820077 - CENG - Computational Engineering

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering
Teaching unit: 749 - MAT - Department of Mathematics
Academic year: 2019
Degree:
- BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
- BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
- BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
- BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
- BACHELOR'S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Teaching unit Optional)
- BACHELOR'S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Teaching unit Optional)
- BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
- BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
- BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
- BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
- BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
- BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
- BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Teaching unit Optional)
- BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
- BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
ECTS credits: 6
Teaching languages: English

Teaching staff
Coordinator: Núria Parés, Yolanda Vidal
Others: Dept. de Matemàtiques - Secció Besòs

Prior skills
It is advisable that students have passed the courses Calculus, Algebra and Multivariable Calculus, and Numerical Calculus - Differential Equations before taking this course.

Degree competences to which the subject contributes

Transversal:
1. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.

Teaching methodology
The course is based on lectures given by the instructors (40%) and individual and group work (60%)
All the lecture notes and tutorial of the laboratory sessions are available in the website http://compeng.gimel.es
The availability of all the teaching materials that will be used in class allow students to keep track of the course in case of not being able to attend 100% of the lectures

Learning objectives of the subject
The goal of this elective course is to introduce students to numerical calculus, providing them with a broad knowledge of numerical techniques that will be very useful throughout the degree and later development of their profession. In particular the course will qualify students to numerically solve partial differential equations with particular interest in the Finite Element Method.
The aim of the lectures is to present the subjects without a deep theoretical formalisms in order to be able to provide a simple and practical training. Lectures are held in computer rooms, where theoretical explanations of the different numerical methods are combined with the implementation of the methods using MATLAB. Because of this, the first lectures of the course are devoted to provide a fast and easy introduction to the software MATLAB.

<table>
<thead>
<tr>
<th>Study load</th>
<th>Hours large group: 45h</th>
<th>30.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group: 0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Hours small group: 15h</td>
<td>10.00%</td>
</tr>
<tr>
<td></td>
<td>Guided activities: 0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Self study: 90h</td>
<td>60.00%</td>
</tr>
</tbody>
</table>
## Content

<table>
<thead>
<tr>
<th>Module 1: Introduction to Matlab</th>
<th>Learning time: 10h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 4h</td>
</tr>
<tr>
<td></td>
<td>Self study : 6h</td>
</tr>
</tbody>
</table>

**Description:**
Introduction to the Matlab software. Overview of the basic features, basic operations, definition of variables, vectors and matrices; files *.m; debugger; control statements. Basics on programming.

<table>
<thead>
<tr>
<th>Module 2: Introduction to numerical methods</th>
<th>Learning time: 10h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 4h</td>
</tr>
<tr>
<td></td>
<td>Self study : 6h</td>
</tr>
</tbody>
</table>

**Description:**
Brief introduction to the subject. Applications of numerical methods in engineering.

<table>
<thead>
<tr>
<th>Module 3: Numerical linear algebra - basic tools</th>
<th>Learning time: 30h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 12h</td>
</tr>
<tr>
<td></td>
<td>Self study : 18h</td>
</tr>
</tbody>
</table>

**Description:**

<table>
<thead>
<tr>
<th>Module 4: Numerical calculus - review of basic tools</th>
<th>Learning time: 30h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 12h</td>
</tr>
<tr>
<td></td>
<td>Self study : 18h</td>
</tr>
</tbody>
</table>

**Description:**

<table>
<thead>
<tr>
<th>Module 5: Introduction to partial differential equations (PDEs)</th>
<th>Learning time: 30h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 12h</td>
</tr>
<tr>
<td></td>
<td>Self study : 18h</td>
</tr>
</tbody>
</table>

**Description:**
Module 6: Numerical solution of PDEs - Introduction to the Finite Element Method

Learning time: 40h
  Theory classes: 16h
  Self study: 24h

Description:
Introduction to the basic concepts. Formulation of the finite element method. Structure of finite element codes. Pre and post-process. Applications to engineering.

Qualification system

Exams: 40%
Assignments: 35%
Validation of the assignments: 20%
Generic Skills: 5%

Bibliography

Basic:

Complementary:

Others resources:
The lecture notes associated to both the theory and laboratory sessions is available in the website http://compeng.gimel.es
This website contains all the tutorials and lecture notes that students need to reach all the concepts introduced in the course

Hyperlink
Lecture notes and course tutorials (Apunts i tutorials de l'assignatura)
http://compeng.gimel.es