Course unit title:	Introduction to Finite Element Method in Structural Engineering		
Course unit code:	ME 219		
Type of course unit:	Compulsory		
Level of course unit:	Bachelor (1st Cycle)		
Year of study:	2		
Semester when the unit is delivered:	4 (Spring)		
Number of ECTS credits allocated :	5		
Name of lecturer(s):	Dr.-Ing. Loucas Papadakis		
Learning outcomes of the course unit:	1. Explain the theory, fundamentals and application of the finite element method in solving structural engineering problems. 2. Apply of matrix algebra to describe mechanical problems with the finite element method. 3. Describe the relationship between external loads, displacement and structural stiffness. 4. Explain and apply the discretisation method and resulting the degrees of freedom for describing structural problems. 5. Outline the definitions of bars/trusses and beam elements. 6. Determine the stiffness matrix with the assembly method. 7. Describe the matrix equation and perform the calculation of nodal displacements and reaction force. 8. Perform analysis of total structural problems with the use of appropriate shape functions		
Mode of delivery:	Face-to-face		
Prerequisites:	ME 214, AMAT 181	Co-requisites:	None
Recommended optional program components:	None		
Course contents:	• **Types of Statically Indeterminate Structures**: Double-Integration Method, Method of Superposition, Moment-Area Method. • **Theory and fundamentals of the Finite Element Method:** matrix algebra for the problem description, space discretisation, constraints and loads. • **Stress and strain tensors:** Analysis of stress and strain for linear elastic materials and structures, traction and projection of stress and strain. • **Bar and Truss Elements:** axial stiffness, nodal displacements and internal forces of springs and bar elements. • **Beam Elements:** flexural stiffness, nodal displacements and rotations and internal forces and moments in beam elements. • **Stiffness Matrix:** Assembly method for the setup of the stiffness matrix of whole structural problems for the calculation of nodal displacements and loads (external and internal). • **Shape functions:** use of shape function for approximating solutions in the finite element analysis. • **Application on different examples:** the taught aspects in the finite element analysis are applied and demonstrated on specific structural problems • **Computer laboratory work**, where students can apply their gained knowledge on FE-software and evaluate practical problems for better comprehension		

Recommended and/or required reading:	
Textbooks:	M. Saeed, ***Finite Elements Analysis - Theory And Application With Ansys***, Pearson, 2nd Edition, 2003 C. Tirupathi, R. B. Ashok, ***Introduction to Finite Elements In Engineering***, Pearson, 3rd Edition, 2002
References:	D. Hutton, ***Fundamentals of Finite Element Analysis***, McGraw Hill, 2004 G. R. Buchanan, ***Finite Element Analysis***, McGraw Hill, 1995 N.-H. Kim and B. V. Sankar, ***Introduction to Finite Element Analysis and Design***, Wiley, 2009
Planned learning activities and teaching methods:	The taught part of course is delivered to the students by means of lectures, conducted with the help of computer presentations. Lecture notes and presentations are available through the web for students to use in combination with the textbooks. Furthermore theoretical principles are explained by means of specific examples and solution of specific problems. Lectures are supplemented with computer laboratory work carried out with the supervision of a lab assistant. Here a demonstration of actual problems and computational methods takes place. Additionally, during laboratory sessions, students apply their gained knowledge and identify the principles taught in the lecture sessions by means of working on different modelling tasks and evaluating simulation results.
Assessment methods and criteria:	• Assignments: 10% • Tests: 20% • Laboratory Work: 10% • Final Exam: 60%
Language of instruction:	English
Work placement(s):	No