Course guides
250725 - 250725 - Structural Engineering

Unit in charge: Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering.
Degree: MASTER'S DEGREE IN STRUCTURAL AND CONSTRUCTION ENGINEERING (Syllabus 2015). (Compulsory subject).
Academic year: 2020  ECTS Credits: 6.0  Languages: English, Spanish

LECTURER
Coordinating lecturer: GABRIEL BUGEDA CASTELLTORT
Others: GABRIEL BUGEDA CASTELLTORT, MIGUEL ENRIQUE CERROLAZA RIVAS, ALEJANDRO CORNEJO VELÁZQUEZ, SERGIO JIMÉNEZ REYES

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
13368. Mathematically modelling structural engineering problems.
13369. To apply methods and advanced design software and structural calculations, based on knowledge and understanding of forces and their application to the structural types of civil engineering.

General:
13360. To conceive, design, analyze and manage structures or structural elements of civil engineering or building, encouraging innovation and the advance of knowledge.
13361. To develop, improve and use conventional materials and new construction techniques to ensure the safety requirements, functionality, durability and sustainability.

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

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours medium group</td>
<td>13,0</td>
<td>8.67</td>
</tr>
<tr>
<td>Guided activities</td>
<td>2,0</td>
<td>1.33</td>
</tr>
<tr>
<td>Hours large group</td>
<td>26,0</td>
<td>17.33</td>
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<tr>
<td>Hours small group</td>
<td>13,0</td>
<td>8.67</td>
</tr>
<tr>
<td>Self study</td>
<td>96,0</td>
<td>64.00</td>
</tr>
</tbody>
</table>

Total learning time: 150 h
## CONTENTS

### Introduction

**Description:**
Introduction and discrete systems

**Specific objectives:**
Describe the course and present the analogy with discrete and bar systems.

**Full-or-part-time:** 4h 48m

- Theory classes: 2h
- Self study: 2h 48m

### 2D Solids

**Description:**
Structural analysis in plane stress and strain assumptions as well in axisymmetric 3D structures.

- Introduction to Programming the FEM in MATLAB
- Learning a finite element program
- Solution of two-dimensional structures using FEM

**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

**Full-or-part-time:** 28h 47m

- Theory classes: 8h
- Practical classes: 4h
- Self study: 16h 47m

### 3D Solid

**Description:**
Define the finite element method in three-dimensional elasticity problems.

- Solution of 3D structures using the FEM

**Specific objectives:**
- Consolidate the MEF study by its matrix formulation.
- Consolidate the use of computers to solve problems by the FEM

**Full-or-part-time:** 9h 36m

- Theory classes: 2h
- Practical classes: 2h
- Self study: 5h 36m
### Beams

**Description:**
Study the theories of Timoshenko and Euler-Bernulli for solving bending beams.

**Specific objectives:**
Studying higher-order elements and know the complications that can present the numerical solution of a problem by the FEM

**Full-or-part-time:** 14h 23m
- Theory classes: 6h
- Self study: 8h 23m

### Evaluation

**Full-or-part-time:** 9h 36m
- Laboratory classes: 4h
- Self study: 5h 36m

### Plates

**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

**Specific objectives:**
Extending theories of beams to two-dimensional case
Consolidate the use of computers to solve problems by the FEM

**Full-or-part-time:** 19h 12m
- Theory classes: 6h
- Practical classes: 2h
- Self study: 11h 12m

### Shells

**Description:**
Develop the FEM to the analysis of thin and thick shells extending Kirchoff theories and Reissner-Mindlin as well as the 2D plane stress to the 3D flat shells analysis.
Shells structures solution using the FEM

**Specific objectives:**
Expanding and combining elasticity theories applied to the FEM
Consolidate the use of computers to solve problems using the FEM

**Full-or-part-time:** 24h
- Theory classes: 8h
- Practical classes: 2h
- Self study: 14h
real examples

Description:
Presentation of real studies conducted by engineering firms.

Specific objectives:
Knowing the actual use of the method and its scope.

Full-or-part-time: 4h 48m
Theory classes: 2h
Self study: 2h 48m

Introduction to dynamic analysis

Description:
Introduction to dynamic analysis of structures using the FEM

Specific objectives:
show the scope of the FEM in the structures design.

Full-or-part-time: 4h 48m
Theory classes: 2h
Self study: 2h 48m

Introduction to nonlinear problems

Description:
Introduction to nonlinear analysis and coupled problems, using the FEM

Specific objectives:
show the scope of the FEM in structural design.

Full-or-part-time: 4h 48m
Theory classes: 2h
Self study: 2h 48m

GRADING 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.

EXAMINATION RULES.

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

Basic: