# 820423 - ELAS - Elasticity

**Coordinating unit:** 295 - EEBE - Barcelona East School of Engineering  
**Teaching unit:** 737 - RMEE - Department of Strength of Materials and Structural Engineering  
**Academic year:** 2018  
**Degree:** BACHELOR’S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)  
**ECTS credits:** 6  
**Teaching languages:** Catalan, Spanish  
**Coordinator:** DANIEL DI CAPUA  
**Others:** Di Capua, Daniel  
Carbonell Puigbo, Josep Maria  
Conesa Busto, Gabriel

### Opening hours

**Timetable:** Office hours to be arranged with the lecturers of the course.

### Degree competences to which the subject contributes

**Specific:**  
5. Understand and apply the fundamentals of the elasticity and strength of materials to the behaviour of real solids.

**Transversal:**  
3. 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.

### Teaching methodology

The course consists of 3 hours per week of classroom sessions that will be held in two sessions of 1 and 2 hours respectively. In these sessions theoretical classes and problems will be combined. Additionally, laboratory practices will be held 2 hours every two weeks.

### Learning objectives of the subject

The study of the mechanics of continuous media precedes and establishes the principles and fundamental laws used after the resistance of materials. Consequently, the course aims to establish the scientific techniques required for the study of the strength characteristics of materials and for an understanding of the mechanisms of durable and solid mechanical kinematic response bases. It is intended that students acquire a knowledge of the stress state and strains that are created in solids when subjected to a given solicitation. An important academic aspect is that the student, at the end of the course, must distinguish the domains of elastic and plastic response of materials under different loading conditions, and be able to apply the corresponding quantitative theories to each domain to describe the response of solid mechanics analyzed.

Since the elastic and linear response is critical in engineering practice, an important part of the subject moves in the field of linear elasticity, reasoning on a theoretical model of elastic solid: mechanical prism, which we assume has the properties homogeneity, continuity and isotropy.
General objectives of this subject in relation to students be considered:

1. Introduction to the basic concepts of continuum mechanics, with special emphasis on the mechanics of solids.
2. Acquisition of basic vocabulary while specific area of continuum mechanics.
3. Ability to read, interpret correctly and understand texts, figures and tables in technical literature related to the mechanics of solids.
4. Ability for effective and accurate oral or written expression, on matters within the scope of continuum mechanics.
5. Understanding the equations that describe and relate the states of stress and strain in the elastic and plastic domain response of solid mechanics.
6. To acquire knowledge and computing capacity in both domains: domain linear elastic and plastic range.
7. Ability to describe and use different rheological models.
8. Ability to associate the main criteria ruling resistant, prescribed in different technical codes, different types of materials and stress states.
9. Ability to handle basic finite element software.
10. Develop skills in experimental techniques and analysis of results.
11. To acquire knowledge of the basic literature and ability to perform literature searches related to the field of solid mechanics.
12. Knowledge of information sources, institutional and private, related to solid mechanics, strength of materials and structural analysis.
13. Ability for independent learning on matters within the field of solid mechanics, strength of materials and structures in Engineering.

<table>
<thead>
<tr>
<th>Study load</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>Total learning time</td>
<td>150h</td>
<td>45h</td>
<td>10.00%</td>
<td>15h</td>
<td>90h</td>
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<td>0.00%</td>
<td>0h</td>
<td>60.00%</td>
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Last update: 15-06-2018
## Content

**Topic 1: Introduction to Elasticity and Strength of Materials**

**Learning time:** 31h  
Theory classes: 9h  
Practical classes: 0h  
Laboratory classes: 4h  
Self study: 18h

**Description:**  

**Specific objectives:**  
Know and be able to describe the differences and similarities between the theory of elasticity and strength of materials. Know and be able to explain the concept of continuous medium and its potential in solving problems in solid mechanics. Know and be able to apply the notation and basic properties of tensor algebra.

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**Topic 2: Cinemàtica**

**Learning time:** 26h  
Theory classes: 8h  
Practical classes: 0h  
Laboratory classes: 2h  
Self study: 16h

**Description:**  

**Specific objectives:**  
Be able to explain the concepts and derive the equations of motion in solid mechanics. Know and be able to describe the concept of deformation. Knowing the different possibilities of measures deformations, their physical interpretations and properties.
## Topic 3: Stresses

<table>
<thead>
<tr>
<th>Learning time:</th>
<th>23h</th>
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<tbody>
<tr>
<td>Theory classes:</td>
<td>7h</td>
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<tr>
<td>Practical classes:</td>
<td>0h</td>
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<tr>
<td>Laboratory classes:</td>
<td>2h</td>
</tr>
<tr>
<td>Guided activities:</td>
<td>0h</td>
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<tr>
<td>Self study :</td>
<td>14h</td>
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### Description:

### Specific objectives:
Know and be able to describe the concept of stress. Knowing the different stress measurements, their physical interpretations and properties. Recognize the interpretation advantages offered by the geometric description of the stress state through the Mohr Circle. Be able to express the stress state using the plane representation of Mohr Circle. Being able to calculate representative values of the stress state from its graphical representation.

## Topic 4: Conservation and balance equations

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<th>Learning time:</th>
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<tbody>
<tr>
<td>Theory classes:</td>
<td>7h</td>
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<td>Practical classes:</td>
<td>0h</td>
</tr>
<tr>
<td>Laboratory classes:</td>
<td>2h</td>
</tr>
<tr>
<td>Self study :</td>
<td>14h</td>
</tr>
</tbody>
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### Description:

### Specific objectives:
Learn the foundational principles of solid mechanics.
### Topic 5: Constitutive equations

**Learning time:** 20h  
Theory classes: 6h  
Practical classes: 0h  
Laboratory classes: 2h  
Self study: 12h

**Description:**  

**Specific objectives:**  
Ability to deduce the fundamental relationship between the state of tension and the state of deformation in the linear elasticity theory. Analyze and know how to apply several simplifications of the linear elasticity theory: isotropic materials, plane stress and plane strain states. Being able to set the elastic problem. Demonstrate the need of a plasticity theory. Ability to derive the fundamental equations that relate the state of stress and strain state in the theory of plasticity. Know different rheological models. Ability to associate the main failure criteria, prescribed in different technical codes, to different materials types and stress states.

### Topic 6: Energy and variational principles

**Learning time:** 27h  
Theory classes: 8h  
Practical classes: 0h  
Laboratory classes: 3h  
Guided activities: 0h  
Self study: 16h

**Description:**  

**Specific objectives:**  
Knowing the different expressions of the internal potential. Ability to set the differential equations of government of the mechanical problem in a comprehensive way, so that these equations are presented in a useful format for their numerical resolution by the finite element method.
Bibliography

Basic:


Complementary:


Others resources:

Hyperlink

http://www.gidhome.com/

Resource