# COURSE OUTLINE

# MECHANICS OF MATERIALS II

## (1) GENERAL

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|---|---|---|---|
| **SCHOOL** | Engineering | | |
| **ACADEMIC UNIT** | Mechanical Engineering | | |
| **LEVEL OF STUDIES** | Undergraduate | | |
| **COURSE CODE** | MY0802 | **SEMESTER** | 5th |
| **COURSE TITLE** | Mechanics of Materials II | | |

| **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, Practical Exercises | 5 | 6 |
| *Laboratory Exercises* | 4 | |
| *Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).* | | |

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| **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=17901&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

- perform strength calculations in statically indeterminate beams using the "Engineering Bending Theory"
- solve "plane" problems of elastic structures
- use "energy theorems" to solve frame and truss structures
- perform buckling calculations for elastic structures
- perform strength calculations using commercial software (e.g., ABAQUS)
- solve simple problems of steel structures undergoing plastic (permanent) deformations.

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

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

(3) **SYLLABUS**

**Deflection of beams**. Differential equation of the deflection curve, the effect of transverse shear forces, the boundary conditions, discontinuity functions. Statically indeterminate beams. The "three- moment equation" (Clapeyron).

**The plane problem**. Plane strain, plane stress, and generalized plane stress. The plane boundary value problem in linear elastostatics. The problem in terms of stress. The Airy stress function, polynomial stress functions. Applications. Cylindrical coordinates, the general variable-separable solution of the biharmonic equation in polar coordinates. Axisymmetric plane problems, hollow cylinder under internal and external pressure. Infinite plate with a hole. Use of Mathematica for the solution of plane problems.

**Energy methods**. General results: statically admissible stress fields and kinematically admissible displacement fields, the principle of virtual work, the principle of virtual work as a sufficient condition for equilibrium, alternative formulations of the boundary value problem in a deformable continuum, the method of "unit load". Elastic materials (linear or non-linear): the elastic strain energy and the complementary elastic strain energy, work and elastic energy, the theorems of Castigliano and Engesser. Linear elastic materials: the "Betti" reciprocity theorem, elastic strain energy in simple structures, solution of statically indeterminate problems by using Castigliano's theorem, the theorems of minimum potential and minimum complementary energy, approximate solutions, the finite element method. Use of the general purpose finite element program ABAQUS for the solution of various elasticity problems.

**Buckling**. The effect of geometry change on equilibrium. Linear-elastic cantilever under axial force. Imperfect slender columns. Column buckling as an eigenvalue problem. Column buckling under various support conditions.

**Nonlinear materials**. Plastic deformations and creep. Introduction to the theories of plasticity and viscoelasticity.

## (4) TEACHING and LEARNING METHODS - EVALUATION

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|---|---|
| **DELIVERY**<br>***Face-to-face, Distance learning, etc.*** | In class lectures (face-to-face). |
| **USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY**<br>*Use of ICT in teaching, laboratory education, communication with students* | Parts of the course material are presented using ICT |
| **TEACHING METHODS**<br>*The manner and methods of teaching are described in detail.*<br>*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.*<br><br>*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* | |
| **STUDENT PERFORMANCE EVALUATION**<br><br>***Description of the evaluation procedure***<br><br>*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*<br><br>*Specifically-defined evaluation criteria are given, and if and where they are accessible to students.* | Language of evaluation: Greek<br>Methods of evaluation: Final Exams. |

| *Activity* | *Semester workload* |
|---|---|
| Lectures | 60 |
| Laboratory Exercises | 30 |
| Study | 60 |
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| ***Course Total*** | ***150*** |

(5) **ATTACHED BIBLIOGRAPHY**

- PROPOSED BIBLIOGRAPHY:


- *Beer F., Johnston R., DeWolf J., Mazurek D., Sanghi S. "ΜΗΧΑΝΙΚΗ ΤΩΝ ΥΛΙΚΩΝ", 8η Έκδοση, Εκδόσεις Τζιόλα, 2023 [IN GREEK].*
- *Cook, R. and Young, W., "Advanced Mechanics of Materials", 2nd edition, Prentice Hall, 1998.*
- *Hjelmstad, K.D., "Fundamentals of Structural Mechanics", 2nd edition, Academic Press, 2005.Boresi, A.P., Schmidt, R.J., and Sidebottom, O.M., "Advanced Mechanics of Materials", 5th edition, John Wiley & Sons, 1993.*
- *Ugural, A.C. and Fenster, S.K., "Advanced Strength and Applied Elasticity", 4th edition, Prentice-Hall, 2003.*
- *Shames, I.H. and Cozzarelli, F.A., "Elastic and Inelastic Stress Analysis", Taylor & Francis, 1997.*
- *Αράβας Ν., "Μηχανική των Υλικών, Τόμος ΙΙ: Ανάλυση Ελαστικών Δοκών". Πανεπιστημιακές Εκδόσεις Θεσσαλίας, 2008 [IN GREEK].*


- RELEVANT SCIENTIFIC JOURNALS:

- *International Journal of Solids and Structures*
- *ASME Journal of Applied Mechanics*
- *ASCE Journal of Engineering Mechanics*
- *Mechanics of Materials*
- *ASME Journal of Pressure Vessel Technology*
- *Mechanics and Physics of Solids*