Coupled Problems (250963)

General Information

School	ETSECCPB
Departments	Departament d'Enginyeria Civil i Ambiental (DECA) Departament de Mecànica de Fluids (MF)
Credits	5.0 ECTS
Programs	MÀSTER UNIVERSITARI EN MÈTODES NUMÈRICS EN ENGINYERIA (pla 2012) MÀSTER UNIVERSITARI EN MÈTODES NUMÈRICS EN ENGINYERIA (pla 2012)
Course	2025/26

Main teaching language at each group

- Group 10Q2 English (Q2)

Faculty

Responsible Faculty: Ramon Codina Rovira
Faculty: Joan Baiges Aznar, Ramon Codina Rovira

Objectives of Education

This course covers the theoretical and computational aspects for the solution of coupled problems, using the finite elements method (FEM) and the procedures related to discretisation. It emphasizes on the description of the mathematical formulation of each problem and on the details of the practical solution by the FEM.

* To learn the fundamentals of the modeling of geomaterials, porous materials in particular, and termo-hidro-mechanical coupling * Emphasis will be put on the need for students to acquire independence in their studies; they have to learn to use a computer for basic programming and learn to use and make the most of their study hours. * To implement and use computer programs to solve non-linear problems on different fields of application. * To analyse from a critical point of view the results obtained by the simulations.

* Summary and classification of coupled problems.
* Fluid-structure Interaction.
* Fluid-pores interaction in grounds.
* Termo-mechanical coupling.
* Electro-magneto-dynamic coupling.
* Partitions and scales diagrams.
* Programming aspects.
* Applications
Learning resources:
o Textos de conferencias
o O.C. Zienkiewicz et al. The finite element method. Vols 1, 2 y 3. 6ª edición, Elsevier, 2006.

Competencies

Especific

Practical numerical modeling skills. Ability to acquire knowledge on advanced numerical modeling applied to different areas of engineering such as: civil or environmental engineering or mechanical and aerospace engineering or bioengineering or Nanoengineering and naval and marine engineering, etc..
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.
Materials modeling skills. Ability to acquire knowledge on modern physical models of the science of materials (advanced constitutive models) in solid and fluid mechanics.
Experience in numerical simulations. Acquisition of fluency in modern numerical simulation tools and their application to multidisciplinary problems engineering and applied sciences.
Interpretation of numerical models. Understanding the applicability and limitations of the various computational techniques.
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.

Total hours of student work

		Hours	Percentage
Supervised Learning	Large group	45.0 h	100.00 %
	Medium group	0.0 h	0.00 %
	Laboratory classes	0.0 h	0.00 %
	Guided Activities	0.0 h	0.00 %
Self Study		80.0 h	

Contents

Transmission Conditions

Terms of transmission in continuum mechanics
Problems transmission conditions

Coupled Problems

Link to the homogeneous space problems
Link to space problems heterogeneous
Coupling time I
Coupling time II
Problems coupled problems
Problems coupled problems II

Applications

Fluid-structure interaction
Thermal and mechanical coupling
Mechanical and electromagnetic coupling
Application Problems
Practical Matlab II

Implementation issues

Implementation issues
Problems of implementation issues
Practices with MatLab

Activities

MatLab applications

Dedication

7h 30m

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 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.

Test Rules

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

Office Hours

Monday and Wednesday, 12:00-13:00

Bibliography

Basic

- Codina, Ramon; Baiges, Joan. Notes de curs.