

## Course guide

### 240635 - 240635 - Extension in Strength of Materials

**Last modified:** 13/03/2025

**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). (Optional subject).  
**Academic year:** 2025    **ECTS Credits:** 4.5    **Languages:** Catalan, Spanish

#### LECTURER

**Coordinating lecturer:** Francesc Roure Fernández

**Others:**

#### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

##### Specific:

3. Knowledge and capacities to apply fundamentals of materials' elasticity and resistance to the behaviour of real solids.
2. Knowledge and capacities to calculate, design and test machines.
1. Knowledge and capacity to calculate and design industrial structures and buildings.

#### TEACHING METHODOLOGY

Theory and problems are combined in the classes: after presenting and developing a theme, problems related to it are presented and resolved.

Each student will have to realize 3 practical sessions in the laboratory (2 h each session).

Each student will have to do a work, with a team, that will be written and orally presented

#### LEARNING OBJECTIVES OF THE SUBJECT

Extending the knowledge in Strength of Materials to new type of parts and new material behaviours. After finishing the course the student has to be able to:

- Apply the general theory of bending to special sections, parts and cases.
- Use the Linear Elasticity Theory in polar and cylindrical coordinates to analyze axisymmetric components.
- Verify, calculate and optimize parts and components subjected to fatigue.
- Analyse and verify components made with composites (fibre reinforced resins).
- Establish the plastic behaviour of beams and bars.

#### STUDY LOAD

Type	Hours	Percentage
Hours medium group	45,0	40.00
Self study	67,5	60.00

**Total learning time:** 112.5 h

## CONTENTS

---

### 1.- Bending: Special cases

**Description:**

Sections made of different materials. Reinforced concrete sections. Pieces with small radius of curvature.

**Full-or-part-time:** 12h

Theory classes: 6h

Self study : 6h

### 2.- Axisymmetric components

**Description:**

Linear Elasticity in polar and cylindrical coordinates. Analysis of discs. Analysis of pipes. Analysis of tanks subjected to internal pressure.

**Full-or-part-time:** 18h

Theory classes: 9h

Self study : 9h

### 3.- Fatigue

**Description:**

Fatigue failure process. Analysis of parts subjected to fatigue. S - N curves. The Influence of different factors. E - N curves. Linear fracture mechanics.

**Full-or-part-time:** 18h

Theory classes: 9h

Self study : 9h

### 4.- Anisotropic materials: Composites

**Description:**

Anisotropic Elasticity. Symmetry in one and three planes. Composites. Changing the reference axis. Stiffness matrix. Flexibility matrix. Failure criteria. Sandwich pannels.

**Full-or-part-time:** 18h

Theory classes: 9h

Self study : 9h

### 5.- Plasticity

**Description:**

Elasto - plastic behaviour of materials. Plasticity models. Elasto - plastic bending. Elasto - plastic torsion.

**Full-or-part-time:** 12h

Theory classes: 6h

Self study : 6h



#### - Laboratory

**Description:**

There will be 3 sessions in the Laboratory (2 h each):

- Analysis and measurement of stresses and displacements in a sandwich panel subjected to bending.
- Analysis and measurement of stresses in a tank subjected to internal pressure.
- Plastic bending of a metallic beam.

**Full-or-part-time:** 8h

Laboratory classes: 6h

Self study : 2h

## GRADING SYSTEM

Final Mark = 0,6 NE + 0,1 NL + 0,3 NTR

NE: Final Exam Mark

NL: Laboratory Mark ( 3 points attendance, 7 points written reports)

NTR: Work Mark

## EXAMINATION RULES.

Will be published before each test

## BIBLIOGRAPHY

**Basic:**

- Ugural, A.C. ; Fenster, S.K. Advanced mechanics of materials and applied elasticity [on line]. 6th ed. Boston: Pearson, 2020 [ Consultation : 16/06/2025]. Available on : <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=7117351>. ISBN 0134859359.
- Roure Fernández, Francesc. Fatiga. Barcelona: CPDA - ETSEIB, 1990. ISBN 8440484941.
- Tsai, S.W. ; Miravete A. Diseño y análisis de materiales compuestos. Barcelona: Editorial Reverté, 1988. ISBN 8429148892.
- Roure Fernández, Francesc. Plasticidad : Teoría. Barcelona: CPDA - ETSEIB, 1991.