

250405 - ENGINSTR - 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 Compulsory) MASTER'S DEGREE IN STRUCTURAL AND CONSTRUCTION ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) MASTER'S DEGREE IN CIVIL ENGINEERING (RESEARCH TRACK) (Syllabus 2009). (Teaching unit Optional)
ECTS credits:	6
Teaching languages:	Spanish, English

Teaching staff

Coordinator:	GABRIEL BUGEDA CASTELLTORT, EUGENIO OÑATE IBAÑEZ DE NAVARRA
Others:	GABRIEL BUGEDA CASTELLTORT, MIGUEL ANGEL CELIGUETA JORDANA, DANIEL DI CAPUA, EUGENIO OÑATE IBAÑEZ DE NAVARRA, PAVEL RYZHAKOV, BENJAMIN SUAREZ ARROYO, JOSE FRANCISCO ZARATE ARAIZA

Opening hours

Timetable:	The student consultancy service is two hours per week, intensifying to four hours per week at the exam period. The schedule will be announced at the beginning of each course.
------------	--

Degree competences to which the subject contributes

Specific:

8162. Knowledge of all kinds of structures and materials and the ability to design, execute and maintain structures and buildings for civil works.

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 2.7 hours a week of classes in the classroom where the teacher presents the concepts and basics of the course.

Also 0.9 hours per week is spending in a middle group format, to problem solving with more interaction with the student. Practical exercises are solved to consolidate the general and specific learning objectives.

Support material is used in the form of detailed teaching plan stored at the Virtual Center

<http://www.cimne.com/cdl1/ctrhome/2>: content, programming and evaluation activities directed learning and literature.

Learning objectives of the subject

Students will learn to apply their knowledge of structural engineering and to use advanced calculation methods to analyse, dimension and interpret the resistance behaviour of structures.

Upon completion of the course, students will be able to:

250405 - ENGINESTR - Structural Engineering

Apply their knowledge of structural engineering and use advanced calculation methods to analyse, dimension and interpret the resistance behaviour of structures;
 Use dynamic analysis to examine the seismic behaviour of structures and apply advanced design techniques to improve seismic response;
 Use advanced coupled nonlinear models to analyse and diagnose the possible limit states and ultimate limit states encountered during the life cycle of a structure;
 Evaluate and mitigate structural seismic hazards;
 Conduct durability and vulnerability studies.

Concepts and formulations of the finite element method: Application to the structural analysis of classic and advanced (composite) materials under static and dynamic conditions; Linear problems and introduction to nonlinear problems; Methods applicable to common engineering structures and materials, including dams, tunnels, tanks, sheets, buildings, bridges, mechanical components and plates: Fundamental theoretical aspects and main computational aspects; Hands-on sessions on engineering applications and structures

Study load

Total learning time: 150h	Theory classes:	25h 58,8m	17.32%
	Practical classes:	13h 01,2m	8.68%
	Laboratory classes:	13h 01,2m	8.68%
	Guided activities:	1h 58,8m	1.32%
	Self study:	96h	64.00%

250405 - ENGINESTR - Structural Engineering

Content

<p>Introduction</p>	<p>Learning time: 4h 48m Theory classes: 2h Self study : 2h 48m</p>
<p>Description: Introduccion and discrete systems</p> <p>Specific objectives: Describe the course and present the analogy with discrete and bar systems.</p>	
<p>2D Solids</p>	<p>Learning time: 28h 47m Theory classes: 8h Practical classes: 4h Self study : 16h 47m</p>
<p>Description: Structural analysis in plane stress and strain assumptions as well in axisimetric 3D structures. Introduction to Programming the FEM in MAT LAB Learning a finite element program Solution of two-dimensional structures using FEM</p> <p>Specific objectives: Present the finite element method in two-dimensional elasticity problems Learn to programming and solve with the program the finite element method Consolidate the use of computers for solving problems using FEM</p>	
<p>3D Solid</p>	<p>Learning time: 9h 36m Theory classes: 2h Practical classes: 2h Self study : 5h 36m</p>
<p>Description: Define the finite element method in three-dimensional elasticity problems. solution of 3D structures using the FEM</p> <p>Specific objectives: consolidate the MEF study by its matrix formulation. Consolidate the use of computers to solve problems by the FEM</p>	

250405 - ENGINSTR - Structural Engineering

<p>Beams</p>	<p>Learning time: 14h 23m Theory classes: 6h Self study : 8h 23m</p>
<p>Description: Study the theories of Timoshenko and Euler_Bernulli for solving bending beams.</p> <p>Specific objectives: Studying higher-order elements and know the complications that can present the numerical solution of a problem by the FEM</p>	
<p>Evaluation</p>	<p>Learning time: 9h 36m Laboratory classes: 4h Self study : 5h 36m</p>
<hr/>	
<p>Plates</p>	<p>Learning time: 19h 12m Theory classes: 6h Practical classes: 2h Self study : 11h 12m</p>
<p>Description: Further application of FEM for thin and thick plates analysis using the Kirchhoff and Reissner-Mindlin theories. Analyse the application to composite materials. Solving plate structures using the FEM</p> <p>Specific objectives: Extending theories of beams to two-dimensional case Consolidate the use of computers to solve problems by the FEM</p>	
<p>Shells</p>	<p>Learning time: 24h Theory classes: 8h Practical classes: 2h Self study : 14h</p>
<p>Description: Develop the FEM to the analysis of thin and thick shells extending Kirchhoff theories and Reissner-Mindlin as well as the 2D plane stress to the 3D flat shells analysis. Shells structures solution using the FEM</p> <p>Specific objectives: Expanding and combining elasticity theories applied to the FEM Consolidate the use of computers to solve problems using the FEM</p>	

250405 - ENGINESTR - Structural Engineering

real examples	Learning time: 4h 48m Theory classes: 2h Self study : 2h 48m
<p>Description: Presentation of real studies conducted by engineering firms.</p> <p>Specific objectives: Knowing the actual use of the method and its scope.</p>	
Introduction to dynamic analysis	Learning time: 4h 48m Theory classes: 2h Self study : 2h 48m
<p>Description: Introduction to dynamic analysis of structures using the FEM</p> <p>Specific objectives: show the scope of the FEM in the structures design.</p>	
Introduction to nonlinear problems	Learning time: 4h 48m Theory classes: 2h Self study : 2h 48m
<p>Description: Introduction to nonlinear analysis and coupled problems, using the FEM</p> <p>Specific objectives: show the scope of the FEM in structural design.</p>	

Qualification system

The mark will be obtained from continuous assessment (40%) and the average of two exams (60%). Continuous assessment involves solving individual exercises. These exercises will be graded with a maximum score of four (4) points: One (1) point for the practical exercises solved at class time and three (3) points for the finite element method applied to a practical case.

The exams consist of a questionnaire to be answer individually, without the help of any literature. Each questionnaire adheres to the concepts taught in the course. This exams have a maximum mark of six (6) points.

Regulations for carrying out activities

If there is any exam or continuous assessment within the scheduled period, a zero score will be considered.

250405 - ENGINESTR - Structural Engineering

Bibliography

Basic:

Oñate. E. cálculo de estructuras por el método de los elementos finitos. Análisis estático línea. 2. Barcelona: SPRINGER - CIMNE, 1995. ISBN 84-87867-00-6.

Oñate. E. structural analysis with the finite element method. Linear statics volume i : basis and solids. 1. Barcelona: SPRINGER - CIMNE, 2008. ISBN 978-1-4020-8732-5.

Oñate. E. structural analysis with the finite element method. Linear statics volume ii : beams plates and shells Barcelona. 1. Barcelona: SPRINGER - CIMNE, 2010. ISBN 978-84-96736-18-4.