Course guide
295758 - 295EM113 - Mechanical Behavior of Materials and Their Simulation

Unit in charge: Barcelona East School of Engineering
Teaching unit: 702 - CEM - Department of Materials Science and Engineering.
Degree: MASTER’S DEGREE IN MATERIALS SCIENCE AND ADVANCED MATERIALS ENGINEERING (Syllabus 2019).
(Optional subject).
Academic year: 2022  ECTS Credits: 6.0  Languages: Spanish, English

LECTURER
Coordinating lecturer: FERHUN CEM CANER BASKURT
Others: NOEL LEÓN ARBITER
FERHUN CEM CANER BASKURT
LUIS LLANES PITARCH

PRIOR SKILLS
Degree in science or engineering. Basic knowledge of the relationship between the microstructure of materials and their mechanical behavior. Basic knowledge of mechanical behavior and strength of materials.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES
Specific:
CEMCEAM-02. (ENG) Aplicar métodos innovadores para el diseño, simulación, optimización y control de procesos de producción y transformación de materiales
CEMCEAM-04. (ENG) Realizar estudios de caracterización y evaluación de materiales según sus aplicaciones

TEACHING METHODOLOGY
Theoretical and problem classes are taught during the course, along with simulation activities by Abaqus or Matlab or other similar software as well as laboratory activities. Several evaluations are performed, in the form of in-class and take-home exams/projects.

LEARNING OBJECTIVES OF THE SUBJECT
The objective of this course is to combine theoretical and practical knowledge of the mechanical behavior of engineering materials. The course gives special emphasis to elasticity in 3D and plasticity in 3D at the macro scale and the micro and nano scales as well. At the macro scale, the tensor analysis gains importance and therefore an introduction to tensors will be taught as easily as possible. Tensor knowledge will also facilitate the learning of mechanical behavior on the micro scale. The practical applications will be carried out using simulations by Abaqus, Matlab and other software considered appropriate. Unlike tests in a physical laboratory, using different simulation techniques a virtual laboratory will be created where one can experience and visualize a much wider range of material behavior at different scales.
STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self study</td>
<td>102,0</td>
<td>68.00</td>
</tr>
<tr>
<td>Hours small group</td>
<td>14,0</td>
<td>9.33</td>
</tr>
<tr>
<td>Hours medium group</td>
<td>28,0</td>
<td>18.67</td>
</tr>
<tr>
<td>Guided activities</td>
<td>6,0</td>
<td>4.00</td>
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</tbody>
</table>

Total learning time: 150 h

CONTENTS

Tema 1. Configuration of most used mechanical tests and parameters

Description:
Definition of stress and strain. Mechanical response of structural materials: basic concepts of elasticity and plasticity. Types of curves that relate loads to mechanical response of the material: engineering, true and intrinsic. Characteristics that define them. Most used test configurations, mechanical parameters obtained and their physical meaning, practical particularities of each configuration: Tension, bending (at 3 and 4 points), uniaxial compression. Most used constitutive equations.

Full-or-part-time: 9h 20m
Theory classes: 3h
Self study: 6h 20m

Tema 2. Viscoleasticity of materials

Description:

Full-or-part-time: 18h 40m
Theory classes: 6h
Self study: 12h 40m

Tema 3. Introduction to tensors

Description:

Full-or-part-time: 24h
Theory classes: 7h
Self study: 17h
### Tema 4. Elastic behavior and its simulation

**Description:**

**Full-or-part-time:** 24h  
Theory classes: 7h  
Self study: 17h

### Tema 5. Continuum scale plastic behavior and its simulation

**Description:**

**Full-or-part-time:** 25h  
Theory classes: 7h  
Self study: 18h

### Tema 6. Strength and deformation of materials

**Description:**

**Full-or-part-time:** 49h  
Theory classes: 16h  
Self study: 33h

### GRADING SYSTEM

The part of Prof. N. León: Mid-term Exam 1: 19%  
The part of Prof. F. Caner: Mid-term Exam 2: 24%, Project 1: 24%  
The part of Prof. L. Llanes: Mid-term exams: 33%

The final exam is obligatory if the weighted average grade from continuing education is less than 5.0. If the final exam is taken, the grade from the final exam becomes the final grade of the course. There is no make-up exam in this course.
BIBLIOGRAPHY

Basic: