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: 2019
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: MARCO DE CORATO, SERGIO ZLOTNIK MARTINEZ

Opening hours
Timetable: Outside the classes students can ask for time for questions on the topics of the course an on the homeworks. To arrange a meeting send an email to the corresponding professor.

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.
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
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* Advanced MATLAB subjects.

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

### Study load

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Hours large group: 15h</th>
<th>12.00%</th>
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<tbody>
<tr>
<td></td>
<td>Hours medium group:</td>
<td>15h</td>
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<tr>
<td></td>
<td>Hours small group:</td>
<td>7h 30m</td>
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<td></td>
<td>Guided activities:</td>
<td>7h 30m</td>
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<tr>
<td></td>
<td>Self study:</td>
<td>80h</td>
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</tbody>
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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:**
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**Specific objectives:**
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The final mark of the course is based on several homeworks, done in groups and on the ratings of continuous assessment during the classes and laboratories.

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

Homeworks are done in groups and consist of one or several reports and some code. Reports should cover all the aspects required, including design of the programme, justification of the design decision taken, changes in the design at the different development stages, testing applied, examples run, results, problems known, etc.

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.

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

**Bibliography**

**Basic:**


**Complementary:**