Course guide
240063 - 240063 - Strength of Materials

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 737 - RMEE - Department of Strength of Materials and Structural Engineering.
Degree: BACHELOR’S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Compulsory subject).
Academic year: 2023  ECTS Credits: 6.0  Languages: Catalan, Spanish

LECTURER
Coordinating lecturer: MIQUEL CASAFONT RIBERA
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DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES
Specific:
1. Knowledge and capacities to apply fundamentals 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 strength and stiffness of prismatic beams
- To decide the type of section and its dimensions for prismatic beams subjected to static loading
- To analyse elementery types of statically indeterminate pieces
- To verify the buckling behaviour of beams subjected to pure compression.
STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self study</td>
<td>90.0</td>
<td>60.00</td>
</tr>
<tr>
<td>Guided activities</td>
<td>3.4</td>
<td>2.27</td>
</tr>
<tr>
<td>Hours large group</td>
<td>50.0</td>
<td>33.33</td>
</tr>
<tr>
<td>Hours small group</td>
<td>6.6</td>
<td>4.40</td>
</tr>
</tbody>
</table>

Total learning time: 150 h

CONTENTS

1. Prismatic beam

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

Full-or-part-time: 25h
Theory classes: 10h
Self study : 15h

2. Axial and shear forces

Description:

Full-or-part-time: 15h
Theory classes: 6h
Self study : 9h

3. Bending moment

Description:

Full-or-part-time: 17h
Theory classes: 8h
Self study : 9h

4. Shear force

Description:

Full-or-part-time: 19h
Theory classes: 8h
Self study : 11h
### 5. Torsion

**Description:**

**Full-or-part-time:** 15h
- Theory classes: 6h
- Self study: 9h

### 6. Deflections in beams

**Description:**

**Full-or-part-time:** 14h
- Theory classes: 6h
- Self study: 8h

### 7. Statically indetermined beams

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

**Full-or-part-time:** 15h
- Theory classes: 6h
- Self study: 9h

### 8. Buckling of columns

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

**Full-or-part-time:** 5h
- Theory classes: 2h
- Self study: 3h

### Laboratory practices

**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 built by the student.

**Full-or-part-time:** 10h
- Laboratory classes: 8h
- Self study: 2h
Work

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.

Full-or-part-time: 15h
Self study : 15h

GRADING SYSTEM

Nota Final = 0,2 NT + 0,6 NE + 0,2 NLT

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 practical sessions in the Lab and course project.

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

In the event of confinement during the first term of the 2020-2021 course, the method of assessment will be
- the formula for calculating the final mark is the same
- the only differences are those motivated by distance-learning:
  + Theory-Problem lectures will be online, each group with its professor, within the scheduled time
  + The lab programme will be adapted to distance learning.
  + The assignment will be adapted to replace the experimental part by a numerical simulation part.
  + The Midterm and Final Exams will be online.

EXAMINATION RULES.

- In the Midterm Test and in the part of theory of the Final Exam and the Revaluation exam, nomaterial can be used.
- In the part of problems in the Final Exam only the official formular can be used (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: Copisteria Imatge, 2012.

Complementary:
RESOURCES

Computer material:
- PRISMATIC 1.0 ([http://www.upc.edu/demormee/index.html](http://www.upc.edu/demormee/index.html)). Multimedia material to support self learning, accessible through Internet. Contents: resumed theory, solved problems and problems to be resolved.