UNIVERSITY of NICOSIA

Course Code	Course Title	ECTS Credits
MENG-450	Introduction to Finite Elements	6
Department	**Semester**	**Prerequisites**
Engineering	Fall or Spring	MATH-270, MATH-330
Type of Course	**Field**	**Language of Instruction**
Elective	Engineering	English
Level of Course	**Year of Study**	**Lecturer(s)**
1st Cycle	4th	Dr Anastasis Polycarpou
Mode of Delivery	**Work Placement**	**Co-requisites**
Face-to-face	N/A	None

Objectives of the Course:

The main objectives of the course are to:

- Incorporate math, science and physics to solve complex engineering problems using computational tools and techniques
- Introduce students to the main principles behind the finite element method in engineering
- Provide guidelines and rules on proper mesh generation and selection of shape/basis functions
- Formulate boundary value problems using the Galerkin weighted residual method and/or the Rayleigh-Ritz method.
- Develop numerical skills and abilities in order for the students to formulate and solve engineering problems using the finite element method
- Acquaint students with programming and numerical techniques using commercial software and platforms (e.g. MATLAB)

Learning Outcomes:

After completion of the course students are expected to:

- Formulate and solve ordinary and partial differential equations using the finite element method
- Apply the finite element method to model engineering problems governed by differential equations and a set of boundary conditions
- Use linear and higher-order basis/shape functions (1-D and 2-D) to obtain the governing elemental matrices
- Introduce assembly methods to generate the global matrix system of equations
- Impose Dirichlet and Robin-type (mixed) boundary conditions
- Solve the global matric system of equations using direct and iterative methods
- Post-process finite element solutions to produce graphs and illustrations suitable for technical presentations and reports
- Apply the finite element method to formulate and solve structural, fluid and

thermal problems in engineering.

Course Contents:

- Introduction of the finite element method
- Domain discretization and mesh refinement
- Interpolation/shape functions (1D-, 2-D, and 3-D)
- Higher-order finite elements in 1-D, 2-D, and 3-D
- Generation of element matrices and vectors
- Assembly of elements and imposing boundary conditions (Dirichlet, Neumann and Robin-type)
- Galerkin weighted residual approach and Rayleigh-Ritz variational approach
- Numerical solution of finite element equations (direct methods, iteration methods)
- Numerical error and posteriori error analysis
- Applications to solid mechanics problems
- Applications to fluid mechanics problems
- Applications to fluid mechanics problems
- Commercial software on finite elements

Learning Activities and Teaching Methods:

Lectures, in-class examples and exercises, demonstration through software

Assessment Methods:

Homework, project, midterm exams, final exam.

Required Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
Singiresu S. Rao	The Finite Element Method in Engineering, 5th ed.	Butterworth-Heinemann	2010	978-1856176613

Recommended Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
Anastasis C. Polycarpou	Introduction of the Finite Element Method in Electromagnetics	Morgan & Claypool Publishers	2006	978-1598290462
J.N. Reddy	An Introduction to the Finite Element Method, 3rd ed.	McGraw-Hill Education	2005	978-0072466850