240063 - Strength of Materials

Coordinating unit: 240 - ETSEIB - Barcelona School of Industrial Engineering

Teaching unit: 737 - RMEE - Department of Strength of Materials and Structural Engineering

Academic year: 2017

Degree: BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)

BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)

ECTS credits: 6

Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: FRANCESC ROURE FERNANDEZ

Others: Mª Magdalena Pastor Artigues
Marc Mundet Bolós
Romà Suñé Lago
Josep Mª Pons Poblet
Jordi Fàbrega Freixas
Josué López Hermoso

Opening hours

Timetable: M.M. Pastor: Mon and Fri 10 - 13 h
F. Roure: Tue 12 - 14 h and 15 - 17 h, and Thu 15 - 17 h

Degree competences to which the subject contributes

Specific:
1. Knowledge and capacities to apply fundaments of materials' elasticity and resistance to the behaviour of real solids.

Teaching methodology

Lessons combining theory and problems: a subject is explained and then problems related to the subject are presented and solved. Every week several exercises are proposed to be solved by each student at home, and the solution is presented in the following week. The exercises are corrected in the classroom, revised by the professor and returned to each student.

Each student does 4 practices in the laboratory (of 2 h), and a team work (teams of 3 students), that consists of designing, analyzing, building and testing a structural element (a multisectiom, non stright beam).

Learning objectives of the subject

- To determine internal forces in prismatic beams, in the plane and in the space
- To verify prismatic beams in strength and in stiffness
- To decide the type of section and its dimensions for prismatic beams subjected to static loading
- To resolve elementery types of statically indeterminate pieces
- To verify the buckling behaviour of beams subjected to pure compression.
## Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 50h</th>
<th>33.33%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours medium group:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td>Hours small group:</td>
<td>10h</td>
<td>6.67%</td>
</tr>
<tr>
<td>Guided activities:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td>Self study:</td>
<td>90h</td>
<td>60.00%</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>Content</th>
<th>Learning time:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Prismatic beam</strong></td>
<td>25h</td>
</tr>
<tr>
<td>Description: The prismatic beam. Links and actions. Method of sections. Diagrams of internal forces.</td>
<td></td>
</tr>
<tr>
<td><strong>2. Axial and shear forces</strong></td>
<td>15h</td>
</tr>
<tr>
<td>Description: Axial force. Plane frame structures. Shear, Design of rivets, bolts and pins.</td>
<td></td>
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<tr>
<td><strong>3. Bending moment</strong></td>
<td>17h</td>
</tr>
<tr>
<td>Description: Pure bending: Navier hypothesis. Asymmetrical bending. Bending moment and axial force.</td>
<td></td>
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<tr>
<td><strong>4. Shear force</strong></td>
<td>19h</td>
</tr>
<tr>
<td><strong>5. Torsion</strong></td>
<td>15h</td>
</tr>
</tbody>
</table>
### 6. Deflections in beams

**Learning time:** 14h  
Theory classes: 6h  
Self study: 8h

**Description:**  

### 7. Statically indetermined beams

**Learning time:** 15h  
Theory classes: 6h  
Self study: 9h

**Description:**  
Straight beams of one and several spans. Systems with several beams.

### 8. Buckling of columns

**Learning time:** 5h  
Theory classes: 2h  
Self study: 3h

**Description:**  
Buckling of straight columns. Euler's formula. Design of columns subjected to buckling.

### Laboratory practices

**Learning time:** 10h  
Laboratory classes: 8h  
Self study: 2h

**Description:**  
Practice 1: STRAIN GAGES.  
Analysis, by means of strain gages, of beams subjected to uniaxial traction, biaxial traction and bending.  
Practice 2: FINITE ELEMENT METHOD.  
Analysis of beams by means of finite elements models.  
Practice 3: ASYMMETRICAL BENDING.  
Analysis of the bending behaviour of a section in non principal axes of inertia.  
Practice 4: TESTING OF A BEAM.  
Strength and stiffness experimental analysis of a beam build by the student.
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<table>
<thead>
<tr>
<th>Work</th>
<th>Learning time: 15h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Self study: 15h</td>
</tr>
</tbody>
</table>

**Description:**
The work is done by a team of 3 students. It consists in designing, calculating, building and testing (Practice 4 in the Laboratory) a beam.

**Qualification system**

Nota Final = 0.2 NT + 0.6 NE + 0.1 NL + 0.1 NTR

NT: Mark from the Test, obtained in the Test that is done in the middle of the semester
NE: Mark from the Final Exam, mark obtained as mean from all the parts of the exam
NL: Mark from the practices in the Laboratory:
  - 4 points for attending the 4 practices
  - 6 points for the evaluation of the reports realized during the practices in the laboratory
NTR: Mark for the Work, obtained by doing, presenting and defending the work

Reevaluation: The Mark of the Reevaluation Exam (NER) substitutes the Mark of the Final Exam (NE)

**Regulations for carrying out activities**

- In the Test and in the part of theory of the Final Exam and the Revaluation exam, no consult material can be used
- In the part of problems in the Final Exam only the official formular can be consulted (1 sheet DIN A4)
- In the Test, in the Final Exam and in the Reevaluation Exam only a non-programmable calculator can be used
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Bibliography

Basic:

Roure, Francesc; Frederic Marimon ; Xavier Ayneto. Resistencia de Materiales (Fascicles 1 a 8). Barcelona: Copistería Imatge, 2012.


Complementary:


Others resources:

Computer material

PRISMATIC 1.0 (http://www.upc.edu/demormee/index.htm)

Multimedia material to support self learning, accessible through Internet. Contents: resumed theory, solved problems and problems to de resolved.