### Postgraduate Studies Programme
«ENVIRONMENTAL ENGINEERING»

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<th>Specialization:</th>
<th>PhD Level</th>
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<th>Code:</th>
<th>Course: Advanced topics in computational mechanics with emphasis on dynamic analysis</th>
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**Instructor:** Associate Professor Yiannis Tsompanakis

**Bibliography**
1. Μ. Παπαδρακάκης, Ανάλυση φορέων με τη μέθοδο των πεπερασμένων στοιχείων, Εκδόσεις Παπασωτηρίου, 2001. (In Greek)
2. Π. Κωμοδρόμος, Ανάλυση κατασκευών: σύγχρονες μέθοδοι με χρήση ηλεκτρονικών υπολογιστών, 2η Έκδοση, Εκδόσεις Παπασωτηρίου, 2009. (In Greek)
4. E-class (Slides – Lecture Notes - E-books - Exercises – Bibliographic material): https://www.eclass.tuc.gr/courses/MHPER100/

**Course objectives**
Students will improve their knowledge of the issues covered in the context of the course in order to be able:
1. To understand and optimize the process required to achieve an effective and reliable numerical simulation of complex problems in computational mechanics.
2. To understand the basic principles of finite element method (FEM) and learn how to use various types of finite elements (beam, plane stress/strain, three dimensional, etc).
3. To be able to deal with errors that may arise during the numerical simulation and the solution of static and dynamic problems in computational mechanics.
4. To perform linear and nonlinear static and dynamic analyses FEM and be able to understand and interpret the results.
5. To understand the basic structure and functions of a complex FEM software.
6. To master advanced FEM software capabilities and to be capable of effectively utilizing them for the static and dynamic analysis of various types of structures.

**Course Syllabus**
- Overview of numerical simulation issues in structural mechanics.
- Matrix stiffness method and its application in analysis of planar and spatial frame & truss structures.
- Application of the matrix stiffness method in computer software.
- Finite element method (FEM).
• Beam finite elements.
• Plane stress and strain finite elements.
• Three-dimensional finite elements.
• Finite element mesh generation, discretization errors - adaptive FEM.
• Numerical solution techniques for FEM equilibrium equations.
• Structure and storage of stiffness matrices.
• Domain decomposition methods - Parallel programming techniques.
• Non-linear structural analysis - Numerical integration of dynamic equilibrium equations for single- and multi-degree of freedom engineering systems.
• Special issues in computational mechanics.
• Application of the finite element method in the static and dynamic analysis of complex structures using advanced software (commercial and/or open-source).

**Work load**
1. Weekly exercises
2. Semester project report

**Student evaluation**
1. Weekly exercises (20%)
2. Semester project report (50%)
3. Final presentation (20%)