COURSE OUTLINE

(1) GENERAL

SCHOOL	Engineering		
ACADEMIC UNIT	Mechanical Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	MY2100	**SEMESTER**	4th
COURSE TITLE	Mechanics of Materials I		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	5	6
Laboratory Exercises	2	
Add rows if necessary. The organization of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialized general knowledge, skills development*	General background
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://www.mie.uth.gr/?page_id=17838&lang=en

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Upon successful completion of the course it is expected that the student is able

- to solve statically indeterminate frame and truss problems
- to calculate deformations and stresses in mechanical structures
- to perform strength calculations on thin-walled pressure vessels
- to perform basic elastic stress analysis calculations in simple mechanical constructions
- to perform strength calculations on beams that are subjected to bending, shear and torsional loadings.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

Working independently Project planning and management Production of free, creative and inductive thought

(3) SYLLABUS

Introduction. The notion of a continuous medium. Principles of analysis of statically indeterminate problems. Examples of simple statically indeterminate systems: plane truss, airplane landing gear, beams.

Analysis of deformation. Analysis of infinitesimal motion, the tensors of infinitesimal deformation and rotation. Normal and shear strains. Maximum and minimum normal and shear strains, the principal directions. Change of volume in an infinitesimal material element, the volumetric strain. Plane motion, change of coordinate system, extensiometers, the Mohr circle. Simple states of deformation: pure volumetric deformation, simple shear. The deviatoric strain tensor. The compatibility equations and the calculation of displacement from the strain tensor.

Stresses. External and internal forces in deformable media. The stress vector, the stress tensor, the stress vector on an arbitrary surface. Conservation of linear and angular momentum: the differential equations of equilibrium and the symmetry of the stress tensor. Principal directions and principal stresses. Plane stress states, change of coordinate system, the Mohr circle of the stress tensor. Simple stress states: uniaxial tension/compression, biaxial tension/compression, hydrostatic stress, pure shear. The deviatoric stress tensor.

Elastic constitutive equations. Stress-strain relations in isotropic linear-elastic materials. Young's modulus, Poisson's ratio, the shear and bulk moduli, the relationships among the elastic constants. Incompressible materials. Thermal strains and the corresponding thermomechanical constitutive equations.

Thin-walled pressure vessels. Stresses in spherical and cylindrical vessels under internal and external pressure. Stresses in axisymmetric pressure vessels.

The boundary value problem. The general boundary value problem of linear elastostatics: problem formulation, the principle of superposition, the principle of Saint-Venant. Uniqueness of solution and "ellipticity" of the differential equations.

Analysis of beams (the Saint-Venant problem). Problem formulation and the Saint-Venant boundary conditions. Exact solutions: i) tension/compression, ii) torsion of beams with circular and arbitrary cross-sections, the warping function and the Prandtl stress-function, the shear flow, iii) pure bending, symmetrical and non-symmetrical bending, the neutral axis of bending of the cross-section, iv) bending by terminal loads, the "shear center" of the cross-section, the "Jourawski formula". Approximate calculation of shear stresses for the problem of bending by terminal loads. Eccentric axial loads, the "core" of the cross-section. Comparison of axial and shear stresses in beams. Design of power-transmitting shafts, combination of torsional and bending loads.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY ***Face-to-face, Distance learning, etc.***	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Parts of the course material are presented using ICT

TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non- directed study according to the principles of the ECTS

Activity	*Semester workload*
Lectures	60
Laboratory Exercises	30
Study	60
Course total	***150***

STUDENT PERFORMANCE EVALUATION ***Description of the evaluation procedure*** *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open- ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Language of evaluation: Greek Methods of evaluation: Final Exams

(5) SUGGESTED BIBLIOGRAPHY

- Bibliography:
  - N. Aravas (2005). *Cartesian Tensors*. University Publications of Thessaly. (In Greek)
  - N. Aravas (2023). *Mechanics of Materials: Introduction to the Mechanics of Deformable Bodies and Linear Elasticity*. Publications Tziola. (In Greek)
  - F. Beer, R. Jhonson, J. DeWolf, and D. Mazurek (2015). *Mechanics of Materials*. McGraw-Hill Education.
  - P.L. Gould and Y. Feng (2018). *Introduction to Elasticity*. Springer.
  - R. Cook and W. Young (1998). *Advanced Mechanics of Materials*. Prentice Hall.
  - I. S. Sokolnikoff (1992). *Mathematical Theory of Elasticity*. Robert E. Krieger Publishing Company.
  - J. M. Gere and S. P. Timoshenko (1990). *Mechanics of Materials*. PWS Publishing Company.
  - S. Timoshenko and J. N. Goodier (1970). *Theory of Elasticity*. McGraw-Hill Education.

- Relevant Scientific Journals:
  - Journal of the Mechanics and Physics of Solids
  - International Journal of Solids and Structures
  - Mechanics of Materials