

Computational Mechanics Tools (250961)

General Information

School	ETSECCPB
Departments	Departament d'Enginyeria Civil i Ambiental (DECA)
Credits	5.0 ECTS
Programs	MÀSTER UNIVERSITARI EN MÈTODES NUMÈRICS EN ENGINYERIA (pla 2012) MÀSTER UNIVERSITARI EN MÈTODES NUMÈRICS EN ENGINYERIA (pla 2012)
Course	2024/25

Main teaching language at each group

- Group 10EN1 English (Q1)

Faculty

Responsible Faculty: Jose Sarrate Ramos

Faculty: Irene Arias Vicente, Nativitat Pastor Torrente, Denise Carina Santos Ferreira, Jose Sarrate Ramos

Objectives of Education

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

Total hours of student work

		Hours	Percentage
Supervised Learning	Large group	25.5 h	56.67 %
	Medium group	9.75 h	21.67 %
	Laboratory classes	9.75 h	21.67 %
	Guided Activities	0.0 h	0.00 %
Self Study		80.0 h	

Contents

Introduction to mesh generation methods

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Introduction to the digital representation of geometric models
Methods for the discretization of geometric models
Quality and adaptation of meshes
Mesh generation with GiD

Specific Objectives

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Engineering problem simulation with PDE tools

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

Simulation of engineering problems with Abaqus

Introduction to Abaqus
Solving problems with Abaqus
Modeling with Abaqus

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.

Grading Rules

() The evaluation calendar and grading rules will be approved before the start of the course.*

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).

Test 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.

Office Hours

It will be announced at the beginning of the course.

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.
- Abaqus/CAE user manual.

Complementary

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