Course guides
250703 - 250703 - Composite Materials Structures

Unit in charge: Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering.
Degree: MASTER'S DEGREE IN GEOTECHNICAL ENGINEERING (Syllabus 2015). (Optional subject).
MASTER'S DEGREE IN STRUCTURAL AND CONSTRUCTION ENGINEERING (Syllabus 2015). (Optional subject).
Academic year: 2020
ECTS Credits: 5.0
Languages: Spanish

LECTURER

Coordinating lecturer: LUCIA-GRATIELA BARBU
Others: LUCIA-GRATIELA BARBU, JAVIER MARTINEZ GARCIA

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
13364. To conceive and design civil and building structures that are safe, durable, functional and integrated into its surroundings.
13365. Designing and building using traditional materials (reinforced concrete, prestressed concrete, structural steel, masonry, wood) and new materials (composites, stainless steel, aluminum, shape memory alloys?).
13368. Mathematically modelling structural engineering problems.
13369. To apply methods and advanced design software and structural calculations, based on knowledge and understanding of forces and their application to the structural types of civil engineering.

Generical:
13360. To conceive, design, analyze and manage structures or structural elements of civil engineering or building, encouraging innovation and the advance of knowledge.
13361. To develop, improve and use conventional materials and new construction techniques to ensure the safety requirements, functionality, durability and sustainability.

TEACHING METHODOLOGY

This course takes place in 14 classes of three hours each. Each class will have about 1:30 hours devoted to theoretical dictates of the same i 0:30 discussions and consultations. Also, 13 hours were devoted to the development of work / problems implementing some topics of the course, and 8 hours of work evaluation.

Support material is used in the form of detailed teaching plan using the virtual campus ATENEA: content, programming and evaluation activities directed learning and literature.
LEARNING OBJECTIVES OF THE SUBJECT

Subject to know the behavior and calculation of structures made of composite materials

Capability to design and calculate structures made of composite materials. Ability to interpret results from finite element programs appropriate for non-linear analysis of composite structures


The aim of this course is to get students to acquire extensive information about the behavior and calculation of structures built in composite materials. It is also expected that these studies will allow interpreting results from appropriate programs for non-linear analysis of composite structures finite elements. The study of this subject is discussed under the assumption that the structures can achieve cinematic nonlinear constitutive behavior and/or. To numerically analyze the behavior of structures, two basic theories will be studied: 1) blends theory and its various evolutions and 2) the theory of homogenization and its various forms. Some nonlinear constitutive models will also be remembered for representing the behavior of each basic substance.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours medium group</td>
<td>9,8</td>
<td>7.83</td>
</tr>
<tr>
<td>Guided activities</td>
<td>6,0</td>
<td>4.80</td>
</tr>
<tr>
<td>Hours small group</td>
<td>9,8</td>
<td>7.83</td>
</tr>
<tr>
<td>Self study</td>
<td>80,0</td>
<td>63.95</td>
</tr>
<tr>
<td>Hours large group</td>
<td>19,5</td>
<td>15.59</td>
</tr>
</tbody>
</table>

Total learning time: 125.1 h

CONTENTS

Introduction, definition and use of some composite materials

Description:

Full-or-part-time: 4h 48m
Theory classes: 2h
Self study: 2h 48m
**Anisotropy of the material**

**Description:**

**Full-or-part-time:** 12h  
Theory classes: 2h 30m  
Practical classes: 1h 30m  
Laboratory classes: 1h  
Self study: 7h

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**Mixing Theory**

**Description:**

**Full-or-part-time:** 12h  
Theory classes: 2h 30m  
Practical classes: 1h 30m  
Laboratory classes: 1h  
Self study: 7h

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**Fiber-matrix debounding**

**Description:**
Stress distribution along the reinforcing fiber. Interaction between cracks and fibers. Constitutive models for composite materials with "DFM". Implementation. Lagrangian formulation "Total" and "Update". Implementation of mixing theory and anisotropy in the context of "MEF". Phenomenon "DFM" micropattern blends theory and anisotropy.  
Fiber-matrix debounding (DFM) (Class 1.5)

**Full-or-part-time:** 9h 36m  
Theory classes: 2h 30m  
Practical classes: 1h 30m  
Self study: 5h 36m
### Delamination of laminated composites

**Description:**
Identification of the phenomenon. Defining the formulation. Coupling with the formulation of the theory of mixtures in small and large deformations.

Delamination in laminated composites (Class 1.5)

**Full-or-part-time:** 9h 36m  
Theory classes: 2h 30m  
Practical classes: 1h 30m  
Self study: 5h 36m

### Homogenization Theory

**Description:**

Theory homogenisation (Class 2.0)

**Full-or-part-time:** 13h 12m  
Theory classes: 3h 30m  
Practical classes: 2h  
Self study: 7h 42m

### Inelastic buckling reinforced composites

**Description:**

Inelastic buckling in reinforced composites (class 1.5)

**Full-or-part-time:** 9h 36m  
Theory classes: 2h 30m  
Practical classes: 1h 30m  
Self study: 5h 36m

### Fuselage and wing structures of aircraft composite materials

**Description:**
Introduction. Different structural designs in composite materials and structural evaluation of the same: simplified solution, finite element solution  
Fuselage and wing structures of aircraft composite materials (Class 1.5)

**Full-or-part-time:** 9h 36m  
Theory classes: 2h 30m  
Practical classes: 1h 30m  
Self study: 5h 36m
Strengthening and repair of structures with composite materials

Description:
Introduction. Possible solutions for structural reinforcement of beams and concrete frames. Repair and effectiveness of possible solutions. Calculation and evaluation of reinforcements and repairs. Repair and reinforcement of structures with composite materials (Class 2.0)

Full-or-part-time: 13h 12m
- Theory classes: 4h
- Practical classes: 1h 30m
- Self study : 7h 42m

GRADING SYSTEM

The course grade is obtained from continuous assessment grades and measurable practical work on each of the topics.

The rating of the asignatura results from the average of the marks of the papers presented.

Work will be done using tools like MathCad and/or Matlab and/or using Finite Element programs that provide students...

EXAMINATION RULES.

If any or practical work continuous assessment in the scheduled period is performed it shall be considered as zero score.

BIBLIOGRAPHY

Basic:

Complementary: