COURSE OUTLINE

(1) GENERAL

SCHOOL	**Engineering**
ACADEMIC UNIT	Mechanical Engineering
LEVEL OF STUDIES	Undergraduate
COURSE CODE	MY1100 **SEMESTER** 8th
COURSE TITLE	ADVANCED MECHANICS OF MATERIALS

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
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialized general knowledge, skills development*	Special background and specialized general knowledge
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (lecturing)
COURSE WEBSITE (URL)	https://www.mie.uth.gr/?page_id=18452&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*

This course serves as an introduction to the fundamental principles and methods of the Theory of Composite Mateirials. Special emphasis is placed on the application of well-known analytical solutions to composite materials of practical and technological interest, including estimates of the Hashin-Shtrikman type which are suitable for particulate microstructures and the self-consistent estimates which are appropriate for polycrystalline materials.

With the successful completion of the course the students will be able to:
- Formulate the homogenization problem for a composite material, including the definition of the constitutive behavior of its constituent (homogeneous) phases, the statement of the associated equilibrium equations, the description of the underlying microstructure and the definition of its macroscopic or homogenized behavior.
- Solve homogenization problems by employing exact or approximate methods.
- Study the dependence of the macroscopic response of a composite material on its underlying microstructure and the material behavior of its constituent phases.

Γενικές Ικανότητες
Λαμβάνοντας υπόψη τις γενικές ικανότητες που πρέπει να έχει αποκτήσει ο πτυχιούχος (όπως αυτές αναγράφονται στο Παράρτημα Διπλώματος και παρατίθενται ακολούθως) σε ποια / ποιες από αυτές αποσκοπεί το μάθημα;.

Αναζήτηση, ανάλυση και σύνθεση δεδομένων και πληροφοριών, με τη χρήση και των απαραίτητων τεχνολογιών	*Σχεδιασμός και διαχείριση έργων*
	Σεβασμός στη διαφορετικότητα και στην πολυπολιτισμικότητα
	Σεβασμός στο φυσικό περιβάλλον
Προσαρμογή σε νέες καταστάσεις	*Επίδειξη κοινωνικής, επαγγελματικής και ηθικής υπευθυνότητας και*

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Working independently
- Team work
- Production of new research ideas
- Production of free, creative and inductive thinking

(3) SYLLABUS

Basic concepts and definitions. Convex funtions and the Legendre-Fenchel transform. Constitutive behavior of materials: elasticity, viscoplasticity, plasticity. Material symmetries (anisotropy): orthotropy, transverse isotropy, isotropy. Static equilibrium of heterogeneous materials: field equations and the classical variational principles. The homogenization problem: the concept of the representative volume element (RVE), periodic and random microstructures, definition of the homogenized (or macroscopic) behavior of composites. The classical Voigt and Reuss bounds. Some exact solutions: simple and hierarchical laminates, Hashin' s composite sphere and cylinder assemblage microstructures. Eshelby' s problem: an ellipsoidal, linear elastic particle in an infinite linear elastic matrix. The Hashin-Shtrikman method and the Hashin and Shtrikman bounds for composite materials with statistically isotropic phase distributions. Generalizations (Willis) of the Hashin-Shtrikman method to materials with anisotropic ("ellipsoidal") phase distributions. Bounds and estimates for linear composites with random phase distributions: ellipsoidal, spheroidal, spherical, fibrous and lamellar microstructures. Polycrystalline (granular) microstructures: the self-consistent estimate.

(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*	Supporting material provided through the UTH e-Class platform	
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	70
	Homeworks	35
	Study and analysis of bibliography	45
	Course total (25 hours per credit unit)	**150**

STUDENT PERFORMANCE EVALUATION	*Language of evaluation*: Greek
Description of the evaluation procedure	*Methods of evaluation*: four written homeworks (30%), oral presentation of a team project (20%), and a written final exam (50%) in the classroom.
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.*	

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
- Ponte Castaneda, P., Heterogeneous Materials, Lecture Notes, 2005.
- Willis, J.R., Mechanics of Composite Materials, Lecture Notes, 2002.
- Milton, G. W., Theory of Composites, Cambridge University Press, 2002.
- Christensen, R. M., Mechanics of Composite Materials, New York: Wiley-Interscience, 1979.
- Torquato, S., Random Heterogeneous Materials: Microstructure and Macroscopic Properties, Springer, 2002.

- Related academic journals:
- Journal of the Mechanics and Physics of Solids
- International Journal of Solids and Structures
- Advances in Applied Mechanics