250231 - ESTRUCT - Structures

Coordinating unit: 250 - ETSECCPB - Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering
Academic year: 2017
Degree: BACHELOR’S DEGREE IN PUBLIC WORKS ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
ECTS credits: 6

Teaching languages: Catalan, Spanish

Coordinator: LUIS MIGUEL CERVERA RUIZ
Others: LUIS MIGUEL CERVERA RUIZ, JOSE MANUEL GONZALEZ LOPEZ, ANTONIA LARESE DE TETTO

Opening hours

Timetable: Tuesday 12:00 am to 14:00 pm Module C1
Thursday 12:00 am to 14:00 pm Module C1
and hours to be agreed with professors.

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

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 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.

3113. Students will learn to identify user requirements, to draft definitions and specifications of the product, process or service in question, including a product design specification (PDS) document, and to follow industry-standard design management models. Students will be expected to show advanced knowledge of the steps involved in the design, execution and operation phases and to use the knowledge and tools covered in each subject area to the design and execution of their own projects. Finally, students will assess the impact of national, European and international legislation applicable to engineering projects.

Transversal:

585. ENTREPRENEURSHIP AND INNOVATION - Level 1. Showing enterprise, acquiring basic knowledge about organizations and becoming familiar with the tools and techniques for generating ideas and managing organizations that make it possible to solve known problems and create opportunities.

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 a week of classes during the 15 weeks of the semester. The approximate distribution of the 60 contact hours is:

15 hours of lectures devoted to the exposition of the concepts and basic materials for the course.
15 hours of practical sessions devoted to the presentation of examples and exercises and problems.
24 hours laboratory and directed activities devoted to practical exercises to consolidate the objectives of general and specific learning of the subject.
6 hours devoted to psychological testing.

Learning objectives of the subject

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
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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>
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<tbody>
<tr>
<td>Total learning time</td>
<td>150h</td>
<td></td>
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<tr>
<td>Hours large group:</td>
<td>15h</td>
<td>10.00%</td>
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<tr>
<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

## Fundamentals of Structural Analysis

<table>
<thead>
<tr>
<th>Learning time: 33h 36m</th>
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<tbody>
<tr>
<td>Theory classes: 2h</td>
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<tr>
<td>Practical classes: 2h</td>
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<tr>
<td>Laboratory classes: 10h</td>
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<tr>
<td>Self study : 19h 36m</td>
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**Description:**

Fundamentals of Structural Analysis. Problems
Fundamentals of Structural Analysis. Laboratory

## Stresses and Movements

<table>
<thead>
<tr>
<th>Learning time: 14h 23m</th>
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<tbody>
<tr>
<td>Theory classes: 2h</td>
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<tr>
<td>Practical classes: 2h</td>
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<tr>
<td>Laboratory classes: 2h</td>
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<tr>
<td>Self study : 8h 23m</td>
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</tbody>
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**Description:**
Efforts and movements. Laboratory

## Work and Energy

<table>
<thead>
<tr>
<th>Learning time: 33h 36m</th>
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<tbody>
<tr>
<td>Theory classes: 4h</td>
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<tr>
<td>Practical classes: 4h</td>
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<tr>
<td>Laboratory classes: 6h</td>
</tr>
<tr>
<td>Self study : 19h 36m</td>
</tr>
</tbody>
</table>

**Description:**

Work and Energy. Problems
Work and Energy
<table>
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<tr>
<th>Method</th>
<th>Learning time</th>
<th>Description</th>
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</table>
| **Compatibility Method** | 9h 36m         | Theory classes: 1h  
Practical classes: 1h  
Laboratory classes: 2h  
Self study: 5h 36m  

**Description:**  
Bases of the method. Continuous beams: equation of three moments, support settlements, elastic supports.  
Frames. Imposed movements and deformations.  
Compatibility method. Problems  
Compatibility method. Laboratory |
| **Equilibrium Method**  | 33h 36m        | Theory classes: 4h  
Practical classes: 4h  
Laboratory classes: 6h  
Self study: 19h 36m  

**Description:**  
Bases of the method. Continuous beams: equation of the three rotations, support settlements, elastic supports.  
Frames: intrasational and traslational frames  
Balance Method. Problems  
Balance Method. Laboratory |
| **Stiffness method**    | 19h 12m        | Theory classes: 2h  
Practical classes: 2h  
Laboratory classes: 4h  
Self study: 11h 12m  

**Description:**  
Types of bar structures.  
Stiffness method. Problems  
Stiffness method. Laboratory |
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: