Professional Software in Electromagnetism

ECTS: 6 ECTS

COORDINATOR: Mª Dolores Gómez Pedreira (mdolores.gomez@usc.es)

UNIVERSITY WHERE THE COORDINATOR IS: USC

HAVE YOU GIVEN PERMISSION TO RECORD YOUR CLASSES? No, it does not apply in this case.

LECTURER 1: Mª Edita de Lorenzo Rodríguez (edita.delorenzo@uvigo.es)

UNIVERSITY WHERE THE LECTURER 1 IS: UVigo

HAVE YOU GIVEN PERMISSION TO RECORD YOUR CLASSES? No, it does not apply in this case.

LECTURER 2: Mª del Pilar Salgado Rodríguez (mpilar.salgado@usc.es)

UNIVERSITY WHERE THE LECTURER 2 IS: USC

HAVE YOU GIVEN PERMISSION TO RECORD YOUR CLASSES? No, it does not apply in this case.

SUBJECT CONTENTS

1. Introduction to the finite element method in electromagnetism.
    a. Different formulations of two and three dimensional electromagnetic models.
    b. Finite Lagrange and edge elements.
2. Description of FLUX2D.
    a. Introduction and description of the software.

b. Use of the package to solve various problems of electromagnetism: electrostatics, direct current, magnetostatics, alternating current,…

3. Introduction to the method of finite differences in electromagnetism.

4. Description of XFDTD software package.

a. Introduction and description of the software.

b. Use of the package to solve different problems: radiation, guided media, detection etc.

METHODOLOGY

The lessons will take place at the computer lab and will be treated as expository teaching and computer practices and seminars. The exercises to be carried out by the students will be described in some notes provided by the teachers, as well as notes concerning the theoretical part of the subject.

LANGUAGE USED IN CLASS: Spanish/Galician in function of the students.

IS IT COMPULSORY TO ATTEND CLASS? No. The course will be given at the USC and attendance is strongly recommended. Nevertheless, students can attend the course via the conference system unless the great number of exterior attendants makes difficult to follow them in an adequate manner.

BIBLIOGRAPHY

Basic bibliography:

FLUX2D User's guide.

A. Bermúdez, D. Gómez, P. Salgado, Mathematical models and numerical simulation in electromagnetism. Springer, 2014

XFDTD, Full Wave 3D Electromagnetic Analysis Software, Reference Manual, REMCOM.

C.A. Balanis, Antenna Theory: Analysis and Design. Wiley. 3ª ed, 2005.

Complementary bibliography:

A. Bossavit. Computational electromagnetism. Variational Formulations, Complementarity, Edge Elements. Academic Press. San Diego, CA, 1998.

K. Kunz, R. Luebbers, The Finite Difference Time Domain Method for Electromagnetics, CRC Press, 1993.

B.D. Popovic, Introductory Engineering Electromagnetics, Addison Wesley, 1971.

A.B. Reece and T.W. Preston, Finite Elements Methods in Electrical Power Engineering, Oxford University Press, Oxford, 2000.

P.P. Silvester and R.L. Ferrari, Finite Elements for Electrical Engineers, Cambridge University Press, Cambridge, 1996.

A. Taflove, S. C. Hagness, Computational Electrodynamics. The Finite-Difference Time-Domain Method. Artech House, 3ª edición, 2005.

SKILLS

Basic:

CG1: To have knowledge that provide a basis or opportunity for originality in developing and / or applying ideas, often within a research context, knowing how to translate industrial needs in terms of R & D in the field of mathematics Industrial.

CG4: To have the ability to communicate the findings to specialist and non-specialist audiences in a clear and unambiguous way.

Specific:

CE4: To be able to select a set of numerical techniques, languages and tools, appropriate to solve a mathematical model.

CE5: To be able to validate and interpret the results, comparing them with visualizations, experimental measurements and functional requirements of the physical engineering system.

Numerical specialization:

CS1: To know, be able to select or use how to handle most suitable professional software tools (both commercial and free) for the simulation of processes in the industrial and business sector.

CS2: To adapt, modify and implement software tools for numerical simulation.

WILL YOU BE USING A VIRTUAL PLATFORM? Yes. Moodle (USC)

WILL YOU BE USING ANY SPECIFIC SOFTWARE? Yes. Flux2D®, XFDTD

CRITERIA FOR THE 1ST ASSESSMENT OPPORTUNITY

A continuous assessment at the lab lessons will be done as well as a final exam.

The student evaluation will be based on continuous assessment of work done throughout the course (C) and a final exam (F) consisting on theory and practice.

The continuous assessment will be based on different jobs assigned to the students and corresponding to the different blocks of the course.

The numerical qualification in each part will be 0.7*F + 0.3*C. The final numerical qualification will be computed taking into account that the part corresponding to XFDTD will represent 1/3 and the part of Flux2D will represent 2/3 of the total mark. More precisely, we define:

$$M = 1/3 * CAL\_XFDTD + 2/3 * CAL\_Flux2D$$

Where

CAL_XFDTD: Numerical qualification obtained in the XFDTD part,

CAL_FLUX2D: Numerical qualification obtained in the FLUX2D® part.

To pass the course the student should obtain at least 4 points over 10 in each part.

The official qualification to appear in the student's achievement record will depend on whether the minimum of 4 points required in each part is exceeded or not. Thus,

Official qualification = M, if the minimum of each part is achieved

Official qualification = min(M, 4), on the contrary.

The qualifications associated to the continuous assessment (C) will be communicated to the students before the exam.

Due to the eminently practical nature of the subject, the competencies specified in the "Competencies" section will be evaluated both through the exam and the proposed works. The methodology is the same in both cases: a physical problem will be presented to the student, who will have to solve it numerically by using the software tools presented in the subject. In order to do that, students must, first of all, determine the mathematical model appropriate to the posed problem and explain reasonably the reason for such a choice. This would validate the CG1, CE4 and CS1 competences.

Then, students must solve the problem numerically using the commercial packages explained in the matter and prepare a critical report of the results obtained in the different questions. This will allow, in addition to evaluating their knowledge, to assess the degree of development achieved in the competences CG4, CE5 and CS2.

CRITERIA FOR THE 2ND ASSESSMENT OPPORTUNITY

The evaluation will be done by using the same procedure of the first period. The numerical qualification corrresponding to the continuous assessment C will be the same as the as the mark obtained in the first period.

Students who do not attend any official exam will receive the grade of "not presented". Students who repeat the course will be evaluated with the same system.

If for duly justified exceptional reasons, a student could not follow the continuous assessment, he/she will have a single test of all the contents of the course.