Degree competences to which the subject contributes

Specific:

4060. Knowledge of the strength of materials and structures theory

Transversal:

588. SUSTAINABILITY AND SOCIAL COMMITMENT - Level 1. Analyzing the world’s situation critically and systemically, while taking an interdisciplinary approach to sustainability and adhering to the principles of sustainable human development. Recognizing the social and environmental implications of a particular professional activity.

592. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.

596. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.

599. EFFECTIVE USE OF INFORMATION RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.

602. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.

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

This course involves 31% of their time on theoretical lectures, which sets out the basic concepts to understand the subjects. Also, the 59% of the time is dedicated to model exercises and solving problems with students (this requires that students assimilate theoretical concepts). Also, dedicates 10% of the time to evaluation and control of knowledge.

In the ATENEA website, the material supports for the students are founded.
Students will acquire an understanding of structural behaviour, learn to interpret and verify the behaviour of specific structures, and learn how this discipline applies to technological problems.

Upon completion of the course, students will be able to: 1. Use analytical calculation to derive laws of stress and deformation for isostatic and hyperstatic structures; 2. Determine the stress distributions of the forces acting on a structure.

Fundamentals of resistance of materials and structures (deformable solids, stress, motion and boundary conditions, deformation and Hooke’s law); Elastic behaviour; Determination of stress and displacement due to external forces; Laws of stress and deformation; Sectional behaviour and stress derived from strain exerted on a section (axial, bending, shear and torsional). Energy theorems (virtual work, Castigliano, least work, Maxwell, etc.); Methods for solving standard forms (continuous beams, portal frames, arches, etc.)

### Study load

<table>
<thead>
<tr>
<th>Total learning time: 225h</th>
<th>Hours large group: 27h 30m</th>
<th>12.22%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group: 52h 30m</td>
<td>23.33%</td>
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<tr>
<td></td>
<td>Hours small group: 10h</td>
<td>4.44%</td>
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<tr>
<td></td>
<td>Guided activities: 9h</td>
<td>4.00%</td>
</tr>
<tr>
<td></td>
<td>Self study: 126h</td>
<td>56.00%</td>
</tr>
</tbody>
</table>
## 250328 - ESTRUCT - Structures

### Content

<table>
<thead>
<tr>
<th>Item 1. Introduction to the course</th>
<th>Learning time: 9h 36m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Practical classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Self study : 5h 36m</td>
</tr>
</tbody>
</table>

**Description:**
Basics structures. Cross section: Geometric Center, Mechanical Center and mass center. Static or 1st order Moment, 2nd order Moment or Moment of Inertia. Application to cross-sections made up of different materials, etc.
Solution of supplementary problems presented in theory.

**Specific objectives:**
Obtaining the knowledge and skills in solving the problems presented in this issue.

<table>
<thead>
<tr>
<th>Item 2. Basic elasticity.</th>
<th>Learning time: 9h 36m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Practical classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Self study : 5h 36m</td>
</tr>
</tbody>
</table>

**Description:**
Stress, strain, constitutive law and its particularization to beams.
Solution of supplementary problems presented in theory.

**Specific objectives:**
Obtaining the knowledge and skills in solving the problems presented in this issue.

<table>
<thead>
<tr>
<th>Item 3. Equilibrium of isostatic structures. Computation of bending, shear and axial diagrams</th>
<th>Learning time: 24h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 2h</td>
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<tr>
<td></td>
<td>Practical classes: 6h</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Self study : 14h</td>
</tr>
</tbody>
</table>

**Description:**
Diagram of internal forces: Axial, Bending, Shear and Torsion
Solution of supplementary problems presented in the theory.
### Item 4. Beam cross section: axial force and buckling of columns

**Learning time:** 19h 12m
- Theory classes: 3h
- Practical classes: 5h
- Self study: 11h 12m

**Description:**

**Specific objectives:**
Obtaining the knowledge and skills in solving the problems presented in this issue.

### Item 5. Beams cross section: Bending moment

**Learning time:** 24h
- Theory classes: 3h
- Practical classes: 5h
- Laboratory classes: 2h
- Self study: 14h

**Description:**

**Specific objectives:**
Obtaining the knowledge and skills in solving the problems presented in this issue.

### Item 6. Beams cross section: Shear force

**Learning time:** 19h 12m
- Theory classes: 3h
- Practical classes: 5h
- Self study: 11h 12m

**Description:**
Stress produced by shear force. Simple shear stresses in solid sections. Shear stresses into open and closed thin cross sections. Beams composed by different materials. Solution of supplementary problems presented in the theory.

**Specific objectives:**
Obtaining the knowledge and skills in solving the problems presented in this issue.
Item 7. Beams cross section: Torsion moment.

Description:

Specific objectives:
Obtaining the knowledge and skills in solving the problems presented in this issue.

Learning time: 14h 23m
Theory classes: 1h 30m
Practical classes: 2h 30m
Laboratory classes: 2h
Self study: 8h 23m

Item 8. Introduction to the structural analysis

Description:
Degrees of freedom and supports of the structures. Structural hypothesis (elastic, geometric, kinematics, equilibrium). Equilibrium of the differential slice of beams.

Specific objectives:
Obtaining the knowledge and skills in solving the problems presented in this issue.

Learning time: 4h 48m
Theory classes: 2h
Self study: 2h 48m

Item 9. Analysis of pin-jointed trusses

Description:

Specific objectives:
Obtaining the knowledge and skills in solving the problems presented in this issue.

Learning time: 14h 23m
Theory classes: 1h 30m
Practical classes: 4h 30m
Self study: 8h 23m
<table>
<thead>
<tr>
<th>Item</th>
<th>Analysis of simple bending beams I</th>
<th>Learning time: 14h 23m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Description:</td>
<td></td>
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<tr>
<td></td>
<td>Slope and deflection of the beams by direct integration method of Euler-Bernoulli differential equation. Simple case of the Navier-Bresse method. Solution of simple statically indeterminate structures by compatibility of displacement. Solution of supplementary problems presented in the theory.</td>
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<tr>
<td></td>
<td>Specific objectives:</td>
<td></td>
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<tr>
<td></td>
<td>Obtaining the knowledge and skills in solving the problems presented in this issue.</td>
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</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Analysis of simple bending beams II</th>
<th>Learning time: 19h 12m</th>
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<tbody>
<tr>
<td></td>
<td>Description:</td>
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<tr>
<td></td>
<td>Specific objectives:</td>
<td></td>
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<tr>
<td></td>
<td>Obtaining the knowledge and skills in solving the problems presented in this issue.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Analysis of continuum bending beams.</th>
<th>Learning time: 19h 12m</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Description:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Analysis of continuum beams by compatibility method (The Clapeyron's equation or three moment equation). Direct solution by equilibrium method. Matrix formulation of equilibrium method or stiffness matrix method, general form of equilibrium method. A simplified computer-based approach. Solution of supplementary problems presented in the theory.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Specific objectives:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Obtaining the knowledge and skills in solving the problems presented in this issue.</td>
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</tbody>
</table>
Assessment Procedure:
- The course follows the continuous assessment scheme, with 7 (seven) exams, which include 2 (two) personal home works to be submitted for its evaluation.
- The course is approved with an average mark equal or greater than 5 (five). Otherwise, the student does not pass the course and automatically switch to the final exam of the course.
- The student who has more than 2 (two) exams/work rejected with a mark less than 4 (four), not pass the course and automatically switch to the final exam of the course.

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
Exams are held in class schedules. The mark of a test that has not been done, be considered as zero score.
Bibliography

Basic:


Complementary:


