ENGINES

Course code	206
Instructor(s)	D. Kolokotronis
Semester	7

ECTS	4.5
URL	http://eclass.uowm.gr/courses/MECH125/
Hours per week	5
Recommended Prerequisites	• Thermodynamics I • Thermodynamics II • Fluid Mechanics I
Course content	Energetic issues of internal combustion engines. Spark ignition engines. Compression ignition engines. Ideal, adopted, and real cycle. Mean pressures and efficiencies of the above cycles. Quality factor. Mechanical efficiency. Energy balances. Combustion chamber geometries. Fuel types and mixture formation, ignition, combustion, flame speed. Pollution due to IC Engines, pollution control. Analysis of indicator diagram. Control practices, representative operation curves at different loads. Operation at partial load. Detailed study of the real cycle of reciprocating engines. Experimental determination of representative cycle characteristics. Control. Heat losses. Basic phenomena and criteria. Cooling systems. Gas flow. Gas exchange mechanisms. Scavenging and supercharging systems. Comparison between commercial and racing internal combustion engines. Modern combustion technologies, homogeneous charge compression ignition engines, hydrogen engines.
Expected learning outcomes and competences to be acquired:	This course provides knowledge of the basic principles of operation and thermodynamics of the internal combustion engines as long as analysis of the operational parameters, indicator diagram, combustion and intake and exhaust processes in natural aspirated and supercharged engines. It is expected that at the end of the course, students familiarize with the above so they are able to study and understand ICE operation for various applications by means of deep study of theory and exercises. Upon successful completion of the course the students will be able to: • Have an understanding of the basic principles, operating parameters and processes taking place in internal combustion reciprocating engines (atmospheric or supercharged). • Have knowledge of the tools and techniques used to study the operation of internal combustion engines.

	• Combine knowledge in order to choose the appropriate internal combustion engine depending on the application. • Use the knowledge from the course material to examine the operation of an internal combustion engine. • Combine information either from the course material or from the international literature to suggest optimization of the operation of an internal combustion engine. • Evaluate the operation data of a reciprocating internal combustion engine and anticipate any failures.
Teaching methods	Oral presentations and exercises
Assessment methods	Final written exam (compulsory), course project (optional)

COMPUTATIONAL MECHANICS I

Course code	228
Instructor(s)	M. Politis - R. Sotiropoulou
Semester	7
ECTS	4.5
URL	http://eclass.uowm.gr/courses/MECH186/
Hours per week	4
Recommended Prerequisites	• Introduction to Programming • Mathematics II, III, IV • Numerical Analysis • Fluid Mechanics I • Heat transfer
Course content	Introduction. The conservation laws and their mathematical foundation and description using Partial Differential Equations (PDE’s). Nondimensionalization and boundary conditions. Boundary value problems solution procedure. Finite difference methods. Physical domain discretization. Simple and complex expressions. Higher order approximations. Finite difference methods for parabolic

	PDE's. Model equation case. Explicit and implicit methods. Numerical solution of the transient diffusion (or conduction) equation. Finite difference methods for elliptic PDE's. Model equation case. Solution using direct and iterative processes. Successive Over Relaxation (SOR) methods. The Alternate Direction Implicit (ADI) method. Numerical solution of Laplace's or Poisson's equation. Finite difference methods for hyperbolic PDE's. Model equation case. Up-winding and the problem of artificial dispersion/viscosity. Wave propagation in one-dimension. Non-linear problems. Solution of Burgers equation. Introduction in the solution of the Navier Stokes equations.
Expected learning outcomes and competences to be acquired:	Aim of this course is to make the student become familiar with the basic concepts of computational techniques and the acquisition of the necessary knowhow to solve engineering problems requiring the solution of differential conservation laws in the fluid or solid state. Several techniques will be examined and evaluated in terms of accuracy, stability and consistency. Upon successful completion of the course, the student will be able to develop finite difference numerical schemes to discretize the Partial Differential Equations of Conservation laws and solve them with appropriate computer programming.
Teaching methods	Hours of Instruction 52 (Theory: 26, Laboratories: 26)
Assessment methods	Class project on three main topics plus an optional choice. Written report, presentation and poster of main results. Oral presentation and assessment.

EXPERIMENTAL METHODS AND MEASUREMENT TECHNOLOGY

Course code	250
Instructor(s)	O. Maaita
Semester	7
ECTS	4.5
URL	http://eclass.uowm.gr/courses/MECH156/
Hours per week	4
Recommended	• Statistics

Prerequisites	• Fluid Mechanics I • Heat Transfer
Course content	Measurement science: mathematical description of measurement systems, input-output signal characteristics, transfer function, measurement standards, static and dynamic calibration, bias and random errors, statistical analysis of data, measurement uncertainty and error propagation, analogue and digital signal processing. Measurement techniques for temperature, static and dynamic pressure, local flow velocity, flowrate, strain, displacement, force and torque.
Expected learning outcomes and competences to be acquired:	The course provides an introduction to the basic principles of measurements and experiments. The students become acquainted with measurement science and the methods of statistical analysis of the measurement data and with measurement techniques of mechanical properties. The course comprises laboratory exercises during which students get hands on experience on conducting measurements and analyzing data. Upon successful completion of the course, the students will be able to: • Understand the measurement procedure and its steps • Properly state the results of a measurement • Properly present data in graphical and tabular form • Identify the sources of measurement errors and their attributes • Classify deterministic (bias) and random errors • Estimate the uncertainty of single-sample and multiple-sample direct measurements • Utilize uncertainty analysis to estimate the uncertainty in indirect measurements • Fit empirical relationships to measurement data • Statistically process random data • Understand the basic techniques for the measurement of temperature, pressure, fluid velocity and flow-rate and their error sources

Teaching methods	lectures, tutorials and laboratory exercises
Assessment methods	30% laboratory reports, 70% final written exam

QUALITY CONTROL	
Course code	230
Instructor(s)	S. Panagiotidou
Semester	7
ECTS	4.5
URL	http://eclass.uowm.gr/courses/MECH167/
Hours per week	4
Recommended Prerequisites	• Statistics
Course content	Introduction: brief history of quality methodology, quality management, quality costs, methods for quality improvement. Acceptance sampling: lot-by-lot acceptance sampling for attributes, single, double and multiple sampling plans, statistical and economic design. Statistical Process Control: capability analysis, control charts for attributes and variables, statistical and economic design. Planning, organizing and developing quality systems for industry.
Expected learning outcomes and competences to be acquired:	The course presents systematically the modern methods of quality assurance placing special emphasis on the techniques of Statistical Quality Control (SQC). After the completion of the course the students should be able to: • understand the importance of quality in business • comprehend the economic and operational impact of quality on businesses • model problems related to control and assurance of quality of products and processes by means of scientifically rigorous quantitative methods • obtain optimum solutions to quality-related problems • optimize quality decisions with various criteria.
Teaching methods	Hours of Instruction 52 (Theory: 26, Exercises: 26)
Assessment	Final written exam (compulsory) , Intermediate written

methods	exam (optional)

TURBOMACHINERY	
Course code	205
Instructor(s)	K. Vafiadis
Semester	8
ECTS	5.5
URL	http://eclass.uowm.gr/courses/MECH158/
Hours per week	5
Recommended Prerequisites	• Mathematics I • Mathematics II • Fluid Mechanics I • Fluid Mechanics II • Thermodynamics • Heat Transfer
Course content	Introduction. Applications and basic concepts of turbomachinery. Basic principles of fluid mechanics and thermodynamics. Velocity diagrams. Energy conversion in turbomachinery, efficiency, degree of reaction. Phase changes and cavitation. Characteristic curves of turbomachines and of systems, determination of operating point, connection in parallel and in series. Concepts of similarity, dimensional analysis, non-dimensional numbers, specific speed, non-dimensional cavitation numbers. Axial machines, airfoil theory, flow phenomena and forces on airfoils, non-dimensional numbers, cascade analysis, deviation angle. Radial equilibrium theory. Secondary flows and losses. Axial pumps, axial compressors and blowers, instability phenomena, supersonic flow compressors. Axial turbines, degree of reaction, types and mechanisms of aerodynamic losses in airfoils, turbine blade cooling. Hydraulic turbines. Centrifugal compressors and pumps, flow and velocity diagrams, manufacturing aspects, blade

	design, exhaust system.
Expected learning outcomes and competences to be acquired:	The main aim of the course is to provide to the student to the principles governing the operation of turbomachinery. The student will gain knowledge and in depth understanding of the principles of operation, flow phenomena and design characteristics of turbomachinery components. The student will also gain experience in using specific techniques of analysis, design and selection of various classes of turbomachinery. The student will be able to use basic principles of Fluid Mechanics and Thermodynamics in order to design and analyze various types of turbomachinery such as pumps, compressors, turbines, wind turbines etc. He will learn how to effectively use open source software for aerodynamic airfoil analysis as well as software for the design and analysis of gas turbines.
Teaching methods	Lectures, exercises, laboratory tutorials for the use of commercial software. Homework and personal assignments with the application of commercial software on real design and analysis problems. Utilization of information technology for the course management.
Assessment methods	Final examination, intermediate examination, two individual assignments

INVENTORY MANAGEMENT

Course code	255
Instructor(s)	G. Nenes
Semester	8
ECTS	4.5
URL	http://eclass.uowm.gr/courses/MECH169/
Hours per week	4
Recommended Prerequisites	• Statistics
Course content	Introduction: The significant role of Inventory management and Logistics. Introduction to Supply Chain Management. Forecasting Methods. Deterministic systems of inventory management: (a) the case of known and constant demand (EOQ methods) and (b) the case of known and inconstant.

	Stochastic systems of inventory management: sQ, RS, sS, RsS systems. Seasonable and innovative products (Newsvendor problem). Introduction to Supply Chain Management and multi-echelon inventory optimization.
Expected learning outcomes and competences to be acquired:	To familiarize students with the techniques and tools for organizing and optimizing inventory systems and supply chains in the industrial environment. After the completion of the course the students should be able to: • understand the importance of inventory management in enterprises • comprehend the economic and operational impact of inventories on businesses • model real inventory management systems • solve real inventory management problems • optimize design parameters economically and statistically
Teaching methods	Hours of Instruction 52 (Theory: 26, Exercises: 26)
Assessment methods	Final written exam (compulsory) , Intermediate writtenexam (optional)

FLUID MECHANICS II

Course code	249
Instructor(s)	O. Maaita
Semester	8
ECTS	5.5
URL	http://eclass.uowm.gr/courses/MECH137/
Hours per week	4
Recommended Prerequisites	• Fluid Mechanics I • Thermodynamics I
Course content	Review of basic principles of fluid mechanics. Mathematical description of isothermal flow, continuity and Navier-Stokes equations. Boundary layer theory and practice, flow parallel to a flat plate, velocity profile, Pandtl's analysis, Blaussius

	solution, momentum-integral analysis, skin friction, turbulent boundary layers, law of the wall, effect of surface roughness, boundary layers in flows with pressure gradients, flow separation. External flow over submerged bodies, drag coefficient, aero/hydrodynamic forces on submerged bodies, effect of Reynolds number, unsteady phenomena, flow over a circular cylinder, vortex shedding, Strouhal number, vortex-induced vibrations, vehicle aerodynamics, flow past airfoils, lift, drag-lift curve, dynamic stall. Transition to turbulence, types of transition, linear stability analysis, Orr-Somerfield equation, shear layers and wakes. Turbulent flows, statistical description of turbulence, integral scales, inertial subrange, Kolmogorov theory, energy dissipation, turbulence modelling, eddy viscosity, Reynolds-Averaged Navier-Stokes equations, large-eddy simulation, direct numerical simulation. Compressible flow, speed of sound, Mach number, unidirectional adiabatic and isentropic flow, normal shock waves, Fanno and Raileigh flow. Two-dimensional compressible flows, oblique shock waves.
Expected learning outcomes and competences to be acquired:	The course aims at advancing students' understanding of fluid mechanics and their introduction to more advanced fluid flow problems. The students become familiarized with the phenomenology of complex flows and their mathematical description so that they can tackle practical fluid flow problems. Upon successful completion of the course, the students will be able to: • Describe flow fields using streamlines, streaklines, and particle pathlines • Understand flow visualization techniques • State in differential form the conservation laws for mass and momentum • Simplify and solve the differential conservation laws • Understand and utilize approximate solutions of the differential conservation laws • Compute the skin-friction and pressure forces from their distributions around bodies • Estimate the drag force using empirical relationships • Estimate the lift on airfoils and understand stall

	• Understand the concept of hydrodynamic instability and transition to turbulence • Recognize the consequences of transition in boundary layers • Compute inertial and drag forces in unsteady flows around bodies • Estimate the speed of sound and understand compressibility effects • Calculate property changes in isentropic compressible flows • Calculate property changes across normal shock waves
Teaching methods	lectures and tutorials
Assessment methods	25% homework (x3), 75% final written exam

STRATEGIC MANAGEMENT	
Course code	224
Instructor(s)	-
Semester	8
ECTS	4.5
URL	-
Hours per week	4
Recommended Prerequisites	-
Course content	Strategic management is defining the fundamental long-term goals and objectives of a company, as well as the adoption of a series of acts and the determination of the necessary instruments for the realization of these objectives the strategy Strategic management takes into account the conditions prevailing on the exterior and interior environment of a company before determining its mission, objectives,

	strategies and options of how to implement and evaluation. SM sets guidelines for support in order to obtain uniform decisions and the definition of a business in connection with the competition.
Expected learning outcomes and competences to be acquired:	After completion of the course the student should be able to: • understand simple fundamentals that govern workplace Business Strategy, • analyze the contribution of each aspect of the strategy • develop the entrepreneurial project. • analyze the internal environment of the company • analyze the establishment environment of business can market strategy selects or industry • evaluate strategies • implement strategies
Teaching methods	Lectures (13 wks x 5 hrs theory) and one big homework project.
Assessment methods	30% final oral exam, 70% two homework projects

COMPUTER AIDED MANUFACTURING FOR INDUSTRIAL PRODUCTION

Course code	252
Instructor(s)	E. Varitis
Semester	8
ECTS	4.5
URL	http://eclass.uowm.gr/courses/MECH252/
Hours per week	4
Recommended Prerequisites	• Fundamentals of Machining
Course content	Introduction to Computer Numerical Control (CNC) Machines, CNC Lathe, CNC Milling. CNC Programming Languages. Fundamentals of CNC programming using G-code. Rapid Prototyping, 3D Printing, Additive Manufacturing. Basic principles of 3D parametric design in CAD system, CAD/CAM interoperability. Preparation of

	CNC manufacturing programs and simulations with CAM systems.
Expected learning outcomes and competences to be acquired:	Upon successful completion of the course the student will: • have a thorough understanding of the common types of CNC machines. • have a thorough understanding of the fundamental principles of Numerical Control (NC & CNC). • have a thorough understanding of the fundamental programming principles of CNC machines using G-code. • Be able to prepare programs in G-code for CNC Lathe and / or CNC Milling. • Be able to design any component in a CAD system. • Be able to prepare the program and the manufacturing simulation of any component using a CAM system. • Be able to perform all the necessary functions / tasks to construct a three-dimensional CAD component in a Rapid Prototyping machine.
Teaching methods	13 weeks of Instruction (5 weeks of CNC theory and G-code programming exercises, 3 weeks of CAD theory and laboratory exercises, 3 weeks of CAM theory and laboratory exercises, 1 week of Rapid Prototyping theory and laboratory exercises).
Assessment methods	80% final written exam, 20%, either mid-term exam or homework.

ENERGY DESIGN OF BUILDINGS I

Course code	251
Instructor(s)	G. Panaras
Semester	8
ECTS	4.5
URL	http://eclass.uowm.gr/courses/MECH227/
Hours per week	4

Recommended Prerequisites	• Heating, Ventilation and Air-Conditioning
Course content	Objectives & Content of Energy Design of Buildings. Building uses. Building comfort requirements: Thermal comfort, ventilation, visual, acoustic comfort. Estimation of heating & cooling loads. System Design. Bioclimatic design of buildings. Passive solar systems for heating and cooling. Natural and forced ventilation of buildings. Conventional energy systems. Solar thermal systems. Solar air conditioning systems. RES systems in the building. Energy performance analysis of building: Energy load modeling, monthly semi-stationary method, system modeling, energy consumption calculation. Application into optimum building design.
Expected learning outcomes and competences to be acquired:	The course presents the basic design principles for achieving the lowest possible energy consumption in buildings. The course presents the basic design principles for achieving the smallest possible energy consumption in buildings. After successful completion of the course, the students will have: • Understood the difference between designing a building facility and assessing its behavior and profitability • Understood the impact of the environment and the comfort requirements on the energy design of buildings • Understood the objectives of energy planning at a technical, environmental and economical level. • Acquired knowledge of the passive and active systems that can be applied in a building in the direction of energy saving and maximum exploitation of RES systems. • Gained the ability to compose existing methods, tools and technologies in the direction of optimal design. • Gained the ability to apply the acquired knowledge to an Energy Planning problem, according to the low / near zero energy design project (of their own choice) assigned to them.
Teaching methods	Hours of Instruction 52
Assessment methods	Final written exam (compulsory), Building Energy Design Project (optional)

TECHNOLOGICAL SYSTEMS RELIABILITY AND MAINTENANCE

Course code	241
Instructor(s)	S. Panagiotidou
Semester	8
ECTS	5.5
URL	http://elearn.materlab.eu/course/view.php?id=2
Hours per week	5
Recommended Prerequisites	• Statistics
Course content	Reliability theory, reliability distributions, exponential distribution, distribution gamma, Weibull distribution, normal distribution. Systems reliability, reliability estimation, Markov reliability chains, estimation of reliability using generic parts, fault tree analysis, Monte-Carlo Simulation, Duane model. Reliability data collection, cost estimation, maintenance policies, maintenance indices, economic implications of idle time. The theory of replacement, deterministic and stochastic replacement policies. Preventive maintenance, total productive maintenance TPM, Use of simulation in maintenance.
Expected learning outcomes and competences to be acquired:	This undergraduate subject aims: • introduce the student to the concepts of reliability and maintainability of simple or complex mechanical components or devices. • introduce the student to the maintenance strategies and replacement policies. • help the student to combine his knowledge of theory of statistics with solving reliability problems and applying scientific based maintenance policies in any industrial environment. • train the student to topics of rationally and scientifically documented maintenance policies in business and industrial environment. • train the student to use simulation models of maintenance and replacement.

	• train the student to use computer based tools in maintenance management.
Teaching methods	Lectures (13 wks x 3 hrs theory and 2 hrs computer based laboratory exercises) and two homework projects.
Assessment methods	70% final written exam, 30% one homework project or/and a computer-based intermediate exam

NONDESTRUCTIVE TESTING

Course code	256
Instructor(s)	Th. Theodoulidis
Semester	8
ECTS	4.5
URL	http://eclass.uowm.gr/courses/MECH171/
Hours per week	4
Recommended Prerequisites	-
Course content	Non-destructive testing of materials and structures. Radiography method, ultrasound method, electromagnetic methods (eddy currents, magnetic leakage), magnetic particle and liquid penetrant methods, visual inspection, thermography and other methods. International Standards and Specifications.
Expected learning outcomes and competences to be acquired:	Upon successful completion of the course, the student will be able to: • Understand the phenomenon of any recognized Non-Destructive Check method. • Perform simple laboratory tests with at least 4 methods (Magnetic, Penetrating, Edge, Ultrasound). • Interpret industrial radiographs. • Evaluate the application and the expected errors in the test specimen. • Choose the appropriate Non-Destructive Check method. • Interpret specifications. • Prepare simple reports of non-destructive testing.

	• Develop problem-solving abilities and evaluate numerical calculations to understand the order of magnitude.
Teaching methods	Hours of Instruction 52 (Theory: 38, Laboratory: 14)
Assessment methods	80% Final written exam (compulsory), 20% Laboratory assignments (compulsory)

DESIGN AND ANALYSIS OF EXPERIMENTS

Course code	257
Instructor(s)	S. Panagiotidou
Semester	8
ECTS	4.5
URL	http://eclass.uowm.gr/courses/MECH205/
Hours per week	4
Recommended Prerequisites	-
Course content	Analysis of variance: the fixed and random effects models for one factor. Design of statistical experiments: factorial and fractional factorial experiments, design and statistical analysis. Simple and multiple linear and nonlinear regression analysis. Correlation.
Expected learning outcomes and competences to be acquired:	After the successful completion of the course, students will be able to: • perform statistical experiments with a single factor and interpret the results • perform special types of statistical experiments with a single factor and interpret the results • perform statistical experiments with more than one factors and interpret the results • design fractional factorial experiments with several factors at two levels • use orthogonal arrays • identify the significant factor effects and interactions

	• perform simple and multiple linear regressions • perform significance tests of the regression variables • calculate confidence intervals and prediction intervals in regression models
Teaching methods	Hours of Instruction 52 (Theory: 26, Exercises: 26)
Assessment methods	Final written exam (compulsory), Intermediate written exam and/or assignments (optional)

BIOMEDICAL ENGINEERING

Course code	258
Instructor(s)	I. Ziganitidis
Semester	8
ECTS	4.5
URL	http://eclass.uowm.gr/courses/MECH258/
Hours per week	4
Recommended Prerequisites	• Technology of Materials I & II • Statics • Dynamics • Numerical Methods in design of mechanical structures
Course content	Basic principles of biology, biological materials and their properties (tissues, cells, proteins, amino acids, blood, etc.). Understanding biological systems and interactions between them. Mechanisms of mechanical signal transmission and its conversion into biochemical. Evolutionary mechanics and effect of daily loads on tissue morphogenesis. Techniques, biocompatibility, biodegradation and principles governing implants. Types of implants and their peculiarities based on the intended use. Smart / biomimetic materials and nano-materials. Implant design, material selection, clinical trials, optimization, and legislative framework for disposal. Examples of orthopedic and dental engineering and interdisciplinary benefits.
Expected learning outcomes and	After the successful completion of the course, students will: • acquire the theoretical background in various fields of

competences to be acquired:	biomedical technology and knowledge for the application of engineering in medicine. • be able to understand, describe and categorize key technologies used in Biomedical, with diagrams and data. • be able to evaluate comparatively and substantiates the relative advantages and disadvantages of alternative technology approaches and solutions. • be able to select the appropriate among the alternative descriptions of the digital system, based on the problem it faces. • be familiar with the basic principles of material technology in all materials used in bio-medical devices. • be familiar with the basic principles of biomaterial manufacturing and their properties as well as prosthetic members.
Teaching methods	Lectures (13 weeks x 2 hour of Theory and 2 hours of Exercises) and homeworks.
Assessment methods	50% written final examination, 50% grade of homework.

ADVANCED INFORMATION TECHNOLOGIES AND PROGRAMMING FOR MECHANICAL ENGINEERS

Course code	259
Instructor(s)	C. Grompanopoulos
Semester	8
ECTS	4.5
URL	http://eclass.uowm.gr/courses/MECH259/
Hours per week	4
Recommended Prerequisites	• Numerical Methods in design of mechanical structures • Introduction to Computing • Numerical Analysis and Simulation
Course content	Introduction to Computer Programming. Representation and

	processing of information, Introduction to high level programming languages (e.g., C, C++, C#, Java). Object Oriented programming and application in the analysis of mechanical structures. Command line and GUI applications, Programming with C++ (Selections, Loops, Arrays and Pointers, Functions, Strings, Files, Libraries), Memory and Disk management, Algorithms, Debugging, Computational Accuracy in the analysis of mechanical structures. Special issues in Algorithms and Data Structures with emphasis on the representation of mechanical systems.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course the students should be able to: • recognize the contribution of programming to the analysis and solution of mechanical engineering problems, • have adequate knowledge of the fundamental principles of Object Oriented Programming (hierarchy, polymorphism, data abstraction etc.), • formulate specifications and analyze requirements for the creation of an computer program in the engineering field, • utilize core programming techniques in the application creation process, • apprehend and utilize fundamental data structures (lists, trees, graphs) for the representation of technological data, • utilize software libraries for the creation of new applications, • implement programming techniques to discover possible problems and debug applications
Teaching methods	Lectures (13 weeks x 2 hours theory and 2 hours practice problems in the lab).
Assessment methods	Home assignments (50%) Final written exam (50%).

UNIT OPERATIONS	
Course code	210

Instructor(s)	To be assigned
Semester	8
ECTS	4.5
URL	http://eclass.uowm.gr/courses/MECH180/
Hours per week	4
Recommended Prerequisites	• Thermodynamics II • Introduction to Environmental Technology
Course content	Introduction to the basic conservation laws: Momentum, heat and mass transfer. Absorption processes. Phase equilibrium and Henry's law. Absorption using packed towers and transfer units. Resistances to mass transfer between the two phases. Design of absorption towers for dilute and concentrated mixtures. Analytical and graphical methods. Distillation process. Phase equilibrium in binary mixtures. Ideal and azeotropic mixtures and Raoult's law. McCabe Thiele's graphical method and Lewis's computational method. Short-cut methods for the distillation of multi-component mixtures. Cooling Towers. Design using short-cut methods. Adsorption methods. Equilibrium isotherms, Langmuir's equation. Use of laboratory scale experimental breakthrough curves to design middle scale columns. Membrane processes for gas and liquid separations. Simple and complex flow models. The well mixed model; analytical expressions and design equations. Filtration methods: reverse osmosis, hyper-filtration and micro-filtration. Mechanical separations.
Expected learning outcomes and competences to be acquired:	This course aims to introduce the student to traditional and novel unit operation processes used in the industry. The student understands first the basic physicochemical mechanisms of each process and then learns to design each process using short-cut or detailed (graphical or computational) methods.
Teaching methods	Hours of Instruction 52 (Theory: 26, Exercises: 26)
Assessment methods	Final written exam (80% of the final grade), optional midterm exam (20% of the final grade)

DECISION ANALYSIS	
Course code	260
Instructor(s)	-
Semester	8
ECTS	4.5
URL	-
Hours per week	4
Recommended Prerequisites	• Statistics • Operations Research I
Course content	Introduction to decision analysis and game theory, decision making and decision trees, utility theory and probability, games of complete and incomplete information, zero and non-zero sum games, applications of game theory in management science.
Expected learning outcomes and competences to be acquired:	After the successful completion of the course, students will be able to: • apply the fundamentals of decision analysis • derive utility functions • construct decision trees • represent operational problems with appropriate decision theory models • solve game theory problems • plan strategies for decision making • use Bayes Theorem in decision analysis
Teaching methods	Hours of Instruction 52 (Theory: 26, Exercises: 26)
Assessment methods	Final written exam (compulsory), Intermediate written exam and/or assignments (optional)

ENERGY DESIGN OF BUILDINGS II	
Course code	327
Instructor(s)	G. Panaras
Semester	9
ECTS	4
URL	http://eclass.uowm.gr/courses/MECH217/
Hours per week	4
Recommended Prerequisites	• Energy Design of Buildings I
Course content	National regulation for the Energy Performance of Buildings (KENAK), basic principles. Estimation of building energy performance, available methodologies and calculation tools. Energy inspection of the building as a whole, as well as of its installations. Requirements and equipment for the inspection. Laboratory exercise: Study of the operation of a system responsible for the regulation of thermal comfort conditions (Psychrometry, Cooling cycle).
Expected learning outcomes and competences to be acquired:	The course aims at acquainting students with the certification of the energy performance of buildings and its requirements; methodologies and software tools are included. The theoretical knowledge gained from the Energy Design of Building I course can be re-examined with regard to the applied character of the Regulation for the Performance of Buildings (KENAK). The laboratory exercises in the regulation of thermal comfort conditions, also contribute towards a more applied direction. Within the context of the course, the students select an existing building and proceed to its certification, while also proposing specific interventions towards the upgrading of its energy class. After successful completion of the course, the students will have: • Understood the difference between methodological tools for building energy performance assessment and certification. • Acquired knowledge of the key processes anticipated by KENAK (e.g. energy study, inspection).

	• The ability to apply the acquired knowledge, including the TEE-KENAK energy analysis software, to an actual building (of their own choice). • Gained experience on actual issues of thermal comfort / HVAC facilities through laboratory exercises. • Understood the effect of conventional fuel consumption on the environmental performance of a building
Teaching methods	Instruction, Specialized software practice, Execution of laboratory exercises (total hours 52)
Assessment methods	Final written exam (compulsory), Laboratory exercise (compulsory), Building Certification Project (compulsory). Calculation of the final grade: 70% final exams, 30% laboratory exercises and student projects.

ATMOSPHERIC POLLUTION

Course code	391
Instructor(s)	R. Sotiropoulou
Semester	9
ECTS	4
URL	http://eclass.uowm.gr/courses/MECH239/
Hours per week	4
Recommended Prerequisites	-
Course content	The atmosphere: Origins - Structure – Composition. Key features and principles of the atmosphere - The Boundary layer. Atmospheric pollutants and their sources. Basic principles of air pollution. Air pollution meteorology. Atmospheric stability. Basic atmospheric diffusion principles. Effective emission height. Atmospheric diffusion modeling. Scalar transport theory. Pollutants deposition. Instrumentation - Measurement of Meteorological Parameters.
Expected learning outcomes and competences to be	The aim of this course is to provide students the basic principles of physics and atmospheric dynamics, the sources of pollution, the life cycle of atmospheric pollutants starting

acquired:	from their emissions or formation and until their final removal from the atmosphere, the environmental burden mechanisms and the impacts on health and ecosystems. The course is especially focused on industrial processes and plants. Students will also be introduced to the European legislative framework on air quality and to international conventions. After the teaching of this course, the student will be able to apply integrated approaches towards environmental impact assessment. Specific objectives are listed below. • Gain understanding of the basic concepts of air pollution and its effects on human and ecosystem health. • Explore how atmospheric chemical composition both drives and responds to changes in the earth system, including climate change. • Look at the major air pollutants, their sources, chemical transformations in the atmosphere and impacts. • Articulate current air pollution policies applied in Europe for criteria pollutants. • Know how to interpret meteorological data for atmospheric stability and air pollutant transport and dispersion. • Get an insight into the fundamentals of air quality models.
Teaching methods	Hours of Instruction 52 (Theory: 34, Lab - Exercises: 18)
Assessment methods	Final written exam (compulsory), Weekly exercises (compulsory).

WIND AND WATER TURBINES, HYDROELECTRIC PLANTS

Course code	318
Instructor(s)	K. Vafiadis
Semester	9
ECTS	4
URL	http://eclass.uowm.gr/courses/MECH159/

Hours per week	4
Recommended Prerequisites	• Fluid Mechanics I • Turbomachinery
Course content	Wind turbines. Introduction to wind energy and wind turbines. Atmosphere and wind energy potential. Types of wind turbines and subsystems. Aerodynamic design of horizontal axis wind turbines. Aerodynamic design of vertical axis wind turbines. Static and dynamic wind loading. Selection of installation site. Wind farms. Turbine components' selection. Economics of wind energy. Water turbines and hydroelectric plants. Global and national situation, benefits and impacts. Hydroelectric plants and their classification , advantages and disadvantages, hydrodynamic potential, hydrographs. Principles of operation and classification of water turbines, impulse turbines, reaction turbines, similarity theory, specific speed, cavitation phenomena.
Expected learning outcomes and competences to be acquired:	The main aim of the course is to provide the student with an introduction to the principles governing the operation of wind generators and water turbines. The student will gain an in depth knowledge and understanding of the principles of operation, of the flow phenomena and the design characteristics of these machines. He / she will also gain experience in using specific techniques for the analysis, design and selection of various classes of wind and water turbines. During the course the development and use of computational methods are encouraged, and there is also requirement for an experimental activity and a group project. The student will be able to assess the wind potential of an area, to select the location for the installation of wind turbines and perform economic and technical evaluations. In addition, the student will be able to assess the hydrological potential of a region, select the appropriate type of turbines and assess the expected power output.
Teaching methods	Lectures, exercises, laboratory tutorials for the use of open source software. Homework and personal assignments with the application of software on real design and analysis problems. Utilization of information technology for the course management.
Assessment methods	Final Examination, group project assignment

SPECIAL TOPICS ON POLLUTION CONTROL TECHNOLOGIES

Course code	350
Instructor(s)	E. Papista
Semester	9
ECTS	4
URL	http://eclass.uowm.gr/courses/MECH131/
Hours per week	4
Recommended Prerequisites	• Chemistry • Environmental Technology
Course content	Introduction, Wastewater (Physicochemical Properties, Quantities), Wastewater Treatment Technologies, Pretreatment, Primary, Secondary, Advanced Wastewater Treatment, Solid Waste, Integrated Solid Waste Management, Thermochemical and Biological methods for the energy exploitation of waste (Gasification, Pyrolysis, Anaerobic Digestion), Mobile Sources of Pollution, Pollution control technologies in Otto and Diesel Engines, Otto Cycle, Three-way Catalytic Converters, λ sensors, Control pollution technologies in Diesel engines, Diesel Cycle, Formation of soot particles, Soot traps, Control pollution technologies in air transport, Brayton cycle, Catalytic ozone abatement, Hybrid vehicles, Fuel cell vehicles, Alternative fuels.
Expected learning outcomes and competences to be acquired:	The course focuses on the methods of control pollution technologies used in the case of wastewater and solid waste as well as in the case of mobile sources. Through lectures and dedicated exercises, the students are introduced to wastewater treatment technologies and learn how to design such plants. The students are also introduced into the concept of integrated solid waste management. Finally, emphasis is given on control pollution technologies employed in Otto and Diesel cars (three-way catalytic converters, soot traps) as well as on hybrid and fuel cell. Upon completion of the course the student will be able to: • Understand the origin of wastewater (sources,

	categories, quantities) • Understand the physicochemical (solid, gases, BOD, COD, TOC) and biological (microorganisms) characteristics of wastewater, and how they can be measured/estimated. • Understand the technologies employed in wastewater treatment plants • Be able to design screens, aerators, primary sedimentation tanks, aerobic reactors, anaerobic tanks for biogas production • Be aware of the types of solid waste and physicochemical characteristics • Be aware of methods of waste collection • Understand the use and operation of landfills. • Understand which processing technologies should be used depending on the physicochemical characteristics of the waste, • Be aware of combustion and composting technologies • Be aware of the thermochemical (combustion, gasification, pyrolysis) and biological (anaerobic digestion) processes of the organic fraction of the waste. • Be aware of the contribution of transport to air pollution and the significance of control pollution technologies. • Understand the principle of operation of three-way catalytic converters • Understand the principle of soot traps in diesel engines' • Being adequately informed of hybrid vehicles and hydrogen powered vehicles. • Calculate the equivalent air/fuel ratio • Be able to calculate the amount of exhausts according to the employed air/fuel ratio.
Teaching methods	Hours of Instruction 52 (Theory: 26 h, Exercises: 26 h)
Assessment methods	Final written exam (compulsory) , Midterm written exam (optional)

COMPUTER-AIDED DESIGN	
Course code	380
Instructor(s)	N. Sapidis
Semester	9
ECTS	4
URL	http://eclass.uowm.gr/courses/MECH117
Hours per week	4
Recommended Prerequisites	• Introduction to Computing • Linear Algebra • Mechanical Drawing II • Mathematics IV • Machine Elements II
Course content	Introduction to Computer-Aided Design and to CAD/CAE/CAM Systems. Coordinate systems and geometric transformations. Basic principles of CAD and related mathematical & information models. Elements of three-dimensional (3D) Computer Graphics. Mathematical models, data structures and algorithms for geometric modeling of curves, surfaces and 3D solids. Representation and processing/management of mechanical assemblies. Mechanical Computer-Aided Design. Laboratory exercises using CAD systems.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course the students should be able to • demonstrate knowledge of basic principles of software technology and of their application in Computer-Aided Design (CAD). • comprehend mathematical/information models for three-dimensional (3D) solid objects, • comprehend representation methods/models for mechanical assemblies in CAD, • sufficiently comprehend elementary concepts of 3D

	Computer Graphics used in CAD, • construct a correct Mechanical Drawing (for an object of medium complexity) using appropriate CAD software, and be experienced in using at-least two different CAD systems, • comprehend fundamental concepts of Computer-Aided Engineering (CAE) and Computer-Aided Manufacturing (CAM), • sufficiently comprehend difficulties (and research issues) related to applying CAD-related software technologies in the manufacturing industry and in the work of mechanical engineers.
Teaching methods	Lectures (13 weeks x 2,5 hours of Theory and 1,5 hours of CAD Exercises)
Assessment methods	50% final written exam, 50%, either mid-term exam or homework.

VEHICLE DESIGN METHODS

Course code	371
Instructor(s)	I. Ziganitidis
Semester	9
ECTS	4
URL	http://eclass.uowm.gr/courses/MECH143
Hours per week	4
Recommended Prerequisites	• Dynamics • Machine Elements I • Mechanical Vibration and Machine Dynamics • Internal Combustion Engines
Course content	Introduction, VEHICLE TECHNOLOGY: Introduction: Definitions, historical development, vehicle classification, basic technical characteristics, one- two-three-wheeled vehicles. Power unit systems: Internal combustion engines, electric motors, accumulators, gearboxes. Frames-Subframes: Technology, manufacturing methods, materials, loads. Wheels and Tires: Dynamic wheel behavior, tire

	types, friction, wear. Brake system: Brake types, braking assist systems (ABS). Suspension-steering systems: Suspension types, passive-active suspensions, driving behavior, handling. VEHICLE MOTION MODELING: Kinetic / Kinematics: motion in straight line, motion in curve, accelerations, steering behavior, handling, vibrations, kinetic / kinematics study of the front and rear suspension system and the steering system. VEHICLE DESIGN: Basic design principles, implementation of CAD / CAE techniques for the design of vehicle components
Expected learning outcomes and competences to be acquired:	Students after successful completion of the course: • Will be able to clearly define a motor vehicle and identify the individual categories according to geometry, road type and speed. In addition, they will be able to identify and describe the individual mechanical, electrical and electronic systems of which they are composed, as well as to understand their organizational structure. • Will be able to implement basic parametric 3D CAD and strength analysis techniques for the develepoment of the main structural subsystems of vehicles such as the frame. • They will have the necessary skills to analyse the performance of the power transmission system of a vehicle using both qualitative and quantitative criteria and to propose design improvements or even its complete redesing. • They will posses the knowledge to perform kinetic and kinetic analysis of subsystems related to suspension and steering mechanism as well as dynamic analysis of the overall vehicle in various driving scenarios. • They will have a high level of understanding of the basic concepts of vehicle design procedure. In particular, they will be able to methodically develop a new vehicle by defining the basic technical specifications, creating and implementing a structured work plan with clear work packages, timetables and deliverables.
Teaching methods	Lectures (13 weeks x 2 hour of Theory and 2 hours of Exercises).
Assessment	100% written exam

methods	

TECHNOLOGY, RESEARCH, INNOVATION POLICIES AND ENTREPRENEURSHIP

Course code	356
Instructor(s)	E. Samara
Semester	9
ECTS	4
URL	http://elearn.materlab.eu/
Hours per week	5
Recommended Prerequisites	• Technology and Innovation-Economic Science and Entrepreneurship
Course content	Innovation and competitiveness, Innovation as a management process, Innovation Systems, Technological entrepreneurship, Entrepreneurship and innovation practices, Research, Technology and Innovation Policies in America, Europe and Greece, Indicators of innovation measurement, Drafting and Developing a Business Plan
Expected learning outcomes and competences to be acquired:	Upon successful completion of the course, students will be able to: • List the innovation types. • Describe the concepts of posture, propensity and innovation performance. • Identify the difference between innovation and invention. • Describe the types and characteristics of innovation. • Apply the standards of the innovation process. • Recognize innovation systems. • Identify the types of entrepreneurship. • Choose appropriate financial tools for entrepreneurship. • Compare innovation policies. • Draw up a business plan.
Teaching methods	Oral presentations

Assessment methods	100% homework project, business plan.

RISK MANAGEMENT AND SAFETY OF LARGE INDUSTRIAL SYSTEMS

Course code	389
Instructor(s)	I. Bakouros
Semester	9
ECTS	4
URL	-
Hours per week	4
Recommended Prerequisites	-
Course content	This course covers the scientific area of Risk Management and Safety of Large Industrial Systems with emphasis to Petroleum Industry. The following subjects are covered In details: Safety and loss prevention, definition of hazard, risk and risk assessment, scope and outline of risk management, frequency and severity, intrinsic and extrinsic safety, risk balance, Pareto principle, epidemiological approach, hazard warning. Identification of hazards and basic definitions: toxicity, flammability, sources of ignition, fires, explosions, ionizing radiation, noise pollution, temperature and pressure deviations. Fire protection: classification of fires, fundamentals of fire suppression, fire protection systems and facilities, thermal radiation. Hazard and operability studies (HAZOP): basic principles, explanation of guide, procedures, critical examination of flow sheets. Risk analysis; acceptable risks and safety priorities, frequency of accidents, safety checklists and fault trees, assessment of risks from complex plants. Strengths and limitations of quantitative risk assessment, modeling, a systematic approach to risk reduction, human factors, and management of process safety, insurance. Industrial hygiene, identification MSDS, evaluating exposure to volatile toxicants. Flow of fluids through a pipe, liquids through

	pipes Toxic release and dispersion models, parameters affecting dispersion.
Expected learning outcomes and competences to be acquired:	The aims of this course are: • The understanding the fundamental principles governing the safety and risk management. • The understanding of related to the practical application of safety and risk management issues • The deepening of topics related to the practical implementation of security management. • The deepening of topics related to the study of risk management development skills related to the design, development and submission of written reports. • The development of understanding of professional obligations associated with the discipline of security and risk management. • The familiarity with personal protective equipment measures • The familiarity with labor and industrial hygiene and safety signals
Teaching methods	Lectures, Notes, Related Practical Guides, Internet Sources, Lectures (13 wks x 3 hrs theory and 1 hr computer based laboratory exercises) and two homework projects.
Assessment methods	50% final written exam, 50% one homework project or/and a computer-based intermediate exam

OPERATIONS RESEARCH II

Course code	377
Instructor(s)	G. Nenes
Semester	9
ECTS	4
URL	http://eclass.uowm.gr/courses/MECH204/
Hours per week	4
Recommended Prerequisites	• Statistics

Course content	Stochastic processes and discrete-time Markov chains: classification of states, long-run properties. Markovian processes with rewards, control and optimization. Applications in inventory control and maintenance management. Continuous-time Markov chains, birth-and-death processes. Queuing theory: classification of queuing systems and examples of queuing phenomena. Queuing models with a single or multiple servers, finite or infinite queue, finite or infinite population. Priority in queues service. Linear and nonlinear queuing networks. Optimization of queuing systems and networks.
Expected learning outcomes and competences to be acquired:	This course includes fundamental tools and techniques of stochastic operational research. After the successful completion of the course, students will be able to: • identify and analyze discrete and continuous Markov processes • calculate the steady state characteristics of Markov processes • optimize the operation of Markov processes in steady state • apply Markovian techniques in engineering problems (inventory management, equipment maintenance, quality control, etc.) • solve queuing problems • study networks in series and Jackson networks • optimize queuing networks
Teaching methods	Hours of Instruction 52 (Theory: 26, Exercises: 26)
Assessment methods	Final written exam (compulsory), Intermediate written exam and/or assignments (optional)

TECHNICAL AND ENERGY LEGISLATURE

Course code	376
Instructor(s)	-

Semester	9
ECTS	4
URL	http://eclass.uowm.gr/courses/MECH128
Hours per week	-
Recommended Prerequisites	-
Course content	General principles of law. The basic legal concepts are discussed and explained. The various branches of law are presented and briefly analyzed. The “Technical & Energy legislation” includes the subjects of “Construction works”, “Environmental legislation”, “Energy legislation”, “Energy market deregulation”, “Health and safety legislation”.
Expected learning outcomes and competences to be acquired:	The course presents systematically the engineering and energy legislation issues. It provides fundamental information in the context of the EU and Greek legislation with respect to energy, environment, construction works, health and safety and energy market liberalization. After the completion the students will be able to approach effectively the issues of licensing industrial plants and energy markets as well, and to handle establishment and operation of construction works, energy generation, distribution and services, by means of scientifically rigorous methods.
Teaching methods	Hours of Instruction 39 (Theory: 27, Exercises: 12) & Three home works (3)
Assessment methods	Final written exam (compulsory), three home works (compulsory)

SUPPLY CHAIN MANAGEMENT

Course code	393
Instructor(s)	K. Tasias
Semester	9
ECTS	4
URL	-
Hours per week	4
Recommended	• Statistics

Prerequisites	• Operations Research I • Inventory Management
Course content	Introduction. Management methods, challenges and decision making analysis through every aspect of the process flow, from the raw material procurement to final product delivery to the customer. Customer service. Procurement. Inventory management. Warehousing. Transportation. Information in supply chain and Bullwhip effect. Contemporary product traceability methods. Information systems in supply chains. Supply chain integration strategies: Push-Pull strategy, Risk Pooling, Transshipment etc. Special topics in supply chain management: Reverse Supply Chains, Closed Loop Supply Chains and Humanitarian Logistics.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course the student will be able to: • define the basic principles in supply chain management, • evaluate the importance of customer service in supply chain, • describe principles and techniques in procurement, • describe principles and techniques in inventory management, • describe principles and techniques in warehousing, • organize and conduct the proceedings related to the product transportation and distribution, • solve travelling salesman problem, find a minimum spanning tree and solve maximum flow problems, • evaluate importance of information flow in supply chain, • measure supply chain performance through specific metrics.
Teaching methods	Presentations (Oral) (Teaching Hours: 52, Theory: 26, Exercises: 26).
Assessment methods	Final written exam (mandatory), mid-semester exam or/and assignment (optional).

ADVANCED ROBOTICS TECHNOLOGY IN MECHANICAL MANUFACTURING	
Course code	394
Instructor(s)	-
Semester	9
ECTS	4
URL	http://eclass.uowm.gr/courses/MECH394
Hours per week	4
Recommended Prerequisites	• Statics • Dynamics • Automatic Control Systems
Course content	Acquaintance with industrial robots. Structural analysis of spatial mechanisms. Special Mechanisms. The kinematic problem. Robotic problems in the mechanical engineering industries. Transformations in space. Kinetic equations. Identification of a Jacobian registry. Solutions to the inverse kinematic problem. Speeds and static forces. Calculation of track in Cartesian space. Interference in the field of joint variables. Robot position control with one and many degrees of freedom. Control systems referenced in the Cartesian coordinate system. Implementation of computer and mechanical CAD technologies in the study of robotic systems. Movement with compassion. Power sensors. Power control algorithms. Natural and artificial constraints with emphasis on mechanical applications. Hybrid position / power control - Programming and languages of industrial robots. Applications of industrial robots. Special machining and welding issues. Sensors & actuators (conventional and non-conventional), microprocessors and external communication, signal converters from analog to digital and vice versa, digital signal processing. Mechanical study of the robotic system. Application to robotic machining and welding systems. Machining robot simulation with Mechanical CAD system.
Expected learning outcomes and competences to be	Upon successful completion of this course the student will be able to:

acquired:	• analyze, design and implement robotics applications. • understand the basic principles of operation of Robotic Systems • understand, recognize, formulate and analyze industrial robotic systems. • prepare and present examples of integrated robotics with sensors, action instruments, control unit. • identify kinematic and dynamic analysis of industrial robots, arm structure and geometry. • study and optimize a robot workspace. • understand the contribution of industrial robots to machining.
Teaching methods	Lectures (13 weeks x 2 hour of Theory and 2 hours of Exercises) and homeworks.
Assessment methods	50% written final examination, 50% grade of homework.

ENVIRONMENTAL MANAGEMENT	
Course code	387
Instructor(s)	-
Semester	9
ECTS	4
URL	-
Hours per week	4
Recommended Prerequisites	-
Course content	Introduction to environmental management. Applications in solid waste management. Learning of computational tools for the calculation of the biogas produced by waste disposal sites. Renewable energy and related advanced technologies. Environmental management systems.
Expected learning outcomes and	The course aims at familiarizing students with the basic principles of environmental management. After completion

competences to be acquired:	of the course the student should be able to understand the basic environmental management issues, to use various tools for designing environmental management solutions.
Teaching methods	Instruction of theory, discussion of applications, debate skills
Assessment methods	30% assignments, 30% presentations on environmental management issues, 40% final exam and debate.

TOTAL QUALITY MANAGEMENT

Course code	395
Instructor(s)	K. Tasias
Semester	9
ECTS	4
URL	-
Hours per week	4
Recommended Prerequisites	• Statistics • Operations Research I • Quality Control
Course content	The atmosphere: Origins - Structure – Composition. Key features and principles of the atmosphere - The Boundary layer. Atmospheric pollutants and their sources. Basic principles of air pollution. Air pollution meteorology. Atmospheric stability. Basic atmospheric diffusion principles. Effective emission height. Atmospheric diffusion modeling. Scalar transport theory. Pollutants deposition. Instrumentation - Measurement of Meteorological Parameters.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course the student will be able to: • understand the main principles of quality, • employ tools for measurement, control and improvement of quality, • define cost of quality, • evaluate the advantages of TQM,

	• identify the impediments in implementing TQM • manage practical approaches of TQM implementation, • evaluate importance and demands of quality standard certification.
Teaching methods	Lectures (13 weeks x 2 hour of Theory and 2 hours of Exercises).
Assessment methods	Final written exam (mandatory), intermediate exam and/or assignments (optional).

PIPELINE HYDRAULICS

Course code	309
Instructor(s)	O. Maaita
Semester	10
ECTS	4
URL	http://eclass.uowm.gr/courses/MECH138/
Hours per week	4
Recommended Prerequisites	• Fluid Mechanics I • Turbomachinery
Course content	Review of fluid flow trough closed pipes, head loss, friction factor, minor losses, hydraulic and energy grade lines, empirical relationships, non-cicrcular tubes, hydraulic diameter. Pipelines: material, thickness, optimum diameter, flow control, definition and properties of valves, hydraulic characteristics of valves, selection of valves. Pipe networks: layout, nodes and branches, mathematical description of pipe systems, solution of the system of equations, linearization of equations, Hardy-Cross method, dedicated software. Pumps: types, positive-displacement and dynamic pumps, characteristics, selection. Centrifugal pumps: dimensional analysis, characteristic curves, hydraulic power, efficiency, affinity laws, specific speed, cavitation, Net Positive Suction Head. Pumping stations: design and operation point, operation, control and automation, layout, configuration of suction. Fluid transients: rigid-column

	theory, water hammer, pressure surges, Bergeron method, Parmakian method, numerical solution of equations, method of characteristics, surge protection and control devices, surge tanks, design of air chambers. Transport of gases: basic equation for gas flow, compressibility factor, empirical equations (Panhandle, AGA, Crane), simple models, isothermal flow, analytical computer models, power requirements, compressors, types of, multistage compressors, reduction of compression work.
Expected learning outcomes and competences to be acquired:	The course aims at providing the basic principles and tools for the design of pipelines under pressure and the selection of auxiliary equipment in industrial problems. Upon successful completion of the course, the students will be able to: • Calculate pressure drop and flowrate in pipelines conveying liquids and gases • Select the material, thickness, and diameter of pipelines • Design pipelines using techno-economic criteria • Understand the operating characteristics of different-type pumps • Select pumps for the transport of liquids • Calculate the operating point of pump-pipeline systems • Estimate the required and available Net Positive Suction Head • Control the flow rate delivered by pumps using alternative methods • Calculate the pressure drop and flowrate in pipelines conveying compressible gases • Compute the node pressures and pipe flowrates in complex pipe networks • Understand the origin of hydraulic transients in pipelines and their consequences • Estimate the pressure surges in unsteady flows • Propose counter-measures to avoid or suppress hydraulic transients
Teaching methods	lectures and tutorials
Assessment methods	20% coursework (pump selection and network analysis study), 30% design project, 50% final exam

COMBUSTION PHENOMENA	
Course code	348
Instructor(s)	D. Kolokotronis
Semester	10
ECTS	4
URL	http://eclass.uowm.gr/courses/MECH144/
Hours per week	4
Recommended Prerequisites	• Thermodynamics I • Thermodynamics II • Fluid Mechanics I
Course content	Kinetic theory of gases, transport phenomena, chemical thermodynamics. Reaction speed, steady state phenomena, chemical equilibrium. Overview of chemical kinetics: order of reaction, chain reactions. Detonation limits and oxidizing characteristics of fuels (hydrogen, carbon monoxide, methane, paraffins, aromatic hydrocarbons). Premixed flames: 1-D flow, laminar flame structure, flame speed (Mallard and LeChatelier), ignition limits, quenching distance, flashback and blowoff, flame stability limits. Turbulent flows with flames, turbulent flame structure, turbulent flame speed, flame stabilisation in high velocity flows, Diffusion flames: Phenomenology, 1-D flame balances, turbulent fuel jets. Ignition: chain ignition, forced thermal ignition. Optical experimental techniques for the investigation of combustion phenomena.
Expected learning outcomes and competences to be acquired:	Upon successful completion of the course students will be able to: • Understand basic characteristics of combustion, related either to thermodynamic or fluid dynamic parameters, and the differences between laminar and turbulent combustion. Students will also have an understanding of the turbulent combustion areas as well as of the basic chemical kinetics of combustion. • Know the technological tools used for the study of

	fundamental combustion. • Distinguish the type of combustion studied. • Use the acquired knowledge to design combustors or to optimize their operation. • Combine the operating data of a combustion application and predict operating stability. • Evaluate the operation of a combustor
Teaching methods	Oral presentations and exercises
Assessment methods	Final written exam (compulsory), course project (compulsory)

COMPUTATIONAL MECHANICS II

Course code	381
Instructor(s)	R. Sotiropoulou - M. Politis
Semester	10
ECTS	4
URL	http://eclass.uowm.gr/courses/MECH253
Hours per week	4
Recommended Prerequisites	-
Course content	Introduction to UNIX. Basic laws of gases, liquids and particles. Gas, liquid and particulate pollutants. Equations of transport and diffusion of pollutants in turbulent flow. Transport of particles in turbulent flow. Turbulent diffusion modeling. Atmospheric Diffusion of Pollutants. Features of plumes, The Gauss model for diffusion, Software tools and applications.
Expected learning outcomes and competences to be acquired:	The aim of the course is to provide students the necessary know-how to study engineering problems with emphasis on fluid flows using computational tools. Emphasis will be given to practical engineering applications. After completing the course the student will have the following skills: • Ability to solve technical problems with computational techniques

	• Ability to evaluate reasonable solutions and select appropriate levels of processing of these solutions • Understanding the important physical phenomena that need to be integrated into the solution of the system from the formulation of the problem • Development of appropriate equations and computational models for the given system • Ability to solve computational models for various processes / modules and simulation of the processes involved
Teaching methods	Weekly oral lectures (2 hours theory, 3 hours lab with mandatory presence), 2 mandatory homeworks, final examination.
Assessment methods	60% assignments, 40% final exam

ROTORDYNAMICS

Course code	382
Instructor(s)	D. Giagopoulos
Semester	10
ECTS	4
URL	http://eclass.uowm.gr/courses/MECH114
Hours per week	4
Recommended Prerequisites	• Mechanical Vibrations and Machine Dynamics • Dynamics • Statics • Introduction to Computers
Course content	Free vibration and forced response of single degree of freedom linear oscillators to impulsive, harmonic, periodic and transient excitation (natural frequency, damping ratio, resonance). Response of multiple degree of freedom linear oscillators (formulation of the equations of motion, determination of natural frequencies and mode shapes,

	modal analysis). Axial, torsional and bending vibration of bars. Applications (measurement and evaluation of vibration characteristics, vibration isolation, vibration absorption, balancing, torsional vibration). The course, beyond the theoretical teaching, introduces the student and into programming, based on application programs in an environment of MATLAB. In the course, two (2) laboratory exercises are performed by students able to observe the dynamic response of rotor systems, the effect of balancing on their oscillation, as well as their static and dynamic balancing methods.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • develop simplified rotor models. • develop and solve the rotation system motion equations. • develop and solve rotor system motion equations in torsional oscillations through analytical dynamics. • predict dynamic and oscillating behavior of rotating systems based on model analysis. • understand the basic dynamic features that affect the dynamics of rotating systems. • solve typical examples using analytical and numerical methods. • analyze experimental oscillatory measurements. • apply the static and dynamic balancing methodologies on one level and two levels. • use finite elements to solve rotating systems.
Teaching methods	Lectures (13 weeks x 2 hours of Theory and 2 hours of Exercises) and homeworks.
Assessment methods	Final written exam

APPLICATIONS OF MATERIALS FOR ENERGY AND ENVIRONMENTAL TECHNOLOGIES

Course code	379
Instructor(s)	E. Papista

Semester	10
ECTS	4
URL	http://eclass.uowm.gr/courses/MECH233/
Hours per week	4
Recommended Prerequisites	• Chemistry • Physics • Thermodynamics • Materials Science and Technology I & II
Course content	Energy sector and environmental impacts, Heterogeneous catalysis, Kinetics, External and internal diffusion phenomena in heterogeneous catalysis, Synthesis methods, Physicochemical and surface characterization methods, Physicochemical and morphological properties of catalysts, Applications of catalytic processes in energy (hydrogen production, synthetic fuels production via Fischer-Tropsch, CO2 activation, ammonia synthesis) and environment (decomposition/reduction of nitrogen oxides, abatement of VOCs, photocatalysis), Basic principles of electrochemistry, thermodynamics and kinetics of electrochemical reactions, Electrochemical membrane reactors, fuel cells, batteries, Electrochemical gas sensors, Electrochemical processes in energy and environmental applications.
Expected learning outcomes and competences to be acquired:	The course focuses on the development, characterization and evaluation of materials in catalytic and electrochemical processes employed in energy and environmental applications toward sustainability. Initially, the basic principles of heterogeneous catalysis are presented, emphasizing on intrinsic kinetics, diffusion phenomena, synthesis and characterization of heterogeneous catalysts. In the following, specific catalytic processes for energy (hydrogen production, production of synthetic fuels via Fischer-Tropsch synthesis, CO_2 activation, ammonia synthesis) and environmental (decomposition/reduction of nitrogen oxides, abatement of volatile organic compounds, photocatalysis) applications are analyzed. The second part of the course focuses on electrochemical processes presenting the basic principles of electrochemistry, thermodynamics and kinetics of electrochemical reactions and applications such as membrane electrochemical reactors, fuel cells,

	batteries and electrochemical gas sensors. Emphasis will be given to the appropriate properties of the materials making them suitable for the aforementioned devices and applications (water electrolysis, direct hydrocarbon fed fuel cells, hydrogen pumps, hydrogen gas sensors). Upon completion of the course the student will be able to: • Understand the importance of the selection of suitable materials in the efficiency of processes • Understand the physicochemical processes involved in heterogeneous catalysis. • Understand the different synthesis methods of catalysts and their physicochemical characteristics. • Be able to design catalysts for various catalytic processes employed in energy and environmental applications. • Be aware of the particular characteristics of hydrogen production processes, synthetic fuels production via Fischer-Tropsch synthesis, CO2 activation, ammonia synthesis • Understand the basic principles, kinetics and thermodynamics of the electrochemical processes. • Understand the basic operating principles and characteristics of membrane electrochemical reactors, fuel cells, batteries and electrochemical gas sensors. • Understand the required properties of the materials used for the fabrication of the aforementioned electrochemical devices. • Understand the applications of water electrolysis, hydrocarbon fud fuel cells, hydrogen pumps and hydrogen sensors.
Teaching methods	Lectures and homeworks
Assessment methods	Final written exam (compulsory), Small project at home (optional)

SPECIAL TOPICS ON ENERGY CONVERSION TECHNOLOGIES

Course code	349
Instructor(s)	E. Papista
Semester	10
ECTS	4
URL	http://eclass.uowm.gr/courses/MECH173/
Hours per week	4
Recommended Prerequisites	• Heat Transfer • Fluid Mechanics • Thermodynamics • Steam Generators
Course content	Introduction to energy systems, Global, European and National energy balance, Fossil Fuels, Conventional power generation, Wind Power, Biomass & Synthetic Fuels (thermochemical and biological methods of biomass conversion to gaseous, liquid and solid biofuels), Hydrogen production, storage and use in fuel cells, Technoeconomic evaluation, Kwh cost calculation.
Expected learning outcomes and competences to be acquired:	The course deals with a number of special topics related to energy production: (a) conventional & alternative energy conversion technologies; (b) cogeneration; (c) levelized cost estimation of kWh Upon successful completion of the course the student will be able to: • Acquire a general overview of the energy forms and their share in the global, European and national energy balance. • Be aware of the modern trends in energy balances at a global level. • Understand the origin, types and energy flows of conventional forms of energy (coal, oil, natural gas). • Identify the corresponding shares for RES and nuclear energy. • Understand conventional fossil fuel power technologies

	and the corresponding environmental impacts. • Understand the usefulness of RES (wind, solar, biomass, geothermal). • Understand the principle of operation of energy conversion technologies for converting wind and solar power as well as bioenergy into electricity, heat and biofuels. • Understand wind turbines, their sizing and their theoretical performances. • Be able to calculate which part of the wind power potential can be converted into electrical power. • Understand how to design and estimate the cost of wind farms in a given area with a given wind potential. • Understand biomass potential, biomass types, physicochemical characteristics and conversion technologies (gasification, pyrolysis, anaerobic digestion) into biofuels and energy. • Understand the principles of thermochemical (combustion, gasification, pyrolysis) and biological (anaerobic digestion) processes for converting biomass to biofuels. • Design, size and estimate the cost of processes for the conversion of biomass to bioenergy in conventional thermal and alternative energy conversion devices. • Understand the operating principle of fuel cells, their types and their characteristic operating curves. • Understand the hydrogen economy. • Size and estimate the performance of low and high temperature fuel cells as well as of planar and tubular geometry fuel cells. • Understand hydrogen production technologies by reforming hydrocarbons and water electrolysis.
Teaching methods	Hours of Instruction 52 (Theory: 26 h, Exercises: 26 h)
Assessment methods	Final written exam (compulsory, 70%), Homeworks (Optional, 30%)

SIMULATION AND SYSTEM DYNAMICS	
Course code	367
Instructor(s)	G. Nenes
Semester	10
ECTS	4
URL	http://eclass.uowm.gr/courses/MECH168/
Hours per week	4
Recommended Prerequisites	• Statistics
Course content	Design, analysis and development of simulation, random numbers, random numbers generators and simulation sampling, statistical analysis of simulation results. Applications in industrial management and operations research. Practice on specialized simulation software. Fundamental system concepts, the object of a system dynamics analysis.
Expected learning outcomes and competences to be acquired:	To familiarize students with decision making techniques and tools using simulation methods in the complex industrial environment when analytical methods cannot be utilized. After the completion of the course the students should be able to: • understand the importance and usefulness of mathematical simulation • understand the importance and usefulness of dynamic systems • comprehend the need for mathematical simulation in problems where the analytical solution is either impossible or very difficult • develop simulation models for real problems • solve problems and find optimal solutions using simulation • statistically analyze simulation results
Teaching methods	Hours of Instruction 52 (Theory: 26, Exercises: 26)
Assessment	4 Intermediate Written Assignments (compulsory)

methods	

SOLAR TECHNIQUE/PHOTOVOLTAIC SYSTEMS

Course code	316
Instructor(s)	To be assigned
Semester	10
ECTS	4
URL	http://eclass.uowm.gr/courses/MECH197/
Hours per week	4
Recommended Prerequisites	• Heat Transfer
Course content	Solar Radiation. Parameters and Calculation of the Incoming Solar Radiation on horizontal and Inclined Surface. Calculation of the Energy Needs in Space Heating and Domestic Water Heating. Flat Plate Solar Thermal Collectors. Concentrating Solar Thermal Collectors. Storage of Solar Energy in Heating Processes. Integrated Solar Energy Systems for Heating Processes. F-Chart Method. Technology of the Photovoltaics. Photovoltaic Panels. Photovoltaic Systems. Dimension Process in Photovoltaic Systems.
Expected learning outcomes and competences to be acquired:	The course deals with the basic principles of the exploitation of Solar Energy. After the completion of the course the students should be able to: • Calculate the potential of Solar Energy • Calculate the components of solar radiation falling on a flat plane • Calculate the thermal efficiency and the productive thermal energy of a solar thermal collector • Calculate the thermal efficiency of solar thermal systems combined with collectors and storage tanks • Insert the dimensions of a solar thermal system • Understand the photovoltaic conversion of solar energy • Calculate the maximum electrical efficiency of a

	photovoltaic module • Insert the dimension of a photovoltaic system
Teaching methods	Hours of Instruction 52
Assessment methods	Final written exam, Homeworks

ENVIRONMENTAL MANAGEMENT	
Course code	388
Instructor(s)	A. Kontogianni
Semester	10
ECTS	4
URL	-
Hours per week	4
Recommended Prerequisites	-
Course content	Introduction to the concept of externalities – Institutional and legal context of externality valuation – Externalities in energy and industrial processes – Basic economic concepts - Overview of methods – Stated preferences and surveys: Contingent Valuation Method (CVM) – Designing a questionnaire – Collecting data – Analysis of data I: Descriptive statistics – Analysis of data II: Estimating WTP functions – Problems and case studies
Expected learning outcomes and competences to be acquired:	After completion of the course the student should be able to: • Describe in economic terms energy and industrial externalities • Design a stated preference survey, • Develop an appropriate research protocol • Analyze the data collected.
Teaching methods	Instruction of theory, discussion of empirical applications, individual projects
Assessment	Project work plan 5%, construction of research protocol

methods	10%, intermediate report on field work 30% , final report 55%

ENERGY SAVING TECHNOLOGIES AND INDUSTRIAL SYSTEMS OPTIMIZATION

Course code	383
Instructor(s)	A. Dounavis
Semester	10
ECTS	4
URL	-
Hours per week	4
Recommended Prerequisites	• Thermodynamics • Mathematics • Statistics • Steam generators • Engineering and feasibility studies
Course content	Energy resources and reserves. Energy consumption and energy intensity in the Greece, the EU and the globe. The perspectives of the various energy resources. The energy conservation policy in the EU and in Greece. Global energy and exergy balances, energy and exergy efficiency indices. Combustion issues, combustion reactions, stoichiometry and efficiency. Energy losses and efficiency in combustion systems. Energy efficiency and losses in energy conversion and transportation systems. Methodologies and techniques to reduce energy losses. Objective functions and optimization of industrial plants. Financial analysis of energy conservation.
Expected learning outcomes and competences to be acquired:	Upon the successful completion of the course, students will be able to: • know about the operation of heat generation systems in industry • know about the operation of electrical systems in industry • know about the operation of cooling systems in industry

	• know about the operation and the usefulness of cogeneration systems (CHP) • recognize the basic industrial processes in which improvement of energy efficiency can occur • know about the main sources of energy losses in industrial systems • know the different methods of energy-saving interventions in different industrial sectors • evaluate the potential of improving energy efficiency • evaluate energy-saving interventions based on economic, environmental and other criteria • suggest economically viable energy-saving solutions in industrial plants and processes
Teaching methods	Hours of Instruction 52 (Theory: 26, Exercises: 26) & Three home works (3)
Assessment methods	Final written exam (compulsory), three home works (compulsory)

RENEWABLE ENERGY SOURCES LABORATORY

Course code	390
Instructor(s)	G. Panaras
Semester	10
ECTS	4
URL	http://eclass.uowm.gr/courses/MECH231/
Hours per week	4
Recommended Prerequisites	• New & Renewable Energy Sources • Energy Design of Buildings I
Course content	Introduction to Renewable Energy Sources (RES), RES in buildings. Laboratory exercise: Measurements, quality of measurements and uncertainties. Laboratory exercise: Instrument calibration. Application in liquid flowmeter. Laboratory exercise: Meteorological station. Measurement of ambient temperature, Use of pyranometers for the

	measurement of solar radiation. Measurement of wind velocity and direction. Measurement of humidity. Laboratory exercise: Photovoltaic systems. Study of a photovoltaic panel. Measurement of the I-V characteristic, Measurement and estimation of the characteristic electrical parameters. Design of a PV system. Laboratory exercise: Solar thermal energy. Study of a flat plate solar collector. Estimation of optical efficiency and thermal losses. Study of thermal solar system performance. Heating storage thermal losses. Complete system estimation of performance.
Expected learning outcomes and competences to be acquired:	Students perform lab tests on the operation and efficiency of RES systems, focusing on systems that are applicable to buildings. After successful completion of the course, the students will have: • Understood the importance of applying accurate measurements to determine and evaluate the efficiency of an RES system • Understood the particularities of the analysis in the laboratory environment, in terms of infrastructure (including measuring instruments) and methods. • Acquired knowledge about quantification of measurement quality through the concept of uncertainty. • Acquired knowledge on experimental methods of assessing RES systems performance. • Acquired knowledge about the actual operation of RES systems.
Teaching methods	Instruction (13 hours), execution of Laboratory Exercises (26 hours)
Assessment methods	Written Reports every week (compulsory), Final written exam (compulsory). Calculation of the final grade: 30% final exam, 70% laboratory exercises.

PROJECT MANAGEMENT

Course code	392
Instructor(s)	G. Konstantas
Semester	10
ECTS	4

URL	-
Hours per week	4
Recommended Prerequisites	• Statistics • Operational Research I
Course content	Project management: definitions, project goals. Knowledge areas. Project life-cycle. Project identification - feasibility study. Project design: Work Breakdown Structure, Network Analysis, Gantt Chart. Resource allocation and planning. Planning with limited resources. Cost planning and budgeting. Communication planning. Quality assurance planning. Project crashing. Stochastic task durations: PERT method. Project Risk Management. Earned value Analysis. Project completion and evaluation. Project management Information Systems: Microsoft Project.
Expected learning outcomes and competences to be acquired:	The ability to develop an effective project plan and the ability to decompose complex projects using hierarchy diagramming. The ability to optimize the duration of a project and the sequence of tasks using CPM. The ability to control project uncertainties using stochastic estimating techniques. The ability to use the earned-value management method to track project status. The ability to apply and control changes to the project management plan. The ability to apply detailed cost estimating techniques and identifying and quantifying projects risks.
Teaching methods	Hours of Instruction 52 (Theory: 26, Exercises: 26)
Assessment methods	Final written exam (compulsory) , Intermediate written exam (optional)

GAS TURBINE TECHNOLOGY

Course code	385
Instructor(s)	K. Vafiadis
Semester	10
ECTS	4
URL	http://eclass.uowm.gr/courses/MECH265/

Hours per week	4
Recommended Prerequisites	• Fluid Mechanics I • Thermodynamics I • Turbomachinery
Course content	Introduction and applications of gas turbines. Open cycle configurations. Closed cycle configurations. Aircraft Propulsion. Industrial applications. Environmental issues. Power Cycles. Ideal cycles. Gas turbine component losses. Operation at the nominal operating point. Combined cycle and cogeneration schemes. Gas turbine cycles for aircraft propulsion. Simple Turbojet engine. The Turbofan engine. The Turboprop engine. The Turboshaft engine. Auxiliary power units . Axial and radial flow Compressors. Principles of operation. Work done and pressure rise. Dimensional flow. Compressor performance characteristics and design processes. Combustion systems. Types of combustion systems. The combustion process. Emissions. Coal gasification. Axial and radial flow Turbines. Basic theory. Selection of aerodynamic parameters. Blade cooling. Performance prediction of simple gas turbines. Components characteristics. Operation at off-design conditions.
Expected learning outcomes and competences to be acquired:	The purpose of this course is to introduce to the students the basic operating principles, the components and the applications of gas turbine. Upon completion of the course the student will be able to obtain state-of-the-art knowledge in the area of operation and thermodynamics of modern gas-turbine engines. The student is expected to acquire knowledge and be able to analyze thermodynamic cycles of various types of gas turbine engines for aircraft propulsion and industrial applications. The student will be able to calculate the thrust and specific consumption of various types of aircraft engines such as turbojet, turbofan and turboprop; and, to assess the effects of speed and altitude on performance characteristics. In addition, the students will be able to select the main operating parameters of industrial gas turbines and calculate the effect of the characteristics of individual components on the overall engine performance such as the power output and the specific consumption. The student will be able to use specialized software for the preliminary design and analysis of the operation of gas turbines.

Teaching methods	Lectures, exercises, laboratory tutorials for the use of commercial software. Homework and personal assignments with the application of commercial software on real design and analysis problems. Utilization of information technology for the course management.
Assessment methods	Final examination, intermediate examination, assignment

DESIGN AND DEVELOPMENT OF MECHANICAL PRODUCTS

Course code	396
Instructor(s)	I. Chatziparasidis
Semester	10
ECTS	4
URL	http://eclass.uowm.gr/courses/MECH396
Hours per week	4
Recommended Prerequisites	• Machine Elements I • Mechanical Design I • Mechanical Design II • Mechanics of Materials.
Course content	Introduction to Methods of Design and Development of Mechanical Products. Data collection for products to be developed. Record customer needs and set up Technical Specifications. Conversion of customer needs into product quality features. Develop ideas and explore alternative product design ideas. Evaluation of alternative manufacturing solutions and choice of optimal solution. Design for Manufacturing, Design for Assembly / Disassembly. Ways of failure and analysis of results. Product Families and Modular Design. Parallel Engineering (Concurrent Engineering). Detailed design, operation and behavior analysis, use of modeling and simulation with CAD / CAM / CAE systems.
Expected learning outcomes and competences to be	Upon successful completion of this course the student will: • be able to draft Technical Specifications of a new

acquired:	product based on customer needs, • be able to transform customer needs into product quality features, • be able to manage and systematically evaluate alternative product design ideas, • be able to systematically assess design solutions based on ease of fabrication and / or ease of assembly, • be able to systematically study the possible product faults and their consequences, • have a full understanding of the principles of modular design and product design (Modular Design), • have a good understanding of the principles of Concurrent Engineering, • have an understanding of the use of CAD / CAM / CAE systems in the design and development of engineering products.
Teaching methods	Lectures (13 weeks x 2 hour of Theory and 2 hours of Exercises) and homeworks.
Assessment methods	50% written final examination, 50% grade of homework.

TECHNO-ECONOMIC ASSESSMENT

Course code	352
Instructor(s)	To be assigned
Semester	9
ECTS	4
URL	http://eclass.uowm.gr/courses/MECH163/
Hours per week	4
Recommended Prerequisites	• Thermodynamics • Mathematics • Statistics • Steam generators • Engineering and energy legislation

Course content	Principles and methodology of financial analysis of industrial plants. Design and optimization methodology. Evaluation indices. Engineering and financial evaluation of investment plans. Design and time scheduling. Methodology of feasibility studies and financial analysis of investments.
Expected learning outcomes and competences to be acquired:	The course presents systematically the design and optimization of industrial plants, as well as the preparation of feasibility studies. After the completion the students will be able to approach effectively the issues of the financial and engineering evaluation of industrial plants and to handle design and optimization problems, by means of scientifically rigorous quantitative methods.
Teaching methods	Hours of Instruction 52 (Theory: 26, Exercises: 26) & Three home works (3)
Assessment methods	Final written exam (compulsory), three home works (compulsory)

DIPLOMA THESIS	
Course code	-
Instructor(s)	-
Semester	9-10
ECTS	30
URL	-
Hours per week	-
Recommended Prerequisites	-
Course content	Each student can chooses a thesis topic to develop the thesis. The only limitation to this option is that the thesis should correspond to one discipline (at least) from the courses included in Concentration of Studies, which he himself attended. The assignment of the thesis is at the beginning of the ninth semester and preparation is undertaken throughout the period of the fifth year of study.
Expected learning outcomes and competences to be	This extended written project is an extensive study in a scientific area of the Department. The thesis is meant to demonstrate that the student is able to work and to pursue

acquired:	science in a specific subject.
Teaching methods	-
Assessment methods	-

10. OTHER USEFUL INFORMATION

10.1 ADMINISTRATION OF UNIVERSITY OF WESTERN MACEDONIA

Executive Committee Board Office

St. Demetrios Park, 50131, Kozani

Tel 0030 24 610 56 200. FAX 0030 24610 56201.

Alternatively, all useful information is offered to the public through the University`s website: ***www.uowm.gr***.

10.2 INTERNSHIP

The Department of Mechanical Engineering has also instituted student internships followed by a submitted funding proposal in order to form an integral part of the curriculum.

Students are advised to apply to the Administration Office of the Department for a placement, after a prior agreement between the Department and the companies, clearly defining the terms of employment and work responsibilities during the internship. After assessing the applications by the internship program departmental coordinator, Prof. G. Marnellos and also by Permanent Teaching Staff members who are in charge of the Department's cooperation with each company, the applied students are selected to be placed to specific companies.

The internship could **potentially** deem the Engineering Design Project and students will obtain the corresponding ECTS Credits. In this case the Engineering Design Project should be included in the respective statement of courses.

The duration of the internship will be three (3) months, mainly during summertime (June, July and August).

Students who will gain access to the Internship program must have finished their third Year of studies. Emphasis will be placed mainly on graduating students for participating in internships.

10.3 ERASMUS PROGRAMME

The Department of Mechanical Engineering participates in the Erasmus Plus Programme, which is a European Union student exchange programme for education, training, youth and sport, and aims at the enhancement of students' skills and employability as well as at the upgrading of youth educational and training systems.

Within the framework of enhancing students mobility between universities under the Erasmus Plus Programme, the students of the Department have the opportunity to spend a 3 to12 month period of their curriculum abroad in institutions co-operating with the UoWM. The studies in foreign universities are fully recognized by the UoWM provided that the student has been successfully examined in the courses he/she has chosen.

In addition, within the framework of strengthening students skills and employability under the Erasmus Plus Programme, the students of the Department have the opportunity to practice abroad for a 2 to 12 month period in Universities, Enterprises or Organizations.

The Departmental Coordinator of the Erasmus Plus Programme is Sofia Panagiotidou, Assistant Professor.

10.4 DIPLOMA SUPPLEMENT

Since December 2014, the Department of Mechanical Engineering grants a Diploma Supplement to all graduates according to the provisions of Law 3374/2005 and the M.D. F.5/72535/B3/10.08.2006.

10.5 STUDENTS BOARDING AND ACCOMMODATION

Assisting students who face financial difficulties to cope with their studies and based on both ministerial decrees and decisions of the Executive Committee Board of UOWM, the following services are provided:

a. Free boarding to beneficiary students, in the students restaurant of UOWM located in the city of Kozani (Address: 20 Konstantinoupoleos str.- Kozani, tel.nr. 0030 24611 81039)

b. Rent assistance if **not** provided by the state.

The preconditions for free boarding and provision of the rent benefit (if the student is entitled to one) as well as the dates for submitting applications, are announced timely by the Administration Office.

10.6 HEALTH CARE

All students (undergraduate, postgraduate, expatriates and foreign) are entitled to health, medical and nursing care for a period equal to the years of studies which are considered having a minimum duration of the undergraduate studies incremented by two years.

For this purpose the University provides students with a healthcare booklet that can be used in the region of the university concerned and only in exceptional cases outside it.

In case that the student is entitled directly or indirectly to additional health coverage by another healthcare insurer, and still wants the student healthcare plan, he should waive the insurance from the other carrier and choose the student insurance instead by a solemn statement (Law 1599/86), stating that "he is not insured under any other insurance carrier."

Additional information on healthcare is provided in the Healthcare booklet

For obtaining the Healthcare booklet, the students should address to the Administration Office.

10.7 ACADEMIC IDENTITY CARD – STUDENT TICKET

Every student is granted an Academic Identity Card. The relevant acquisition process is described on the website http://academicid.minedu.gov.gr/. The Academic ID Card is valid for as many years as the student membership lasts and covers multiple uses, including the Student Ticket (Pass). The duration of the Student Ticket is valid for n + 4 semesters. The discounts provided to Means of Transportation, are those laid down by the legislation concerned.

The Academic Identity Card is deposited at the Administration Office of the Department with the swearing-in ceremony of the student or when for any reason the student membership ceases to exist (e.g. interruption of studies). No discounts for the Student Ticket are granted to those admitted to the Department with classification, as graduates of other Universities.

University of Western Macedonia
Department of Mechanical Engineering
Faculty of Engineering

http://www.mech.uowm.gr/