UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH

Course guide
250961 - EINMECCOMP - Computational Mechanics Tools

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). (Compulsory 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: JOSE SARRATE RAMOS

Others: NATIVITAT PASTOR TORRENTE, ANTONIO RODRIGUEZ FERRAN, JOSE SARRATE RAMOS

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.

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

This module presents an introduction to the first and last step of a numerical simulation in computational mechanics. That is, it presents the numerical techniques involved in the pre and post processing steps. On the one hand, the principal techniques that allow building a computational mesh from a CAD model are presented. On the other hand, numerical techniques for the visualization of discrete fields defined on a computational grid are discussed. These techniques are introduced solving practical applications using Gid (an existing commercial package).

* The students will be able to understand and comprehend the basic steps for generating a mesh; advantages and disadvantages of the algorithms most commonly used, as well as knowing the basics of scientific visualization. * The students must be able to understand and identify the different causes of problems for a CAD representation, correct the characteristics of the graphic model and generate a mesh. * The students must equally be able to select the most adequate technique for the visualization in accordance with the variable type to be visualized. * The students must be able to implement and use computer programs, as well as meshing tools to solve solids and fluids problems.

* Geometry representation.
* Meshing algorithms overview.
* Structured mesh generation.
* Triangular and tetrahedral mesh generation.
* Quadrilateral and hexahedral mesh generation.
* Mesh quality improvement.
* Fundamentals of scientific visualization.
* Techniques for discrete field representation

STUDY LOAD

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

Total learning time: 125.1 h

CONTENTS

Introduction to mesh generation methods

Description:
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Quality and mesh adaption
Discretization of geometric models
Mesh generation with GiD

Specific objectives:
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Full-or-part-time: 36h
Theory classes: 5h
Practical classes: 4h
Laboratory classes: 6h
Self study : 21h

Engineering problem simulation with PDE tools

Description:
Introduction to PDE tools
Problem solution with PDE tools
Modeling with PDE tools

Full-or-part-time: 36h
Theory classes: 2h
Practical classes: 5h
Laboratory classes: 8h
Self study : 21h

Simulation of engineering problems with Abaqus

Description:
Introduction to Abaqus
Solving problems with Abaqus
Modeling with Abaqus

Full-or-part-time: 36h
Theory classes: 2h
Practical classes: 5h
Laboratory classes: 8h
Self study : 21h

GRADING SYSTEM

The final mark for the module is obtained from the grades obtained in the assignments and projects completed during the course.

The final mark will be computed as

FM = 0.3 AS + 0.3 MP + 0.4 PC

where FM is the final mark, AS is the average of the grades corresponding to the assignments completed during the course, MP is the grade corresponding to the mesh generation project, and CP is the grade for the course project.

The assignments and the mesh generation project will be done individually while the course project will be done in groups of two students (except for justified situations).

EXAMINATION RULES.

To pass the module it is mandatory to present all the assignments and projects.

Academic dishonesty (including, among others, plagiarism and falsification of results) will be severely punished, in accordance with current academic regulations: any such act will imply a final mark of 0 in the module.

BIBLIOGRAPHY

Basic:
- Thompson J.F., Soni B.K., and Weatherill N.P.. Handbook of Grid Generation. Boca Raton [etc.]: CRC press, 1999. ISBN 0849326877.
- Topping B.H.V ... [et al.]. Finite Element Mesh Generation. Kippen: Saxe-Coburg Publications, 2004. ISBN 1874672105.
- Zienkiewicz, O.C.; Morgan. K. Finite elements and approximation. Mineola, NY: Dover Publications, 1983. ISBN 0486453014.
- Piegl, Les; Tiller, Wayne. The NURBS book. 2nd ed. Berlin; New York: Springer, 1997. ISBN 9783540615453.
- GiD homepage http://www.gidhome.com/.
- Abaqus/CAE user manual [on line]. [Consultation: 15/02/2023]. Available on: http://130.149.89.49:2080/v6.11/pdf_books/CAE.pdf.

Complementary:
- Faux D. and Pratt M.J.. Computational Geometry for Design and Manufacture. Chichester : New York [etc.]: Elli Horwood Publishers, 1981. ISBN 0470270691.