250244 - CALESTRUC - Structural Design

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 Optional)
ECTS credits: 6
Teaching languages: Catalan, Spanish

Teaching staff
Coordinator: LUIS MIGUEL CERVERA RUIZ
Others: LUIS MIGUEL CERVERA RUIZ, JOSE MANUEL GONZALEZ LOPEZ

Opening hours
Timetable: Wednesday 17:00 to 19:00, Friday 17:00 Module C1 to 19:00 Module C1 and hours to be arranged with the teacher

Degree competences to which the subject contributes

Specific:
3079. Knowledge of the different types and basis for calculating prefabricated items and its application to the manufacturing processes
3080. Knowledge of the design, calculation, construction and maintenance of building works in regard to their structure, finishes, installations and equipment.
3085. Ability to construct geotechnical works

General:
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 decisions, managing the different project activities, performing measurements, calculations and assessments, ensuring compliance with specifications, regulations and compulsory standards, evaluating the social and environmental impact of the processes and techniques used, and conducting economic analyses of human and material resources.
3112. Students will develop an understanding of the different functions of engineering, the processes involved in the life-cycle of a construction project, process or service, and the importance of systematising the design process. They will learn to identify and interpret the stages in preparing a product design specification (PDS), draft and optimise
250244 - CALESTRUC - Structural Design

Students will acquire specialised knowledge of structural analysis.

Civil construction pathway

Specifications and planning documents, and apply a systematic design process to the implementation and operation phases. Students will learn to write progress reports for a design process, use a range of project management tools and prepare final reports, and will be expected to show an awareness of the basic economic concepts associated with the product, process or service in question.

Transversal:

586. ENTREPRENEURSHIP AND INNOVATION - Level 2. Taking initiatives that give rise to opportunities and to new products and solutions, doing so with a vision of process implementation and market understanding, and involving others in projects that have to be carried out.

589. SUSTAINABILITY AND SOCIAL COMMITMENT - Level 2. Applying sustainability criteria and professional codes of conduct in the design and assessment of technological solutions.

594. TEAMWORK - Level 3. Managing and making work groups effective. Resolving possible conflicts, valuing working with others, assessing the effectiveness of a team and presenting the final results.

584. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

Teaching methodology

The course consists of 4 hours per week of classes during the 15 weeks of the semester.
The approximate distribution of the 60 contact hours is as follows:

- 36 hours of lectures devoted to the exposition of the concepts and materials of the course.
- 12 hours of practical sessions devoted to the presentation of examples and exercises and problems.
- 4 hours laboratory and directed activities devoted to practical exercises to consolidate the objectives of general and specific learning of the subject.
- 8 hours devoted to assessment.

Learning objectives of the subject

Students will acquire specialised knowledge of structural analysis.

Calculation basis in structural design; Current regulations on actions, calculation and execution; Project conditions for designing and/or testing structures; Ultimate limit states and serviceability limit states; Plate analysis; Approximate plate-analysis methods; Failure methods; Introduction to elasticity; Discretisation of continuous systems: finite element method; 2D and 3D elasticity problems; Pre-process and post-process; Introduction to dynamic and seismic analysis; One-degree-of-freedom systems; Response spectra; Multiple-degree-of-freedom systems; Nonlinear structural calculation; Nonlinear material: theory of plastic moment; Moment diagrams; Geometric non-linearity: Instability
## Study load

<table>
<thead>
<tr>
<th>Description</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes</td>
<td>32</td>
<td>21.33%</td>
</tr>
<tr>
<td>Practical classes</td>
<td>16</td>
<td>10.67%</td>
</tr>
<tr>
<td>Laboratory classes</td>
<td>12</td>
<td>8.00%</td>
</tr>
<tr>
<td>Guided activities</td>
<td>6</td>
<td>4.00%</td>
</tr>
<tr>
<td>Self study</td>
<td>84</td>
<td>56.00%</td>
</tr>
<tr>
<td><strong>Total learning time</strong></td>
<td><strong>150</strong></td>
<td></td>
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### Content

<table>
<thead>
<tr>
<th>Topic</th>
<th>Learning time:</th>
<th>Description:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Structural reliability and structural basis of design</strong></td>
<td>28h 47m</td>
<td>Theory classes: 6h  Practical classes: 2h  Laboratory classes: 4h  Self study : 16h 47m</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td></td>
<td>Introduction. Semiprobabilista probabilistic representation and representation. Required reliability. Actions, action effects (surround, lines of influence) and combination of actions. Limit states. Structural reliability and structural design bases. Problems Structural reliability and structural design bases. Laboratory</td>
</tr>
<tr>
<td><strong>Funicular Structures</strong></td>
<td>9h 36m</td>
<td>Theory classes: 2h  Practical classes: 2h  Self study : 5h 36m</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td></td>
<td>Cables. Arcos. Funicular Structures. Problems</td>
</tr>
<tr>
<td><strong>Second-order analysis</strong></td>
<td>9h 36m</td>
<td>Theory classes: 2h  Practical classes: 2h  Self study : 5h 36m</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td></td>
<td>Slender columns. Isolated concrete column. Isolated concrete column and steel Analysis of second order. Problems</td>
</tr>
<tr>
<td><strong>Plastic Analysis</strong></td>
<td>19h 12m</td>
<td>Theory classes: 4h  Practical classes: 2h  Laboratory classes: 2h  Self study : 11h 12m</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td></td>
<td>Introduction to plastic design. Calculation plastic sections. Elastoplastic behavior of a beam isostatic. General Survey of statically indeterminate systems. Resolution of beams and frames by Theorem maximum and minimum theorem combination of mechanisms. Plastic calculation. Problems</td>
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</tbody>
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### Plates

**Learning time:** 24h  
- Theory classes: 6h  
- Practical classes: 4h  
- Self study : 14h

**Description:**  
Plates. Problems

### Shells

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

**Description:**  
Sheets. Problems

### Dynamic Analysis

**Learning time:** 33h 36m  
- Theory classes: 8h  
- Practical classes: 2h  
- Laboratory classes: 4h  
- Self study : 19h 36m

**Description:**  
Dynamic Analysis. Problems  
Dynamic Analysis. Laboratory
Qualification system

The final grade is the weighted average of the obtained periodic evaluation exercises (A), in the practical exercises in the practical classes and laboratories and guided activities (AD) and the compulsory labor (T). If a grade equal to or greater than 5.0 in the periodic evaluation obtiene, the final grade for the course is obtained as: \( NF = 0.3 \times A + 0.3 \times AD + 0.6 \times T \).

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 extra 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

Failure to perform a laboratory or continuous assessment activity in the scheduled period will result in a mark of zero in that activity.

Bibliography

Basic:


Complementary: