# 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:
2019

## 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

### 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 multisection, 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></th>
<th>Hours large group:</th>
<th>Hours medium group:</th>
<th>Hours small group:</th>
<th>Guided activities:</th>
<th>Self study:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50h</td>
<td>0h</td>
<td>10h</td>
<td>0h</td>
<td>90h 02,4m</td>
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<td></td>
<td>33.32%</td>
<td>0.00%</td>
<td>6.66%</td>
<td>0.00%</td>
<td>60.01%</td>
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<table>
<thead>
<tr>
<th>Total learning time:</th>
<th>150h</th>
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Last update: 08-05-2019
| 02.4m |  |
### 1. Prismatic beam

**Learning time:** 25h  
Theory classes: 10h  
Self study: 15h

**Description:**  
The prismatic beam. Links and actions. Method of sections. Diagrams of internal forces.

### 2. Axial and shear forces

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

**Description:**  

### 3. Bending moment

**Learning time:** 17h  
Theory classes: 8h  
Self study: 9h

**Description:**  

### 4. Shear force

**Learning time:** 19h  
Theory classes: 8h  
Self study: 11h

**Description:**  

### 5. Torsion

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

**Description:**  
## 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.  
Strenght and stifness experimental analysis of a beam build by the student.
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<table>
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<tr>
<th>Work</th>
<th>Learning time: 15h</th>
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<tbody>
<tr>
<td></td>
<td>Self study : 15h</td>
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</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
Bibliography

Basic:

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

Ayneto, Xavier ; Marimon, Frederic ; Pastor, M.Magdalena ; Roure, Francesc. Enunciats de problemes amb solucions. 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 be resolved