Last update: 02-06-2015

820083 - SNAE - Numerical Simulation Applied to Engineering

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering

Teaching unit: 748 - FIS - Department of Physics

Academic year: 2015

Degree: BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
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BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Optional)

ECTS credits: 3 Teaching languages: English

Teaching staff

Coordinator: Domingo García Senz

Others: Domingo García Senz

Opening hours

Timetable: consensuated with the professor.

Prior skills

Ability to work with the computer and a basic knowledge of a programming language.

Requirements

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

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

Study load

Total learning time: 75h	Hours large group:	30h	40.00%
	Self study:	45h	60.00%

Content

1. Chapter: A primer on numerical calculus.	Learning time: 60h Theory classes: 24h Self study : 36h

Description:
Interpolation, fitting. Applied matrix algebra (domain factorization. the homogeneous matrix of transformation, Markov chains). Numerical differentiation. Numerical resolution of differential equations. Stability (exemple: prey-predator dynamics). The fast Fourier transform FFT.

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

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

2. Chapter:Applications to several engineering disciplines.	Learning time: 60h Theory classes: 24h Self study : 36h

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 the heat transfer problem. Simulation of a set of coupled chemical reactions network. Planets and satellites orbital elements. Signal analysis. Aplication of the Markov chains to the economy.

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.

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

3. Chapter: Simulation of discrete systems, bioenginering.	Learning time: 30h Theory classes: 12h Self study : 18h

Description:
Discrete simulation. The game of life. Application to the study of virus replication. Fractal geomtery and applications.

Related activities:
The interested students have to write a simple program based on the discrete simulation methods as a main work of the course. Thre will be a specific session devoted to the exposition of the works done by the students at the end of the course.

Specific objectives:
To introduce the student to this especial class of simulation techniques where a set of empirical rules drive the evolution of a complex system settled in a 2D grid.

Qualification 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%.

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.