250231 - ESTRUCT - Structures

**Coordinating unit:** 250 - ETSECCPB - Barcelona School of Civil Engineering  
**Teaching unit:** 751 - DECA - Department of Civil and Environmental Engineering  
**Academic year:** 2018  
**Degree:** BACHELOR'S DEGREE IN PUBLIC WORKS ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)  
**ECTS credits:** 6  
**Teaching languages:** Spanish

### Degree competences to which the subject contributes

#### Specific:
- 3072. Ability to apply knowledge of construction materials to structural systems. Knowledge of the relation between the structure of materials and the mechanical properties resulting from them  
- 3080. Knowledge of the design, calculation, construction and maintenance of building works in regard to their structure, finishes, installations and equipment.  
- 3087. Knowledge of and ability to design and dimension hydraulic works and facilities, energy systems and the harnessing of hydroelectric energy, and plan and manage surface and underground hydraulic resources  
- 3091. Ability to construct, conserve, dimension and design roads and the items comprising basic road provision  
- 3092. Ability to construct and conserve railway lines with knowledge of the application of the specific technical regulations, differentiating the characteristics of the rolling stock

#### Generical:
- 3105. Students will learn to identify, formulate and solve a range of engineering problems. They will be expected to show initiative in interpreting and solving specific civil engineering problems and to demonstrate creativity and decision-making skills. Finally, students will develop creative and systematic strategies for analysing and solving problems.  
- 3106. Students will learn to assess the complexity of the problems examined in the different subject areas, identify the key elements of the problem statement, and select the appropriate strategy for solving it. Once they have chosen a strategy, they will apply it and, if the desired solution is not reached, determine whether modifications are required. Students will use a range of methods and tools to determine whether their solution is correct or, at the very least, appropriate to the problem in question. More generally, students will be encouraged to consider the importance of creativity in science and technology.  
- 3107. Students will learn to identify, model and analyse problems from open situations, consider alternative strategies for solving them, select the most appropriate solution on the basis of reasoned criteria, and consider a range of methods for validating their results. More generally, students will learn to work confidently with complex systems and to identify the interactions between their components.  
- 3111. Students will learn to plan, design, manage and maintain systems suitable for use in civil engineering. They will develop a systematic approach to the complete life-cycle of a civil engineering infrastructure, system or service, which includes drafting and finalising project plans, identifying the basic materials and technologies required, making
Students will learn to apply their knowledge of the operational strength of structures to the design of structures that comply with current regulations, with the help of analytical and numerical calculation methods. They will also learn to find laws of stress and strain in structures by means of analytical calculation methods.

Upon completion of the course, students will have acquired the ability to: 1. Understand and apply the basics of structural analysis, and understand energy theorems and their utility. 2. Apply compatibility and equilibrium methods to structural analysis. 3. Perform structural analysis and calculation using computer software.

Basics of structural analysis; Common types of structural solutions (continuous beams, portal frames, arches); Continuous
structures and rod structures; Articulated and framed structures; Stresses and motion; Energy theorems (virtual work, Castigliano, least work, Maxwell, etc.); Work and energy in structural systems; Total potential energy; Elastic supports and connections; Compatibility and equilibrium methods; Continuous beams; Frames; Imposed motion and deformations; Stiffness method; Calculation of motion, stresses and reactions; Articulations; Types of rod structures; Computer-assisted structural calculation

<table>
<thead>
<tr>
<th>Study load</th>
<th>Hours large group</th>
<th>15h</th>
<th>10.00%</th>
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<tbody>
<tr>
<td>Total learning time: 150h</td>
<td>Hours medium group</td>
<td>15h</td>
<td>10.00%</td>
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<tr>
<td>Hours small group:</td>
<td>30h</td>
<td>20.00%</td>
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<tr>
<td>Guided activities:</td>
<td>6h</td>
<td>4.00%</td>
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<tr>
<td>Self study:</td>
<td>84h</td>
<td>56.00%</td>
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## Content

<table>
<thead>
<tr>
<th><strong>Fundamentals of Structural Analysis</strong></th>
<th><strong>Learning time:</strong> 33h 36m</th>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
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<table>
<thead>
<tr>
<th><strong>Stresses and Movements</strong></th>
<th><strong>Learning time:</strong> 14h 23m</th>
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<tr>
<td><strong>Description:</strong></td>
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<tr>
<td>Differential equation of the deflection of a beam line. Navier formulas for planar structures. Elastic equations. Efforts and movements. Problems</td>
<td>Theory classes: 2h Practical classes: 2h Laboratory classes: 2h Self study : 8h 23m</td>
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<tr>
<th><strong>Work and Energy</strong></th>
<th><strong>Learning time:</strong> 33h 36m</th>
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<tr>
<td><strong>Description:</strong></td>
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### Compatibility Method

**Description:**

- Compatibility method. Problems
- Compatibility method. Laboratory

**Learning time:** 9h 36m
- Theory classes: 1h
- Practical classes: 1h
- Laboratory classes: 2h
- Self study: 5h 36m

### Equilibrium Method

**Description:**
Bases of the method. Continuous beams: equation of the three rotations, support settlements, elastic supports. Frames: intrasional and traslational frames

- Balance Method. Problems
- Balance Method. Laboratory

**Learning time:** 33h 36m
- Theory classes: 4h
- Practical classes: 4h
- Laboratory classes: 6h
- Self study: 19h 36m

### Stiffness method

**Description:**

- Stiffness method. Problems
- Stiffness method. Laboratory

**Learning time:** 19h 12m
- Theory classes: 2h
- Practical classes: 2h
- Laboratory classes: 4h
- Self study: 11h 12m
Qualification system

The final qualification is the weighted average obtained in the exercises in the practices classes and guided activities (AD), periodic evaluation exercises (AV), and the final work of the course (T). The final grade for the course is obtained as:

\[ NF = 0.4 \times A + 0.4 \times AD + 0.4 \times T \]

Criteria for re-evaluation qualification and eligibility: Students that failed the ordinary evaluation and have regularly attended all evaluation tests will have the opportunity of carrying out a re-evaluation test during the period specified in the academic calendar. Students who have already passed the test or were qualified as non-attending will not be admitted to the re-evaluation test. The maximum mark for the re-evaluation exam will be five over ten (5.0). The non-attendance of a student to the re-evaluation test, in the date specified will not grant access to further re-evaluation tests. Students unable to attend any of the continuous assessment tests due to certifiable force majeure will be ensured extraordinary evaluation periods.

These tests must be authorized by the corresponding Head of Studies, at the request of the professor responsible for the course, and will be carried out within the corresponding academic period.

Regulations for carrying out activities

If you do not perform any activities of continuous assessment or final work subject in the scheduled period, is considered zero punctuation.

Bibliography

Basic:


Complementary: