Simulation tools

Academic Year: (2019 / 2020)   **Review date: 29-04-2019**

Department assigned to the subject: Electronic Technology Department, ENG/Masters interuniversitarios

Coordinating teacher: SANCHEZ MONTERO, DAVID RICARDO

Type: Compulsory ECTS Credits : 3.0

Year : 1 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

There are not specific requirements to take this course. There is no need for a previous knowledge of the simulation tools that will be presented throughout the course however some background in Matlab and/or LabView software is recommended.

OBJECTIVES

The goal of the course is to allow the student understanding and being able to design some photonic devices/components and photonic systems to simulate their performance by any of the proposed simulation tools to study throughout the course.
To achieve this goal, the student must acquire the following competences and skills:

- To be able to apply the acquired knowledge and problem solving skills in new and unfamiliar engineering areas within broader (or multidisciplinary) contexts related to their field of study.
- To be able to apply the acquired knowledge in order to make judgments from information that, incomplete or limited, includes reflections on social and ethical responsibilities linked to the application of their background and judgments.
- To acquire learning skills that allow them to further study in a way that will be largely self-directed or autonomous.
- The ability to understand technical contents, prepare documents, plans and technical/engineering projects in English language.
- The ability to adopt creative solutions that adequately meet the technical requirements and needs.
- The ability to lead and work in teams that integrate multidisciplinary approaches being able to organize and plan his/her own work.
- The ability to apply the scientific method as a fundamental work tool in both the professional and research fields, managing the different sources of information.
- To be able to identify the different blocks that are present within a system where photonics plays an essential role, the design specs, possible subsystems to be used, its integration and its final verification.
- The use of tools that help the design of photonic devices and systems.
- The use of simulation tools in the field of photonics to develop/analyze/design different devices and systems, with application in communications, avionics, automotive, energy sector and civil infrastructures.
- To be able to evaluate the performance of own-designed photonic devices, both passive and active.
- To be able to design and analyze photonic systems for communications and sensing applications.
- The ability to theoretically verify by simulation the fulfillment of the specifications required to a new device or photonic system.

After completing the course the students should be able to:
- Use the basic simulation tools in different photonic applications.
- Design and develop a complete photonic system using the simulation tools, blocks and technologies studied in the master of both active and passive components and in applications with light-matter interaction.
- Design and develop a set of tests and measures to evaluate by simulation the operation of an optoelectronic system.
- Apply the knowledge in the field of photonic engineering, at system level or at component level, in a real and practical environment.

- Participate in a team of multidisciplinary technical work in the field of photonic engineering, with the ability to overcome technical and operational issues in the framework of developing a technical project.
- Properly document the developed project and defend it against third parties.

DESCRIPTION OF CONTENTS: PROGRAMME

At least 5 simulation tools are offered, from which the student will select 3 among them. Students may interact individually or in groups with the interface and software to get used with the simulation tools of their choice.

1. COMSOL (UNIVERSIDAD DE ALCALÁ - UAH)
1.1 Introduction.
1.2 Geometric design.
1.3. Materials selection.
1.4. Selection of physics modules of the systems.
1.5. Setting the starting and boundary conditions.
1.6. Parameters of the physical study.
1.7 Simulation and results displaying.

2. SIMULATION OF PHOTONICS DEVICES AND SYSTEMS WITH MATLAB
2.1 Introduction.
2.2 Definition and operations with functions.
2.3 Data fitting and optimization.
2.4 Examples in real photonics-systems applications.

3. OPTIWAVE ENVIRONMENT TOOLS: OPTIPERFORMER (UNIVERSIDAD POLITÉCNICA DE MADRID - UPM)
3.1 Introduction to OptiPerformer User Interface.
3.2 Simulation of emitters and receptors.
3.3 Simulation of modulators, fibre and amplifiers.
3.4 Simulation of simple single channel systems.
3.5 Simulation of complex systems and presentation of simulations.

4. SIMULATION OF PHOTONICS DEVICES AND SYSTEMS WITH LABVIEW (UNIVERSIDAD POLITÉCNICA DE MADRID - UPM)
4.1 Introduction to the basics of LabView
4.2 Structures and sub-routines, examples and driver installation
4.3 Hardware Interfacing: NiDAQ / GPIB
4.4 Hardware Interfacing: GPIB / NiDAQ and 3rd party
4.5 Hardware Interfacing: Arduino and LINX.

5. VPI PHOTONICS (UNIVERSIDAD CARLOS III DE MADRID, UC3M)
5.1 Introduction.
5.2. Graphical User Interface features.
5.3 Overview of signal models and simulation techniques.
5.4. Parameter sweeps and optimizations.
5.5 Visualization and post-processing of simulation results.
5.6. Scripted simulations and automated system design.

6. RSOFT CAD ENVIRONMENT TOOLS: BEAMPROP, FULLWAVE
 6.1 Introduction.
 6.2. Benefits and areas of application. Software capabilities.
 6.3 Graphical User Interface features.
 6.4. Parameter sweeps and optimizations.
6.5. Scripted simulations and automated system design.

LABORATORY:

Simulation of proposed small projects and simple photonic devices and systems with the aim of getting familiar with the simulation tools under consideration for a more complex further simulation framework.

LEARNING ACTIVITIES AND METHODOLOGY

- Theory - Lectures , problem resolution with support of computer-aided and audio-visual means, in which both the main concepts of the simulation tools that will be treated throughout the course are developed as well as the bibliography/documentation and/or tools necessary to complement the learning from them.

- Personal homework to solve proposed practical cases, problems, etc. ... individually or in a group, which will serve as a self-assessment and to acquire the necessary skills with the use of the proposed simulation tools.

- Works and reports generated individually or in groups associated with the simulations proposed to be developed, useful for self-assessment and knowledge acquisition.

- Individual/group tutorials and own student work; oriented to the acquisition of theoretical knowledge background.

ASSESSMENT SYSTEM

% end-of-term-examination: 30

% of continuous assessment (assigments, laboratory, practicals…):   70

The evaluation allows knowing the degree of satisfaction of the knowledge goal. The students' workload to be evaluated include exercises, exams, lab projects, and other activities. The following scoring will be used:

A. Students will obtain 70% of their final score from:
* Delivery of an individual portfolio that includes proposed simulation problems and exercises to be solved for homework: 30%.
* Individual/team report (evaluation, analysis or study) from those proposed or at the students' own interest using the simulation tools covered within the course: 40%.

In all cases, the progress made by the student throughout the course will be also taken into account.

B. Final exam that includes theoretical/practical issues about the simulation tools seen throughout the course: 30%. At least a score of 3 out of 10 is required.

BASIC BIBLIOGRAPHY

 - Le, Nguyen Binh Optical fiber communication systems with MATLAB® and Simulink® models 2nd ed., CRC Press , 2016

 - Schijndel, Jos van Integrated modeling using MatLab, Simulink and COMSOL : with heat, air moisture applications for building physics and systems, VDM Verlag Dr. Muller, 2008