

## 250439 - MODNUMECE - Numerical Models in Civil and Structural Engineering

Coordinating unit:	250 - ETSECCPB - Barcelona School of Civil Engineering
Teaching unit:	751 - DECA - Department of Civil and Environmental Engineering
Academic year:	2015
Degree:	MASTER'S DEGREE IN CIVIL ENGINEERING (PROFESSIONAL TRACK) (Syllabus 2012). (Teaching unit Optional) MASTER'S DEGREE IN CIVIL ENGINEERING (RESEARCH TRACK) (Syllabus 2009). (Teaching unit Optional) MASTER'S DEGREE IN STRUCTURAL AND CONSTRUCTION ENGINEERING (Syllabus 2015). (Teaching unit Optional)
ECTS credits:	5
Teaching languages:	Spanish, English

### Teaching staff

Coordinator:	MICHELE CHIUMENTI
Others:	LUIS MIGUEL CERVERA RUIZ, MICHELE CHIUMENTI, JOSE FRANCISCO ZARATE ARAIZA

### Opening hours

Timetable: Every day from 14:30 to 15:30 in the office 113 of module C1.

### Degree competences to which the subject contributes

Specific:

8228. Knowledge of and competence in the application of advanced structural design and calculations for structural analysis, based on knowledge and understanding of forces and their application to civil engineering structures. The ability to assess structural integrity.

### Teaching methodology

The course consists of 1,5 hours per week of classroom activity (large size group) and 0,8 hours weekly with half the students (medium size group).

The 1,5 hours in the large size groups are devoted to theoretical lectures, in which the teacher presents the basic concepts and topics of the subject, shows examples and solves exercises.

The 0,8 hours in the medium size groups is devoted to solving practical problems with greater interaction with the students. The objective of these practical exercises is to consolidate the general and specific learning objectives.

The rest of weekly hours devoted to laboratory practice.

Support material in the form of a detailed teaching plan is provided using the virtual campus ATENEA: content, program of learning and assessment activities conducted and literature.

### Learning objectives of the subject

Specialization subject in which knowledge on specific competences is intensified.

Knowledge and skills at specialization level that permit the development and application of techniques and methodologies at advanced level.

## 250439 - MODNUMECE - Numerical Models in Civil and Structural Engineering

Contents of specialization at master level related to research or innovation in the field of engineering.

This course aims to give an overview about the possibilities offered by the numerical simulation in civil engineering. The student will be able to study different topics including the structural analysis and particularly the shape optimization, the transient analysis (thermal and thermo-mechanical problems) and finally the nonlinear analysis. The necessary knowledge will be reviewed and the appropriate tools (software, interface, etc..) will be made available. To carry out the different tasks, the student will have maximum freedom solving the problems proposed and searching for the best solution in each case.

### Study load

Total learning time: 125h	Theory classes:	19h 30m	15.60%
	Practical classes:	9h 45m	7.80%
	Laboratory classes:	9h 45m	7.80%
	Guided activities:	6h	4.80%
	Self study:	80h	64.00%

## 250439 - MODNUMECE - Numerical Models in Civil and Structural Engineering

### Content

<p>Introduction</p>	<p>Learning time: 2h 24m Theory classes: 1h Self study : 1h 24m</p>
<p>Description: Introduction: The aim of the course, format of lessons, tasks</p>	
<p>Brief review of Continuum Mechanics</p>	<p>Learning time: 12h Theory classes: 5h Self study : 7h</p>
<p>Description: Review of concepts and definitions in Continuum Mechanics Review of the theory of elasticity and elastic problem definition</p>	
<p>Geometric modeling and meshing</p>	<p>Learning time: 9h 36m Practical classes: 4h Self study : 5h 36m</p>
<p>Description: Downloading and installing GiD for pre-processing (CAD data) and post processing (results). Guided tutorial for geometric modeling (GID). Guided tutorial for finite element meshing</p>	
<p>Structural Analysis</p>	<p>Learning time: 19h 12m Theory classes: 2h Practical classes: 3h Laboratory classes: 3h Self study : 11h 12m</p>
<p>Description: Tutorial guide on using the software interface for structural analysis with FEM (COMET). Tutorial on Post-Processing (GID). Description of the different failure criteria for ductile and brittle materials.</p>	

## 250439 - MODNUMECE - Numerical Models in Civil and Structural Engineering

<p>Transient Analysis</p>	<p>Learning time: 19h 12m</p> <p>Theory classes: 3h Practical classes: 2h Laboratory classes: 3h Self study : 11h 12m</p>
<p>Description:</p> <p>Thermal and thermo-mechanical problems. Case studies: the numerical simulation of casting and welding processes. Tutorial guide to the software interface for thermo-mechanical FEM analysis (COMET). Guided exercises to solve thermal and thermo-mechanical problems.</p>	
<p>Nonlinear analysis</p>	<p>Learning time: 31h 12m</p> <p>Theory classes: 7h Practical classes: 3h Laboratory classes: 3h Self study : 18h 12m</p>
<p>Description:</p> <p>Computational methods for nonlinear analysis. Numerical techniques for nonlinear analysis: Newton-Raphson, Picard, arc length, prediction techniques, etc ... Elasto-plasticity and elasto-damage constitutive equations for the most common materials in civil engineering (steel, concrete, soil). Yield strength, hardening and softening variables inelastic deformations and damage. Tutorial on solving nonlinear problems.</p>	

### Qualification system

Continuous assessment by different activities, individual or group based will be made during the course.

The assignments consist of a set of application home-works according to the themes developed in the course.

The final mark will be computed as average of the assignments done along the course.

### Regulations for carrying out activities

The assignments proposed during the course as part of the evaluation are mandatory.  
If one or more assignments are not presented the final mark will be: Not Presented (NP).

## 250439 - MODNUMECE - Numerical Models in Civil and Structural Engineering

### Bibliography

#### Basic:

- Fung, Y.C.. A First Course in Continuum Mechanics. Prentice-Hall, 1977.
- Malvern, L.E.. Introduction to the Mechanics of a Continuous Medium,. Prentice-Hall, 1969.
- Mase, G.T. & Mase, G.E.. Continuum Mechanics for Engineers, 2nd edition,. CRC Press, 1999.
1. Fung Y.C., Tong P.. Classical and Computational Solid Mechanics. 2001.
- Bathe K.J.. Finite Element Procedures. Prentice Hall, 1996.
- Zienkiewicz, O.C., Taylor, R.L., Zhu, J.Z.. The Finite Element Method: Its Basis and Fundamentals. Elsevier Butterworth-Heinemann, 2005.
- Zienkiewicz, O.C., Taylor, R.L.. The Finite Element Method for Solid and Structural Mechanics. 2005.
- Crisfield, M.A. Non-Linear Finite Element Analysis of Solids and Structures. John Wiley & Sons., 1991.

#### Complementary:

- West, H.H. & Geschwindner, L.H.. Fundamentals of Structural Analysis. Wiley, 2002.
- Ghali, A., Neville, A.M. & Brown, T.G.. Structural Analysis: A Unified Classical and Matrix Approach. Spon Press., 2003.
- Utku, S., Norris, C.H. & Wilbur, J.B.. Elementary Structural Analysis. McGraw-Hill., 1991.