SUBJECT TEACHING GUIDE

596 - Finite Elements

Master's Degree in civil Engineering, Canal and Port Engineering

Academic year 2024-2025

1. IDENTIFYING DATA					
Degree	Master's Degree in civil Engineering, Canal and Port Engineering			Type and Year	Compulsory. Year 1
Faculty	School of civil Engineering				
Discipline	EXTENSION OF FINITE ELEMENTS				
Course unit title and code	596 - Finite Elements				
Number of ECTS credits allocated	4,5	Term		Semester based (2)	
Web					
Language of instruction	Spanish	English Friendly	No	Mode of delivery	Face-to-face

Department	DPTO. INGENIERIA ESTRUCTURAL Y MECANICA
Name of lecturer	ARTURO JOSE SANTAMARIA SALLAN
E-mail	arturo.santamaria@unican.es
Office	E.T.S. de Ingenieros de Caminos, Canales y Puertos. Planta: + 2. DESPACHO (2064)
Other lecturers	CLAUDIO LOPEZ CASTILLO

3.1 LEARNING OUTCOMES
- To apply the Finite Element Method to civil engineering problems
- To model and predict the behavior of problems in civil engineering
- To model and size structural elements under static actions using the Finite Element Method.
- To model and size structural elements under dynamic actions using the Finite Element Method.

4. OBJECTIVES
To calculate structural elements using the Finite Element Method (FEM)
To idealize continuous structural elements by the Finite Element Method
Ability to analyze Finite Element Method results
Critical analysis of FEM results by comparison with simpler models of analysis

6. SUBJECT PROGRAM	
CONTENTS	
1	INTRODUCTION TO THE FINITE ELEMENT METHOD (MEF). Discrete and continuous systems, matrix analysis of bar systems, FEM in analysis of continuous structures.
2	INTRODUCTION TO MECHANICS FOR SOLIDS AND STRUCTURES. Basic equations of elasticity, energy theorems
3	FUNDAMENTALS OF THE FINITE ELEMENT METHOD Differential and integral formulations, equivalence, variational methods, shape functions, numerical integration, convergence, meshing.
4	FEM FOR ONE-DIMENSIONAL PROBLEMS (I) BARS. Two-node element, stiffness matrix, load vector, boundary conditions, FEM in plane ans spatial trusses, higher order one-dimensional elements, isoparametric formulation.
5	FEM FOR ONE-DIMENSIONAL PROBLEMS (II) BEAMS. Classical theory, resolution by the FEM, beams with shear deformation, FEM in plane and spatial frames
6	FEM FOR TWO-DIMENSIONAL SOLIDS. PLAIN STRESS AND PLAIN STRAIN PROBLEMS. Triangular element, rectangular element, class C0 interpolation functions, isoparametric formulation.
7	FEM FOR AXISYMMETRIC ELEMENTS. Element types, examples, asymmetric loads.
8	FEM FOR THREE-DIMENSIONAL SOLIDS. Elements, examples.
9	FEM FOR PLATES. Classical theory, discretization, convergence, conformal elements, thick plates.
10	FEM FOR SHELLS. Elements, examples, transition elements.
11	FEM FOR NON-LINEAR AND DYNAMIC ANALYSIS. Geometric and mechanical nonlinearity, dynamic analysis

7. ASSESSMENT METHODS AND CRITERIA				
Description	Type	Final Eval.	Reassessn	%
Partial exam (Parts 1 to 4)	Written exam	No	Yes	25,00
Partial exam (Parts 5 to 11)	Written exam	No	Yes	25,00
Continuous assessment activities	Others	No	Yes	30,00
Practical work (Part 6)	Work	No	Yes	20,00
TOTAL				100,00

Observations
In the recovery exam, the student who has passed any of the parts of the course (continuous assessment activities, partial exams or practical work) must only take the part (or parts) not passed. The recovery of the continuous assessment and the practical work activities will be carried out by delivering them prior to the recovery exam.
Observations for part-time students
The assessment will be the same as that of full-time students.

8. BIBLIOGRAPHY AND TEACHING MATERIALS

BASIC

El método de los elementos finitos / O.C. Zienkiewicz, R.L. Taylor, J.Z. Zhu. Centro Internacional de Métodos Numéricos en Ingeniería,2010. ISBN: 978-84-96736-74-0

A First Course in the Finite Element Method. Daryl L. Logan. Thomson,2007. ISBN: 0-534-55298-6