COURSE OUTLINE

1. GENERAL

SCHOOL	of Engineering		
DEPARTMENT	of Environmental Engineering		
LEVEL OF STUDIES	1st Cycle, General Education		
COURSE CODE	**TMC335**	**SEMESTER**	**2nd Year, 2nd Semester**
COURSE TITLE	Solid Mechanics and Strength of Material		

TEACHING ACTIVITIES *If the ECTS Credits are distributed in distinct parts of the course e.g. lectures, labs etc. If the ECTS Credits are awarded to the whole course, then please indicate the teaching hours per week and the corresponding ECTS Credits.*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
	4	5
Please, add lines if necessary. Teaching methods and organization of the course are described in section 4.		

COURSE TYPE *Background, General Knowledge, Scientific Area, Skill Development*	Background, General Knowledge
PREREQUISITES:	Mathematics I & II (Trigonometric functions, vector analysis, deferential and integral calculus)
TEACHING & EXAMINATION LANGUAGE:	Greek
COURSE OFFERED TO ERASMUS STUDENTS:	NO
COURSE URL:	https://eclass.duth.gr/courses/TMC335/

2. LEARNING OUTCOMES

Learning Outcomes

Please describe the learning outcomes of the course: Knowledge, skills and abilities acquired after the successful completion of the course.

- Basic Knowledge of Solid Mechanics – Statics and Strength of Materials

General Skills

Name the desirable general skills upon successful completion of the module

Search, analysis and synthesis of data and information,
ICT Use
Adaptation to new situations
Decision making
Autonomous work
Teamwork
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project design and management
Equity and Inclusion
Respect for the natural environment
Sustainability
Demonstration of social, professional and moral responsibility and sensitivity to gender issues
Critical thinking
Promoting free, creative and inductive reasoning

This course introduces students to the fundamental principles and methods of structural mechanics. Topics covered include: static equilibrium, force resultants, support conditions, analysis of determinate planar structures (beams, trusses, frames), stresses and strains in structural elements, states of stress (shear, bending, torsion), statically indeterminate systems, displacements and deformations, introduction to matrix methods, elastic stability, and approximate methods. Design exercises are used to encourage creative student initiative and systems thinking. Students are expected to have:

- An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
- An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
- The student (as a non-specialist) knows the application possibilities and the limitations of the developed models.
- An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
- The student can calculate or design simple practical constructions, taking into account the boundary conditions (e.g. allowable material properties and deformations, type and applying of loads).

3. COURSE CONTENT

Solid Mechanics - Statics

1. **Introduction to Statics**
   - Mechanics – Basic Concepts
   - Scalar and Vectors (conventions for equations and diagrams, working with vectors)
   - Newton' s Law
2. **Statics of Particle and Rigid Bodies**
   - Coplanar Forces and Moments
   - Forces in Space
   - Equilibrium of a Particle
   - Equilibrium of a Rigid Body in a Plane
   - Forces and Moments in Space
   - Equilibrium of a Rigid Body in a Space
3. **Center of Mass and Centroids – Area Moments of Inertia**
   - Center of Mass (determine the center of gravity, center of mass vs. center of gravity)
   - Centroids of Lines, Areas, and Volumes
   - Rectangular and Polar Moments of Inertia
   - Radius of Gyration
   - Transfer of Axes
   - Rotation of Axes
4. **Structures**
   - Structural Elements
   - Joints between Structural Elements
   - Plane Trusses (simple trusses, truss connections and supports)
   - Method of Joints (internal and external redundancy special conditions)
   - Method of Sections (illustration of the method and additional considerations)
   - Frames (pin joined frames, interconnected rigid bodies with multiforce members, force representation and free body diagram)
5. **Beams – External and Internal Effects**
   - Type of Beams and Distributed Loads
   - Force flow in a member

- Diagrams for the normal force, shear force and bending moment (sign conventions for the N, V, and M diagrams)
- Deformation symbols for shear forces and bending moments

Strength of Materials

6. Introduction

- Normal Stress (σ) and Direct Strain (ε)
- Shear Stress (τ) and Shear Strain (γ)
- Mechanical Properties of Materials (proportional limit, elastic limit, elastic and plastic ranges)
- Ductile and Brittle Material Behaviour
- Temperature Stresses
- Stress concentrations – Stress Concentration Factor
- Allowable Working Stress – Factor of Safety

7. Tension and Compression

- Internal Effects of Forces (axially loaded bar, normal stress, test specimen, normal strain, stress – strain curve)
- Allowable stress - Safety Factor

8. Shear

- Internal Effects of Forces (shear test, shear strain)
- Σύνθλιψη άντυγας οπών,
- Allowable Working Stress - Safety Factor

9. Stress State - Strain State

- Sign Conventions
- Rotate Axes
- Elastic Materials - Hooke's Law
- Relation Between E, G and v
- Principal Stresses – Principal Planes
- Maximum Shearing Stress
- Mohr's Circle of Stress
- Strains in an Inclined Direction

10. Thin – Walled Pressure Vessels

- Internal and External Pressure (hoop or circumferential stress, longitudinal stress, change in dimensions)
- Cylindrical Pressure Vessels
- Spherical Pressure Vessels

11. Torsion

- Simple Torsion Theory
- Polar Second Moment of Area, Section of Modulus
- Torsional Rigidity
- Torsion 0f Hollow Shafts
- Torsion of Thin – Walled Tubes
- Principal Stresses
- Combined Torsion and Axial Loading

12. Bending

- Bending Theory - Pure Plane Bending
- Neutral Axis, Section of Modulus, Second Moment of Area
- Bending Moments and Shearing Forces
- Sign Conventions for Bending Moments and Shearing Forces
- Maximum Normal Stresses – Limitations
- Shearing Force and Bending Moment Diagrams

13. Columns – Stability

- Types of Columns
- Eccentric Loading
- Axial Loaded Compression Members
- Buckling - Stability
- Critical Buckling Load
- Euler' s Theory - Assumptions
- Yield Stress and Buckling Stress, Effective Length and Bracing

Examples – Finite Element Analysis using Comsol Multiphysics, Abaqus and Ansys

4. LEARNING & TEACHING METHODS - EVALUATION

TEACHING METHOD *Face to face, Distance learning, etc.*	Face to Face
USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT) *Use of ICT in Teaching, in Laboratory Education, in Communication with students*	Use of ICT in Teaching
TEACHING ORGANIZATION *The ways and methods of teaching are described in detail.* *Lectures, Seminars, Laboratory Exercise, Field Exercise, Bibliographic research & analysis, Tutoring, Internship (Placement), Clinical Exercise, Art Workshop, Interactive learning, Study visits, Study / creation, project, creation, project. Etc.* *The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards.*	

Activity	*Workload/semester*
Lectures	45
Bibliographic Research & Analysis	41
Field Exercise	20
Individual Project	44
Total	**150**

STUDENT EVALUATION *Description of the evaluation process* *Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Presentation in audience, Laboratory Report, Clinical examination of a patient, Artistic interpretation, Other/Others* *Please indicate all relevant information about the course assessment and how students are informed*	Problem Solving (Weekly): 35% Final Written Assignment: 65%

5. SUGGESTED BIBLIOGRAPHY

1. "Statics and Strength of Materials (Theory - Methodology – Solved Problems ", A. Polyzakis
2. "Statics and Strength of Materials", P. Vouthounis
3. "Strength of Materials", Th. Kermanidis
4. "Engineering Mechanics of Deformable Solids I", P. Vouthounis
5. "Strength of Materials", E. E. Gdoutos
6. "Strength of Materials", E. Papamichos and N. Ch. Charalampakis
7. "Statics", E. E. Gdoutos
8. "Strength of Materials: An Introduction to the Analysis of Stress and Strain", J. Case and A. H. Chilver
9. "Mechanics of Materials (2nd ed.)", F. Beer and E. R Johnston, Jr.
10. "Engineering Mechanics: Statics (5th ed.)", J. L. Meriam and Kraige L. G
11. " Statics and Strength of Materials: Foundations for Structural Design ", B. Onouye
12. " Vector Mechanics for Engineers: Statics and Dynamics (9th ed.)", F. P. Beer, E. R. Johnston, Jr, D. F. Mazurek, P. J. Cornwell and E. R. Eisenberg
13. " Strength of Materials (2nd ed.)", R. Subramanian
14. " Statics and Strength of Materials: Foundations for Structural Design (7th ed.)", H. Morrow and R. Kokernak
15. "Mechanics of Materials (10th ed.)", R.C. Hibbeler
16. "Statics and Strength of Materials", R.C. Hibbeler
17. "Strength of Materials (7th ed.)", W. Nash and M. C. Potter
18. "Applied Strength of Materials (6th ed.)", R. L. Mott and J. A. Untener
19. " Applied Strength of Materials for Engineering Technology (20th ed.)", B. Dupen

ANNEX OF THE COURSE OUTLINE

Alternative ways of examining a course in emergency situations

Teacher (full name):	Panagiotis J. Charitidis
Contact details:	pchariti@env.duth.gr
Supervisors: (1)	Dimoudi Argiro (adimoudi@env.duth.gr), Zoras Stamatios (szoras@env.duth.gr)
Evaluation methods: (2)	There is a final written examination for evaluation of the students.
Implementation Instructions: (3)	

(1) Please write YES or NO

(2) Note down the evaluation methods used by the teacher, e.g.

- *written assignment* or/and exercises
- written or oral examination with distance learning methods, provided that the integrity and reliability of the examination are ensured.

(3) In the **Implementation Instructions** section, the teacher notes down clear instructions to the students:

a) in case of **written assignment and / or exercises:** the deadline (e.g. the last week of the semester), the means of submission, the grading system, the grade percentage of the assignment in the final grade and any other necessary information.

b) in case of **oral examination with distance learning methods:** the instructions for conducting the examination (e.g. in groups of X people), the way of administration of the questions to be answered, the distance learning platforms to be used, the technical means for the implementation of the examination (microphone, camera, word processor, internet connection, communication platform), the hyperlinks for the examination, the duration of the exam, the grading system, the percentage of the oral exam in the final grade, the ways in which the inviolability and reliability of the exam are ensured and any other necessary information.

c) in case of **written examination with distance learning methods**: the way of administration of the questions to be answered, the way of submitting the answers, the duration of the exam, the grading system, the percentage of the written exam of the exam in the final grade, the ways in which the integrity and reliability of the exam are ensured and any other necessary information.

There should be an attached list with the Student Registration Numbers only of students eligible to participate in the examination.