Last update: 14-06-2017

820077 - CENG - Computational Engineering

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

Teaching unit: 749 - MAT - Department of Mathematics

Academic year: 2017

Degree: 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 CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL 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 CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Optional)

ECTS credits: 6 Teaching languages: English

Teaching staff

Coordinator: Núria Parés, Yolanda Vidal

Others: Dept. de Matemàtica Aplicada III - Secció Urgell

Prior skills

It is advisable that students have passed the courses Mathematics I, II and III before taking this course.

Degree competences to which the subject contributes

Transversal:

1. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.

Teaching methodology

The course is based on lectures given by the instructors (40%) and individual and group work (60%).

Learning objectives of the subject

The goal of this elective course is to introduce students to numerical calculus, providing them with a broad knowledge of numerical techniques that will be very useful throughout the degree and later development of their profession. In particular the course will qualify students to numerically solve partial differential equations with particular interest in the Finite Element Method.
The aim of the lectures is to present the subjects without a deep theoretical formalisms in order to be able to provide a simple and practical training.
Lectures are held in computer rooms, where theoretical explanations of the different numerical methods are combined

820077 - CENG - Computational Engineering

with the implementation of the methods using MATLAB. Because of this, the first lectures of the course are devoted to provide a fast and easy introduction to the software MATLAB.

Study load

Total learning time: 150h	Hours large group:	45h	30.00%
	Hours medium group:	0h	0.00%
	Hours small group:	15h	10.00%
	Guided activities:	0h	0.00%
	Self study:	90h	60.00%

Last update: 14-06-2017

820077 - CENG - Computational Engineering

Content

Module 1: Introduction to Matlab

Learning time: 10h
Theory classes: 4h
Self study : 6h

Description:
Introduction to the Matlab software. Overview of the basic features, basic operations, definition of variables, vectors and matrices; files *.m; debugger; control statements.
Basics on programming.

Module 2: Introduction to numerical methods

Learning time: 10h
Theory classes: 4h
Self study : 6h

Description:
Brief introduction to the subject. Applications of numerical methods in engineering.

Module 3: Numerical linearl algebra - basic tools

Learning time: 30h
Theory classes: 12h
Self study : 18h

Description:
Solution of linear systems of equations. Systems with immediate solution: diagonal matrix, triangular matrix. Direct methods. Gauss method. Factorization methods.

Module 4: Numerical calculus - review of basic tools

Learning time: 30h
Theory classes: 12h
Self study : 18h

Description:
Numerical integration (rectangles, trapezoidal rule, Gauss method). Numerical interpolation (splines).

Module 5: Introduction to partial differential equations (PDEs)

Learning time: 30h
Theory classes: 12h
Self study : 18h

Description:
Motivation. Equations of mathematical physics. Bonundary conditions. Method of separation of variables. Heat equation. Wave equation.

Last update: 14-06-2017

820077 - CENG - Computational Engineering

Module 6: Numerical solution of PDEs - Introduction to the Finite Element Method	Learning time: 40h Theory classes: 16h Self study : 24h

Description:
Introduction to the basic concepts. Formulation of the finite element method. Structure of finite element codes. Pre and post-process. Applications to engineering.

Qualification system

Exams: 40%
Assignments: 35%
Validation of the assignments: 20%
Generic Skills: 5%

Bibliography

Basic:

Huerta, A.; Sarrate, J.; Rodríguez-Ferran, A. Métodos numéricos : introducción, aplicaciones y programación. Barcelona: Edicions UPC, Universitat Politècnica de Catalunya, 2001. ISBN 8483015226.

Hoffman, Joe D. Numerical methods for engineers and scientists. 2nd ed. New York [etc.]: Marcel Dekker, 2001. ISBN 0824704436.

Henwood, D.; Bonet, J. Finite elements : a gentle introduction. Houndmills [etc.]: MacMillan, 1996. ISBN 0333646266.

Complementary:

Zill, D. G.; Cullen, M. R. Ecuaciones diferenciales con problemas de valores en la frontera. 7ª ed. México, D.F. [etc.]: Cengage Learning, 2009. ISBN 9789708300384.

Zienkiewicz, O. C.; Taylor, R. L.; Nithiarasu, P. The finite element method [on line]. 6th ed. Oxford; New York: Elsevier/Butterworth-Heinemann, 2005 [Consultation: 02/03/2012]. Available on: <http://www.sciencedirect.com/science/book/9780750664318>. ISBN 9780750664318.

Chapra, S. C.; Canale, R. P. Métodos numéricos para ingenieros. 6a ed. México: McGraw-Hill, 2011. ISBN 9786071504999.