Course guide
820083 - SNAE - Numerical Simulation Applied to Engineering

Last modified: 27/05/2024

Unit in charge: Barcelona East School of Engineering
Teaching unit: 748 - FIS - Department of Physics.

Degree: **Academic year:** 2024 **ECTS Credits:** 3.0
Languages: English

LECTURER

Coordinating lecturer: Jordi José Pont

Others: Jordi José Pont
Yuri Cavecchi

PRIOR SKILLS

Ability to work with the computer and a basic knowledge of a programming language.
Basic knowledge of algebra, calculus and physics.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Transversal:
1. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.

TEACHING METHODOLOGY

40 % Expositive methodology plus 35% individual work plus 25% working in group.

LEARNING OBJECTIVES OF THE SUBJECT

To introduce the student into basic techniques of numerical simulation and their application to solve enginering problems.

STUDY LOAD

Type	Hours	Percentage
Self study	45,0	60.00
Hours large group	30,0	40.00

Total learning time: 75 h

CONTENTS

1. Chapter: A primer on numerical calculus.

Description:
Interpolation, fitting. Applied matrix algebra (matrix inversion. the homogeneous matrix of transformation and its geometrical applications). A primer on fractal geometry. Numerical differentiation. Numerical resolution of differential equations. Stability (exemple: prey-predator dynamics). The fast Fourier transform FFT.

Specific objectives:
To introduce the student to the basic numerical techniques addressed to simulate physical and engineering systems

Related activities:
The last minutes of each session will be devoted to write easy programs of
numerical calculus.

Full-or-part-time: 60h
Theory classes: 24h
Self study : 36h

2. Chapter:Applications to several engineering disciplines.

Description:
Description of articulate systems by means of the homogeneous matrix. Numerical solution of the Laplace equation and its application to electrostatic problems. Applications of the Laplace equation to heat transfer problems. Simulation of a set of coupled chemical reactions network. Planets and satellites orbital elements. Numerical integration of a network of chemical reactions. An introduction to computational fluid dynamics (CFD).

Specific objectives:
Apply the main concepts already learnt in the previous chapter. Applications to interesting engineering problems will be carefully described.

Related activities:
A simulation program dealing to a physical system linked to engineering has to be written by the interested students as a part of the evaluation of the course. There will be a public exposition of the work done.

Full-or-part-time: 60h
Theory classes: 24h
Self study : 36h

GRADING SYSTEM

Two classroom exams P1 and P2 and a practical work, T, consiting in planify and devise a computer algorithm aimed at solving a particular engineering problem.
Final qualification: 0.25 P1+0.25 P2+0.5 T.

The generic competence will be evaluated taking into account: 1) The ability of the student to apply the concepts explained in the classroom to practical engineering problems, 2) the self-study abilities of the students, 3) abilities to make a public presentation and defend the work done. The weight of the generic competence within the evaluation of the course will be of 10%. This subject does not have any re-avalation probe. Performing laboratory probes is not obliged in this subject.

BIBLIOGRAPHY

Basic:
- DeVries, Paul L.; Hasbun, Javier Ernesto. A First course in computational physics. 2nd ed. Sudbury, Massachusetts: Jones and Bartlett Publishers, cop. 2011. ISBN 9780763773144.