DEPARTMENT OF MECHANICAL ENGINEERING & AERONAUTICS
SCHOOL OF ENGINEERING
UNIVERSITY OF PATRAS

ERASMUS COURSES

ACADEMIC YEAR 2026-2027

Ref.No	1st SEMESTER	Hours/ Week T	L	Teaching Credits	ECTS Credits	Avail. For ERASMUS Students	Teaching Faculty
24111	MATHEMATICS I	6		6	5	√	Malefaki S.
24115	MECHANICAL DRAWING & MACHINE-SHOP TRAINING I	4	4	6	5	√	Mourtzis D., Stavropoulos. P Makris S.
24128	SPECIAL TOPICS IN PHYSICS FOR ENGINEERS	4		4	4	√	Loutas Th.

Ref.No	2nd SEMESTER	Hours/ Week T	L	Teaching Credits	ECTS Credits	Avail. For ERASMUS Students	Teaching Faculty
24127	MECHANICAL DRAWING & MACHINE-SHOP TRAINING II	4	4	6	5	√	Mourtzis D., Stavropoulos. P Makris S.
24Π124	HISTORY OF TECHNOLOGY	3		3	2	√	Mourtzis D.

Ref.No	3rd SEMESTER	Hours/ Week T	L	Teaching Credits	ECTS Credits	Avail. For ERASMUS Students	Teaching Faculty
24218	MANUFACTURING SYSTEMS LABORATORY I	3	1	4	5	√	Mourtzis D., Stavropoulos. P

Ref.No	4th SEMESTER	Hours/ Week T	L	Teaching Credits	ECTS Credits	Avail. For ERASMUS Students	Teaching Faculty
24225	MANUFACTURING SYSTEMS LABORATORY II	3	1	4	5	√	Mourtzis D., Stavropoulos. P

Ref.No	5th SEMESTER	Hours/ Week T	L	Teaching Credits	ECTS Credits	Avail. For ERASMUS Students	Teaching Faculty
24319	PROBABILITY & STATISTICS	3	1	4	4	√	Malefaki S.

Ref.No	6th SEMESTER	Hours/ Week T	L	Teaching Credits	ECTS Credits	Avail. For ERASMUS Students	Teaching Faculty
24324	KINEMATICS OF MECHANISMS & MACHINES	5		5	5	√	Koustoubardis P.

Ref.No	7th SEMESTER	Hours/ Week T	L	Teaching Credits	ECTS Credits	Avail. For ERASMUS Students	Teaching Faculty
24319	PROBABILITY & STATISTICS	3	1	4	4	√	Malefaki S.

1 SPECIALIZATION COURSES ON MECHANICAL

Ref.No	9th Semester	T	L	Teaching Credits	ECTS Credits	Avail. For ERASMUS Students	Teaching Faculty
MEA_EE50	NUMERICAL METHODS FOR PARTIAL DIFFERENTIAL EQUATIONS	3		3	3	√	Papadopoulos P.

2 ENGINEERING

Ref.No	7th SEMESTER COMPULSORY COURSES	Hours/ Week T	L	Teaching Credits	ECTS Credits	Avail. For ERASMUS Students	Teaching Faculty
24411	DYNAMICS OF MECHANISMS & MACHINES	5		5	3	√	Koustoubardis P.
24MY1	THEORY OF ELASTICITY	3		3	3	√	Tserpes K.
24ME4	MECHANICAL BEHAVIOR OF MATERIALS	3		3	3	√	Tserpes K., Polatidis E.
24ME38	LIGHT STRUCTURES	4		4	3	√	Lampeas G.
MEA_ME5	BIOMECHANICS I	3		3	3	√	Sakellarios A. Deligianni D.,Athanasiou G. Apostolopoulos K.

Division of Design and Manufacturing Engineering

Ref.No	8th Semester	T	L	Teaching Credits	ECTS Credits	Avail. For ERASMUS Students	Teaching Faculty
24KY9	COMPUTER NUMERICAL CONTROL (CNC)	2	2	3	3	√	Mourtzis D.
24KE26	STOCHASTIC SIGNALS & SYSTEMS	2	2	3	3	√	Fassois S.

Ref.No	9th Semester	T	L	Teaching Credits	ECTS Credits	Avail. For ERASMUS Students	Teaching Faculty
24KY8	ENGINEERING DESIGN	3		3	3	√	Nikolakopoulos P. Filippatos A.
24KY1	APPLICATIONS OF ARTIFICIAL INTELLIGENCE	3		3	3	√	Dermatas E., Filippatos A.
24KE15	SPECIAL TOPICS OF MANUFACTURINGSYSTEMS	3		3	3	√	Mourtzis D., Stavropoulos P. Makris S.

Ref.No	10th Semester	T	L	Teaching Credits	ECTS Credits	Avail. For ERASMUS Students	Teaching Faculty
24KY16	COMPUTER AIDED DESIGN	3		3	3	√	Nikolakopoulos P, Fillipatos A. Postdoc researcher

24KE21	NON CONVENTIONAL MANUFACTURINGPROCESSES	3		3	3	√	Stavropoulos P.

Ref.No	9th Semester	T	L	Teaching Credits	ECTS Credits	Avail. For ERASMUS Students	Teaching Faculty
MEA_AM 15	PROPULSION SYSTEMS	3		3	3	√	Nikolaidis, T.

Division of Applied Mechanics, Technology of Materials and Biomechanics

Ref.No	8th Semester	T	L	Teaching Credits	ECTS Credits	Avail. For ERASMUS Students	Teaching Faculty
24MY2	INTRODUCTION TO COMPOSITE MATERIALS	3		3	3	√	Tserpes K., Papanikolaou G.
24ME16	ADVANCED STRENGTH OF MATERIALS	3		3	3	√	Lampeas G., Tserpes K.

Ref.No	9th Semester	T	L	Teaching Credits	ECTS Credits	Avail. For ERASMUS Students	Teaching Faculty
24MY13	FRACTURE MECHANICS AND STRUCTURAL INTEGRITY	3		3	3	√	Lampeas G.
24ME33	DESIGN WITH FAILURE TOLERANCE	3		3	3	√	Lampeas G.
24ME19	INTRODUCTION TO AERONAUTICAL MATERIALS	3		3	3	√	Lampeas G., Tserpes K., E. Polatidis, Academic Personnel
24ME40	STRUCTURAL DYNAMICS	3		3	3	√	Chrysochoidis N. Saravanos D.,
MEA_ME27	BIOMATERIALS & TISSUEENGINEERING	3		3	3	√	Sakellarios A., Michanetzis G.

Ref.No	10th Semester	T	L	Teaching Credits	ECTS Credits	Avail. For ERASMUS Students	Teaching Faculty
24ME14	NON DESTRUCTIVE INSPECTION OF MATERIALS AND STRUCTURES	3		3	3	√	Loutas Th.

3 Division of Management & Organization Studies

Ref.No	8th Semester	T	L	Teaching Credits	ECTS Credits	Avail. For ERASMUS Students	Teaching Faculty
24ΔΥ14	EXPERIMENTAL DATA ANALYSIS	3		3	3	√	Malefaki S.

COURSE DESCRIPTION

1st SEMESTER

24111. MATHEMATICS I

Method of the mathematical induction, Introduction to the calculus of one variable. Functions of one variable, limit and continuity, Bolzano's theorem. First and higher order derivatives of functions, derivation rules and differential. Inverse, implicit and composite functions, parametric equations and l' Hospital rule. Analysis, monotony and extrema of functions with applications, asymptotes. Fermat and mean value theorems.

Integral calculus. Indefinite integral of functions and analytic techniques of integration. Riemann integral, definite integral, improper integrals. Applications of integrals to the calculation of plane areas, cartesian and polar coordinates on the plane, curve's length.

Sequences, number series and convergence tests. Series of functions, uniform convergence tests and power series. Generalized mean value theorem or Taylor formula and local approximation of function, binomial expansion. Taylor and Maclaurin series, binomial series and convergence.

Introduction to plane vectors and the meaning of the third spatial dimension. Inner, exterior, mixed and double – exterior product, geometric interpretation.

Matrix theory and square matrices, determinant and their properties and inverse matrix. Homogeneous and non homogeneous systems of linear equations, solution with Gauss elimination method. Spectral analysis of matrix, in spaces of finite dimensions, eigenvalues and eigenvectors or characteristic magnitudes and physical meaning, Cayley – Hamilton theorem. Algebraic and geometric multiplicity of eigenvalues, diagonalization of square matrix.

Instructors: Malefaki S.

24115. MECHANICAL DRAWING & MACHINE-SHOP TRAINING I

- *Basic drafting rules and drafting equipment (rules, drafting media and equipment, lettering, scales, Computer Aided Design principles),*
- *Common geometric constructions (angle bisection, dividing geometric elements into equal parts, up- and downscaling, drawing parallel perpendicular and tangent lines, drawing curves),*
- *Multiview projection (metric, orthographic or Monge views), solid sections, involute splines*
- *Mechanical drawing (working and detail drawings, assembly drawings, auxiliary views),*
- *Dimensioning (basics and rules, fundamentals and preferred dimensional practices, baseline dimensioning, direct and chain dimensioning, dimensioning for CAM),*
- *Sectional views (rules, section lines, full sections, half and offset sections, unsectioned features and intersections in section),*

Machine shop training – machining simple parts – lathe, milling machine, drilling and fitting, quality assurance and measurement.

Instructors: Mourtzis D., Stavropoulos P., Makris S.

24128. SPECIAL TOPICS IN PHYSICS FOR ENGINEERS

Linear motion, Vectors, General motion in two and three dimensions, Force and motion (Newton's laws), Kinetic energy and work, Dynamic energy - Potentials, Enegry conservation, Linear momentum andimpulse, Equilibrium, Fluids, Electric charge, Electric fields, Gauss' law, Electric potential, Magnetic fields, Magnetic fields due to currents, Induction and inductance

Instructors: Loutas Th.

2nd SEMESTER

24127. MECHANICAL DRAWING & MACHINE-SHOP TRAINING II

- *Surface characteristics and quality (roughness, criteria for quality, rules and symbols),*
- *Tolerancing (placing of symbols according to ISO, geometric tolerances),*
- *Drawing metal parts and assemblies (permanent joining, welding drawings, fasteners - dimensioning, rules and tools),*
- *Drawing anti-vibrating systems (helical springs, shock absorbers, torsion springs, anti-vibration sheets, rules and drawings, shock absorbers),*
- *Drawing mechanisms and machine elements (axles, bearings, pins, wedges, clutches, brakes, linkages, gears, belt and chain drives, pulleys, lifting mechanisms, wire ropes, winches),*
- *Drawing hydraulic systems (piping, pipe connection, flanges, valves, steam valves, pumps, propellers),*
- *Introduction to three-dimensional (3D) drawing and solid modeling,*

Machine shop training – gear milling, grinding, welding, assembly of mechanism, quality assurance and measurement.

Instructors: Mourtzis D., Stavropoulos P., Makris S.

24П124. HISTORY OF TECHNOLOGY

The precursors of the Industrial Revolution,1500-1750: the agrarian revolution, metallurgy, materials, tools, measuring equipment, machines and mechanisms, fluid power, thermal engines, transport and public works. The Industrial Revolution, 1750-1830: textiles, steam power, steam in transport, measuring instruments, machine tools, metallurgy. The social effects of the industrial revolution. The Age of Steam and Steel, 1830-1900: new inventions, materials, machining technology, machines and mechanisms, hydraulic machines, thermal engineering, mining and metallurgy, constructions, agricultural technology, electricity, other technologies. The evolution of production tools. The transition to capitalism in production. Industrial domination of England, 1850-1870. Science and technology-a review of technology developments that accompanied the Industrial Revolution. The foundation of modern science.

Instructor: Mourtzis D.

3rd SEMESTER

24218. MANUFACTURING SYSTEMS LABORATORY I

Cost, time, quality and flexibility in manufacturing. Introduction to manufacturing processes. Casting, deforming, material removal and joining processes. Comparative study of manufacturing processes. Machine tools and manufacturing equipment- types and functionality.

Laboratory project for the design and manufacturing using CAD, machining processes and statistical quality control (SPC).

Instructors: Mourtzis D., Stavropoulos P.

4th SEMESTER

24225. MANUFACTURING SYSTEMS LABORATORY II

Machine Tools Design for deforming and material removal processes. Control and automation of machine tools. Basic concepts and methods of process planning. Design and operation of manufacturing systems-applications.

Laboratory project for the design and assembly using rapid prototyping (RP), design for assembly techniques, and Virtual Reality (VR)

Instructors: Mourtzis D., Stavropoulos P.

5th SEMESTER

24319. Probability & Statistics

The role of Statistics in Engineering. Probability (rules, lows and theorems). Discrete and continuous random variables and probability distributions. Expectation. Random sampling and data description. Statistical inference. Estimation (point and interval estimation). Hypothesis Testing (for a single sample and for two samples)

Instructor: Malefaki S.

6th SEMESTER

24324. KINEMATICS OF MECHANISMS & MACHINES

Machines and Mechanisms - historical Review, terminology, definitions and assumptions, classification of kinematic pairs, mobility - degrees of freedom. Computer aided methods in design and production. Position analysis of a four-bar linkage with the graphical and the analytical method. Kinematic analysis of mechanisms using analytical and numerical methods, numerical methods in kinematics, planar kinematic analysis, linear algebraic equations, nonlinear algebraic equations. Cartesian coordinates, kinematic

constraints, position analysis, velocity, and acceleration analysis. Kinematic modeling. Computer aided analysis of mechanisms. Cams. Gears. Epicyclic gear train analysis and design.
Instructor: Koustoubardis P.

SPECIALIZATION COURSES ON MECHANICAL ENGINEERING

7th SEMESTER

24411. DYNAMICS OF MECHANISMS & MACHINES
Basic concepts of dynamics. Dynamics of the rigid particle. Dynamics of a system of rigid particles. Dynamics of the rigid body. Dynamics of a system of rigid bodies. Plane motion. Dynamics of mechanisms and machines, the equations of motion, the vector of forces, and reactions in the links. The system of equations for plane motion. Static forces, static equilibrium, kinetostatic analysis. Computer aided algorithm for plane dynamic analysis. Damped vibration, logarithmic decrement, vibration spectra. The method of spectral analysis. Dynamics of reciprocating engines. Engines types, indicative diagrams. Dynamic analysis of reciprocating engines, gas forces, equivalent masses, inertia forces. Bearing loads in a single-cylinder engine. Balancing, rotors balancing, dynamic and static balancing, balancing machines, balancing of reciprocating masses. analytical calculation of unbalance.
Instructor: Koustoubardis P.

24MY1. Theory of Elasticity
INTRODUCTION: Objectives, Historical
CARTESIAN TENSORS.
STRAIN AND STRESS TENSORS: The continuum model, External loads, The displacement vector, Components of strain, Assumption of small deformation, Proof of the tensorial property of strain, Traction and components of stress, Proof of the tensorial property of stress, Properties of the strain and stress tensors, Components of displacement for rigid body motion, The compatibility equations, The equilibrium equations, Cylindrical coordinates, Strain-displacement relations in cylindrical coordinates, Equilibrium equations in cylindrical coordinates, Compatibility equations in cylindrical coordinates.
STRESS-STRAIN RELATIONS: Uniaxial tension or compression under constant temperature, The torsion test, Effect of temperature, Stress-strain relations for elastic materials subjected to three-dimensional stress state, Stress-strain relations for linear elastic materials subjected to three-dimensional stress state, Stress-strain relations for orthotropic linear elastic materials, Stress-strain relations for isotropic linear elastic materials subjected to three-dimensional stress state.
FORMULATION AND SOLUTION OF BOUNDARY VALUE PROBLEMS: Introduction, Boundary value problems for computing the displacement and stress fields, The principle of Saint-Venant, Methods for finding exact solutions for boundary value problems, Prismatic body subjected to uniaxial tension, Prismatic body subjected to bending, Prismatic body subjected to torsion.
PLANE STRAIN AND PLANE STRESS PROBLEMS: Plane strain, Formulation of problems using the Airy stress function, Prismatic bodies in plain strain condition, The equations of plain strain condition in cylindrical coordinates, Plane stress, Plates in plain stress condition, Two-dimensional plane stress condition, Prismatic bodies in axisymmetric plane strain or plane stress conditions.
Instructors: Tserpes K.

24ME4. Mechanichal Behavior of Materials

Atomic structure of solids; Structure of metals: Structure of crystalline materials, elastic anisotropy, Imperfections, Mechanisms of micro-structural hardening; Plasticity in metals, Structure of composite materials: Definition, Constituents, Architecture, Specific mechanical properties; Mechanical behavior: Definition and basic considerations; Mechanical behavior of metals under quasi-static uniaxial loading: Tension test, Superposition of strain, Conditions of maximum load; Mechanical behavior of composite materials under quasi-static loading: Micro-mechanical and Macro-mechanical analysis of the elastic behavior of a lamina, Strength of a lamina;Mechanical behavior of metals under variable loading: Fatigue under constant stress amplitude, Low-cycle fatigue, Fatigue crack growth, Fatigue life prediction; Mechanical behavior of composite materials under variable loading: Fatigue damage mechanisms in composites, Fatigue damage functions, Fatigue life prediction based on S-N curves, Relation between fatigue damage and mechanical properties; Numerical modeling of the mechanical behavior of composite materials; Mechanical behavior of metals under elevated temperature (creep): Creep behavior of materials and components; Oxidation and corrosion: Corrosion mechanisms, Protection methods, Interaction of corrosion with mechanical loads, Mechanical behavior of corroded materials and structures.

Instructors: Tserpes K., Polatidis E.

24ME38. Light Structures

The lightweight design philosophy and the application of strength of materials principles in lightweight design - Design principles. Analysis of thin-walled members with closed or open cross section - shear center - warping and distortion, torsion-bending problems of thin bodies. Analysis of thin-walled pressure vessels under internal / external pressure, bending disturbances due to geometrical discontinuities. Shear flow theory - analysis of beam shear in closed or open cross-section, multiple-web beams, flat or curved members. Simplified analysis of aeronautical structures (fuselage - wing under bending, torsion and shear, wing ribs). The principle of virtual work - The unit load method. Maxwell-Mohr method. Applications in aeronautical and lightweight structures.

Instructor: Lampeas G.

MEA_ME5. Biomechanics I

Introduction to biomechanics: brief history of biomechanics. Kinematics in biomechanics. Statics and dynamics in biomechanics: 2-D and 3-D models of the musculoskeletal system. Human motion analysis. Deformable body mechanics: stress, strain, constitutive equations (elastic and viscous materials, etc.). Skeletal biomechanics: bone and soft connective tissues (ligament, tendon, cartilage). Functional adaptation and mechanobiology. Muscle modelling. Vascular system modelling. Mechanics of the cardiac muscle: Mechanical characteristic of the heart as deformable tissue, pressurized structure and muscle.

Instructors: Sakellarios A. Deligianni D., Athanasiou G. Apostolopoulos K.

SPECIALIZATION COURSES

DIVISION OF DESIGN & MANUFACTURING

8th SEMESTER

24KY9. COMPUTER NUMERICAL CONTROL (CNC)

Introduction to Numerical Control, Definition and history of Numerical Control (NC), Special features of CNC, Concepts and advantages of CNC, applications in industry. Structure of a CNC machine tool, Control systems, Servomechanisms, Loop systems, Process planning and cutting tool selection, Hole making cutting tools, Milling cutters, Special Inserted Cutters, Process of changing and managing cutting tools, Automatic tool changers, tool length and diameter compensation.

CNC lathe and milling programming, Structure of a CNC program, Definition of programming coordinates, Machine tool reference point, (G) and (M) codes in turning and milling, Absolute and relative coordinates for point definition, Two (2) and Three (3) axes programming, Modal / Non-Modal Commands, Canned Cycles, Word Address Format, Do Loops and Subroutines, Mirror Imaging, Polar rotation, Turning, Programming examples in turning and milling. Basic mathematics for programming Numerical Controlled Machine Tools, Application in cutter compensation, Linear Interpolation, Circular interpolation, Helical Interpolation. Perspectives and future of CNC.

Instructor: Mourtzis D.

24KE26: STOCHASTIC SIGNALS & SYSTEMS

The course constitutes a comprehensive introduction into discrete-time stochastic signals and systems, with reference to random vibration. Upon successful completion of the course the student will be in positionto: Understand the form and basic notions of stationary stochastic signals and systems in the time and frequency domains, Appreciate their applications in mechanical & aeronautical engineering, as well as in other scientific disciplines, Mathematically describe stationary, and certain non-stationary, stochastic signals, Comprehend the basic notions of estimation, as well as the estimation of mathematical models of stochastic signals, in the time and frequency domains, Thoroughly analyze mathematical models for stationary stochastic signals and systems in the time and frequency,domains relate the mathematical models to underlying physical systems and their properties, Perform stochastic signal prediction, Validatean estimated model, Model and analyze stationary stochastic signals and systems from the engineering practice using realizations and, proper software (such as MATLAB/SIMULINK, R)

4 Instructor: Fassois S.

9th SEMESTER

24KY8. Engineering Design

Introduction to engineering design: A definition for design, human needs and technological advances, design as problem solving, design models and methods, design and designers, design tools. Analysis of design problem: Product anatomy, types of design, design strategies, dearch for information, information processing, catalogue of design specifications. Conceptual design: design concept, determination of functions, development of alternative design concepts, analysis and evaluation of design concepts. Configuration design: product configuration, part configuration, analysis and refinement of design configurations, analysis and evaluation of design configurations. Parametric design: valuing of design variables, development of alternative solutions, performance evaluation, solution optimization. Detailed design: final valuing of design variables, prototype testing, solution documentation.

Instructors: Nikolakopoulos P. Filippatos A.

24KY1. Applications of Artificial Intelligence

Introduction to Artificial Intelligence. Artificial Intelligence and real-world problems and applications. Problem description. Search algorithms: algorithms for exhaustive and heuristic search. Knowledge representation: propositional, predicate and clausal logic, semantic nets, frames, rules. Knowledge-based systems. Expert systems. Fuzzy logic. Intelligent control. Techniques for intelligent control. Fuzzy controllers: design and applications. Introduction to neural-network-based control.

Instructors: Dermatas E., Filippatos A.

24KE15. Special Topics of Manufacturing Systems

Design of manufacturing systems. The problem of resource requirements. The problem of resources layout. The problem of material flow. The problem of information flow. The problem of queue capacity. Complex design problems. Operation of manufacturing systems. Methods and tools for the operation of the manufacturing systems. The task – resource assignment problem. Decision-making for the operation of manufacturing systems.

Instructor: Mourtzis D., Stavropoulos P., Makris S.

10th SEMESTER

24KY16. COMPUTER AIDED DESIGN

Introduction to computer graphics. Software for CAD. Graphics commands and design techniques. Mathematical elements for computer aided design. Points and lines. Transformations and projections in plane and space.

Axonometric and perspective drawings. Reconstruction of solids from his projections. Removing hidden lines and surfaces. 2D and 3D curves. Description and construction of surfaces. Shading of objects. Animation.

https://eclass.upatras.gr/courses/MECH1179/

Instructor: Nikolakopoulos P., Filippatos A., Postdoc Researcher

24KE21. Non Conventional Manufacturing Processes

Overview of manufacturing processes. Laser assisted processes. Types of Lasers. Characteristics of laser equipment. Basic Laser processes. Drilling. Cutting (two-dimensional, three-dimensional).Laser controlled processes. Heat transfer and fluid dynamics in laser Analysis of Laser processes. Applications of Laser processes. Rapid prototyping techniques. Stereolithography. Selective Laser sintering. Layer Object

Manufacturing. Direct CAD manufacturing. Material deposition manufacturing. Applications of rapid prototyping methods.
Instructor: Stavropoulos P.

DIVISION OF ENERGY, AERONAUTICS & ENVIRONMENT

7th SEMESTER

MEA_AM15: Propulsion Systems

The course is about the aircraft propulsion technologies and systems. It starts with a historical evolution of aircraft propulsion including the analysis of thermodynamic cycle and its variations. It provides a detailed analysis of the concept and design of jet engines emphasizing on their operational characteristics in the aircraft typical flight profile (idle-taxing-take off-climb-step cruise-descend-approach-landing).
The design principles of the basic engine components (intake, compressor, combustor, turbine and nozzle) are described with emphasis on their design parameters and operation. The course offers an evaluation on the engine component matching and its overall performance both for Design and Off-Design operation. It includes the engine's performance assessment under a variety of operating and environmental conditions (e.g., impact of aircraft flight altitude and speed, ambient temperature and/or engine design parameters such as Combustor Outlet Temperature).
The course also discusses the principles of aircraft-engine integration, the installation effects and how these may affect the delivery of thrust (concept of Net Propulsive Force).

Instructor: Nikolaidis T.

9th SEMESTER

MEA_EE50. Numerical Methods for partial differential equations
Classification of Partial Differential Equations (PDEs): General Features of PDEs. Classification of PDEs. The existence of characteristics and their physical interpretation. Elliptic, parabolic and hyperbolic partial differential equations. The convection-diffusion equation. Initial Values and Boundary Conditions.
The Finite Difference Method: Taylor expansion, Forward, backward and central finite difference. Applications to the Diffusion equation, Implicit and explicit methods.
Solution Methods for Linear Systems – Elliptic equations: Direct methods: Gauss-Jourdan elimination, Lower-Upper decomposition, Thomas algorithm for tridiagonal systems. Iterative methods: Jacobi Gauss-Seidel , Successive Over-Relaxation, Successive Line Over-Relaxation, Steepest descent, Conjugate gradient. Convergence analysis for iterative methods. Solution of algebraic system. Solution methods for elliptic equations.
Parabolic Partial Differential Equations: Numerical errors. Consistency, Stability, Convergence. Solution methods for the Parabolic Differential equations (1D & 2D): Forward-Time Centered Space (FTCS), Backward-Time Centered Space (BTCS), Crank Nicolson, Alternating Direction Implicit (ADI). Newmann Boundary conditions.
Hyperbolic Partial Differential Equations: Solution methods for the 1D convection equation: Upwind, Forward-Time Centered Space (FTCS), Lax-Friedrichs, Lax-Wendroff, MacCormack, Implicit methods. The wave equation.
The Finite Volume Method: Conservative form Finite Volume Method (1D). Finite Volume Method (2D): Cartesian grids, orthogonal non-Cartesian grids, non-orthogonal meshes.
Instructor: Papadopoulos P.

DIVISION OF APPLIED MECHANICS, TECHNOLOGY OF MATERIALS AND BIOMECHANICS

8th SEMESTER

24MY2. INTRODUCTION TO COMPOSITE MATERIALS

Nature of polymeric composites, polymeric matrices, mechanical and ultimate properties of polymers, physical properties of polymers, fabrication processes of polymeric systems, fibers, interfaces and interphases, introduction to composites, elastic properties of FRP, mechanical properties of composites, physical properties of composites, fabrication processes of polymer composites.

Instructors: Tserpes K., Papanikolaou G.

24ME16. Advanced Strength of Materials

Thick-walled pipes subjected to internal/external pressure, Limit load of pipes subjected to internal pressure, Composite pipes; Analysis of beams in elastic foundation, Applications to thin-walled pressure vessels; Frames and circular rings, Method of elastic center, Applications; Analysis of thin-walled axisymmetric vessels subjected to internal/external pressure, Perturbation of bending due to geometrical discontinuities; Transfer matrix method, The transfer matrix of beam subjected to bending, The transfer matrix of beam in elastic foundation, Analysis of thin-walled pressure vessels and circular rings using the transfer matrix method, Applications.

Instructors: Lampeas G., Tserpes K.

9th SEMESTER

24MY13. Fracture Mechanics and Structural Integrity

Fracture phenomena. Linear fracture mechanics theory - Griffith theory and failure criterion. The concept of stress intensity factors and methods of calculation (Westergard Complex Functions, Numerical methods, experimental methods). Parameters affecting the stress-intensity factor - influence of the plastic zone. The concept of critical stress intensity factor. Experimental techniques for determining the critical stress intensity factor. The concept of residual strength. Determination of critical crack length - critical load of failure. Cracks under complex loading and linear fracture mechanics limitations. Non-linear fracture mechanics, the J-integral concept and the concept of crack tip opening displacement as failure criteria. Fatigue of structural components and fatigue-life prediction models, fatigue load interaction problems. Crack propagation under variable loading.

Instructors: Lampeas G.

24ME19. Aeronautical Materials

Material selection for lightweight structures - Aeronautical materials - Aluminum - Aluminum alloys (effect of alloying elements on the mechanical behavior, intermetallic phases, hardening mechanisms of the microstructure, codification of aluminum alloys, technological and mechanical properties) - Technological processes and forming processes of the aeronautical aluminum alloys - Steels - Titanium alloys - Nickel alloys - Polymeric composite materials - Metallic composite materials - Fibers and fabrics - Forming processes of composite aeronautical materials - Ceramic materials

Instructors: Tserpes K., Lampeas G. , E. Polatidis

24ME33. **Desig*n with Failure Tolerance***

Introduction to damage tolerance. Non-homogeneous state of loading, characteristic dimensions of a structure, degradation of stiffness and strength under operational loading conditions. Basic concept of damage tolerance.

The concept of strength in the case of structures. Strength under multi-directional loading. Failure criteria.

Damage accumulation. The special case of composite materials.
The evolution/degradation of strength. Progressive damage. Remaining stiffness and strength.
Stiffness degradation of Composites due to matrix cracking. Evolution of stiffness in time. Degradation og stiffness due to hygrothermal loading. Degradation due to combine damage accumulation. Models for the prediction of the remaining life.
Damage size and strength considerations. Determination of residual strength. Analysis of damage growth.
Damage tolerance analysis guidelines
Damage identification and quantification in composites.
Design guide lines for primary and secondary structures.
Damage tolerance evaluation. Impact and CAI. Hot wet compressive behavior.
Repair of composite structures.
Instructors: Lampeas G.

24ME40. Structural Dynamics

i. *Review of dynamic behavior of single degree-of-freedom systems with damping. Free vibration, forced harmonic vibration – frequency response function, Transient response.*

ii. *Equations of motion of continuous deformable solids and structures. Spatial Discretization in the context of the finite element method. Discrete equations of motion. Consistent and lumped mass matrices.*

iii. *Discrete natural dynamic systems with multiple degrees of freedom (MDOF). Free vibration, modal frequencies and shapes, physical meaning and properties. Methods of calculating eigenvalues and eigenvectors. Dynamic analysis in the modal domain. The mode superposition method. Methods of condensation. Forced harmonic response and frequency response functions.*

iv. *Discrete non-conservative dynamic MDOF systems with damping. Proportional and arbitrary structural damping. Effect on dynamic response and method of solution.*

v. *Transient structural response of MDOF discrete systems subject to arbitrary time loading. Prediction of transient response using direct time integration. Discretization in the time domain. Explicit and implicit methods of time integration and FE solvers.*

vi. *Various practical problems.*

vii. *The course is combined with 2 laboratory seminars and exercises which include programing of various dynamic analysis methods and application of commercial software.*

Instructor: Saravanos D., Chrysochoidis N.

MEA_ME27. Biomaterials & Tissue Engineering

Surface properties of biomaterials. Surface energy, critical surface tension. Measurement techniques. Metallic implant materials: Stainless steel, cobalt-chrome, titanium and alloys. Structure and mechanical properties. Fabrication-casting, forging, machining. Ceramics- aluminium and zirconium based, glass ceramics and bio-glasses, natural ceramics, hydroxyapatite. Structure and mechanical properties, fabrication. Polymers, addition and condensation. General structure and mechanical properties, glassy and elastomeric polymers. Chemical reactions, degradation of polymers. Polymeric implant materials examples. Fabrication of devices. Composites, fibres and matrix materials. Relation between structure and mechanical properties. Examples of biomaterial applications, joint replacement, soft tissue replacement, artificial organs. Case study- total hip replacement, metal/ceramic, polyethylene, bone cement. Outcome of implantation.
Interaction of biomaterials and the body. Stability, adsorption, corrosion: electrochemistry, Pourbaix diagram. Resorbable biomaterials. Cell-material interaction. Structure of proteins, adsorption to surfaces. Cell spreading and locomotion-physicochemical and thermodynamic aspects. Inflammation and wound healing. Hemocompatibility. Example of dialyser membranes. Blood vessel damage, tissue damage; clotting, complement and white cell activation. Cell and tissue culture methods- cytotoxicity, biofunctionality, animal testing. Biomaterials sterilization principles. Concepts of tissue engineering. Scaffold characteristics and design methodologies, cell seeding, biofunctionalization, bioreactors. Ethical

issues for tissue engineering & regenerative medicine.
Instructors:. Sakellarios A., Michanetzis G.

10th SEMESTER

24ME14. Non Destructive Inspection of materials and structures
Introduction in Non-Destructive Testing (NDT) of materials and structures, Objectives of NDT, Review of types of discontinuities in metals and composites, Safe-life versus fail-safe design concepts, Review of classical and modern techniques in NDT, Visual testing (endoscopes, borescopes, videoscopes, basic principles), Liquid penetrant testing (analytical presentation, basic techniques and variations, consumables, applications, advantages-disadvantages, laboratory exhibition), Magnetic particles testing (analytical presentation, basic techniques and variations, advantages-disadvantages, applications, equipment and consumables, laboratory exhibition), Eddy current testing (analytical presentation, basic techniques and variations, advantages-disadvantages, applications, equipment), Ultrasound testing (bulk waves, Lamb waves, analytical presentation, basic techniques and variations, advantages-disadvantages, applications, equipment, laboratory exhibition), Acoustic Emission testing (analytical presentation, basic techniques and variations, advantages-disadvantages, applications, equipment, laboratory exhibition), Radiographic testing (analytical presentation, basic techniques and variations, advantages-disadvantages, applications with emphasis in welding, equipment), Introduction to Structural Health Monitoring, visit to industrial site - real-life applications.
Instructor: Loutas Th.

DIVISION OF MANAGEMENT & ORGANIZATION STUDIES

8th SEMESTER

24ΔΥ14. Experimental Data Analysis
Multivariate random variables and their distributions. Chi-square test (Goodness of fit test, Contingency tables, Test of independence, Test of Homogeneity, Test for several proportions), Simple and Multiple linear Regression and correlation. Analysis of Variance (one and two way ANOVA). Nonparametric statistics (Sign test, Wilcoxon, Mann – Whitney, Kruskall – Wallis, Friedman tests) . Bayesian decision theory.
Instructor: Malefaki S.