Course guide
250955 - PROCIENENG - Programming for Engineers and Scientists

Last modified: 28/03/2024

Unit in charge:	Barcelona School of Civil Engineering
Teaching unit:	751 - DECA - Department of Civil and Environmental Engineering.

Degree:	MASTER'S DEGREE IN NUMERICAL METHODS IN ENGINEERING (Syllabus 2012). (Optional subject). ERASMUS MUNDUS MASTER'S DEGREE IN COMPUTATIONAL MECHANICS (Syllabus 2013). (Optional subject).

Academic year: 2023   **ECTS Credits:** 5.0   **Languages:** English

LECTURER

Coordinating lecturer:	SERGIO ZLOTNIK MARTINEZ
Others:	ALBERTO GARCIA GONZALEZ, 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 3 hours per week of classroom activity. Each class is usually divided in a theory part of approximately one hour and two hours of practice on the same topic.

All classes are at the computer laboratory.

The course is part of two Mater programes in Numerical Methods. Therefore, most examples are based in numerical methods and particularly in Finite Element method. Students must have some previous background in Finite Element to maximize their profit in following the course.

In the theory part the teacher presents the basic concepts and topics of the subject, shows examples and present some exercises that should be solved in the following two practice hours.

The practical part is usually done in groups. It is devoted to solving problems with greater interaction with the students. The objective of these practical exercises is to experiment and consolidate the general and specific learning objectives. During the practical part the student work is mixed with some interventions of the teacher to give some guidance or to settle down some particular concept.

Theory, practice and laboratory are mixed. The differents topics covered in this course are kept together in units of one class.

The closure of each topic is done by homeworks, further readings at home and general discussions at the end of the class.

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.

Although most of the sessions will be given in the language indicated, sessions supported by other occasional guest experts may be held in other languages.

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:
o Recktenwald, G. W., Numerical Methods with MATLAB: implementations
and applications, Prentice Hall, 2000.
o Nakamura S. Numerical analysis and graphic visualization with MATLAB,
Prentice Hall, 1996

STUDY LOAD

Type	Hours	Percentage
Hours medium group	9,8	7.83
Hours small group	9,8	7.83
Hours large group	25,5	20.38
Self study	80,0	63.95

Total learning time: 125.1 h

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Description:
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Specific objectives:
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Full-or-part-time: 108h
Theory classes: 17h
Practical classes: 17h
Laboratory classes: 11h
Self study : 63h

GRADING SYSTEM

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 desition 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.

EXAMINATION RULES.

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:

- Recktenwald G.W. Numerical methods with MATLAB: implementations and applications. Prentice Hall, 2000. ISBN 0201308606.
- Stroustrup, B. The C++ programming language. 4th ed. Upper Saddle River, NJ: Addison-Wesley, 2013. ISBN 9780321563842.

Complementary:

- Kwon, Y.W.; Bang, H. The finite element method using MATLAB. 2nd ed. Boca Raton: CRC Press, 2000. ISBN 0849300967.