**250955 - PROCIENENG - Programming for Engineers and Scientists**

**Coordinating unit:** 250 - ETSECCPB - Barcelona School of Civil Engineering  
**Teaching unit:** 751 - DECA - Department of Civil and Environmental Engineering  
**Academic year:** 2015  
**Degree:** MASTER'S DEGREE IN NUMERICAL METHODS IN ENGINEERING (Syllabus 2012). (Teaching unit Optional)  
ERASMUS MUNDUS MASTER'S DEGREE IN COMPUTATIONAL MECHANICS (Syllabus 2013).  
(Teaching unit Optional)  
**ECTS credits:** 5  
**Teaching languages:** English

### Teaching staff

**Coordinator:** SERGIO ZLOTNIK MARTINEZ  
**Others:** SERGIO ZLOTNIK MARTINEZ

### Degree competences to which the subject contributes

**Specific:**

8379. Knowledge of the state of the art in numerical algorithms. Ability to catch up on the latest technologies for solving numerical problems in engineering and applied sciences.
8381. Knowledge of validation and verification criteria. Management capacity for quality control techniques of numerical simulation (Validation and Verification).
8383. Interpretation of numerical models. Understanding the applicability and limitations of the various computational techniques.
8384. Experience in programming calculation methods. Ability to acquire training in the development and use of existing computational programs as well as pre and post-processors, knowledge of programming languages and of standard calculation libraries.

### Teaching methodology

The course consists of 1,2 hours per week of classroom activity (large size group) and 1,2 hours weekly with half the students (medium size group).

The 1,2 hours in the large size groups are devoted to theoretical lectures, in which the teacher presents the basic concepts and topics of the subject, shows examples and solves exercises.

The 1,2 hours in the medium size groups is devoted to solving practical problems with greater interaction with the students. The objective of these practical exercises is to consolidate the general and specific learning objectives.

The rest of weekly hours devoted to laboratory practice.

Support material in the form of a detailed teaching plan is provided using the virtual campus ATENEA: content, program of learning and assessment activities conducted and literature.

### Learning objectives of the subject

The purpose of this module is to introduce the basics of scientific programming. This fundamental knowledge of programming is acquired through the use of MATLAB. However, the basic concepts can extend to any another high-level programming language. At the end of the module the students will have acquired basics skills of high-level programming language, they will also have learnt to write computer programs that allow them implement the necessary algorithms to
solve problems in their own area of science or engineering.

* The students will be able to understand and assimilate the basic tools of programming and coding algorithms. * The students will be able to generate a program for finite elements in MATLAB, to learn the fundamental aspects of error estimation and adaptability, their classification and contemporary methods; to use these adaptive techniques to find optimum meshes. * To understand cyclic processes such as processes of trial and error where numerical simulation plays an important part in the replacement of experiments, guaranteeing the use of suitable tools that certify the quality of the simulations and the veracity of their results, understanding that computational mechanics provides results as approximate as the user wishes and to be able to assimilate the costs that they represents. * It will emphasize the need for students to acquire independence in their studies; that they learn to use a computer for basic programming and learn to use and make the most of their study hours.

* Introduction to MATLAB: its components and its range.
* Numbers, variables, operators and functions.
* Arrays and matrices
* Plotting of curves and surfaces.
* Cycles and decisions.
* Simple I/O resources
* Advanced MATLAB subjects.

Learning resources:
- Nakamura S. Numerical analysis and graphic visualization with MATLAB, Prentice Hall, 1996

<table>
<thead>
<tr>
<th>Study load</th>
<th>Theory classes:</th>
<th>Practical classes:</th>
<th>Laboratory classes:</th>
<th>Guided activities:</th>
<th>Self study:</th>
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<tbody>
<tr>
<td>Total learning time</td>
<td>125h</td>
<td>15h</td>
<td>15h</td>
<td>7h 30m</td>
<td>80h</td>
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Content

<table>
<thead>
<tr>
<th>Learning time: 90h</th>
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<tbody>
<tr>
<td>Theory classes: 15h</td>
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<tr>
<td>Practical classes: 15h</td>
</tr>
<tr>
<td>Laboratory classes: 7h 30m</td>
</tr>
<tr>
<td>Self study : 52h 30m</td>
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Description:

Specific objectives:

Qualification system

The mark of the course is obtained from the ratings of continuous assessment and their corresponding laboratories and/or classroom computers.

Continuous assessment consist in several activities, both individually and in group, of additive and training characteristics, carried out during the year (both in and out of the classroom).

The teachings of the laboratory grade is the average in such activities.

The evaluation tests consist of a part with questions about concepts associated with the learning objectives of the course with regard to knowledge or understanding, and a part with a set of application exercises.

Regulations for carrying out activities

Failure to perform a laboratory or continuous assessment activity in the scheduled period will result in a mark of zero in that activity.

Bibliography