Last update: 15-11-2019

220061 - Lasers and Photonic Technologies for Engineering

Coordinating unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering

Teaching unit: 748 - FIS - Department of Physics

Academic year: 2019

Degree: BACHELOR'S DEGREE IN AEROSPACE VEHICLE ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN AEROSPACE TECHNOLOGY ENGINEERING (Syllabus 2010). (Teaching unit Optional)

ECTS credits: 3 Teaching languages: English

Teaching staff

Coordinator: Cojocaru, Crina Maria

Others: Segon quadrimestre:
CRINA MARIA COJOCARU - 1
SANTIAGO ROYO ROYO - 1

Opening hours

Timetable: Contact the professor:
Crina Cojocaru
Office at building Gaia, 1st floor.
Phone 93 7398571.
crina.maria.cojocaru@upc.edu

Degree competences to which the subject contributes

Specific:

1. Applied knowledge of manufacturing systems and processes, metrology and quality control

2. GrETA - An adequate understanding of the following, as applied to engineering: calculation methods for aeronautical design and development; the use of aerodynamic experimentation and the most important parameters in theoretical application; the experimental techniques, equipment and measuring instruments used in the discipline; simulation, design, analysis and interpretation of in-flight experiments and operations; aircraft maintenance and certification systems.
3. GrEVA - An adequate understanding of the following, as applied to engineering: calculation methods for aeronautical design and development; the use of aerodynamic experimentation and the most important parameters in theoretical application; the experimental techniques, equipment and measuring instruments used in the discipline; simulation, design, analysis and interpretation of in-flight experiments and operations; aircraft maintenance and certification systems.
4. Understanding and mastery of basic concepts about the general laws of mechanics, thermodynamics and electromagnetism fields and waves and their application to solving problems in engineering.

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Teaching methodology

The course is divided into parts: Lectures, practical classes and visits to laboratories and R and R&D (Campus of Terrassa).

In the lectures, the professor introduces the concepts (from a practical point of view), methods and results, illustrating them with examples, and describing the applications.

In practical classes, the professor guides the students (individually or in small groups) in the application of concepts and methods for analyzing systems, solving problems and design solutions, always using critical reasoning. In addition, in many class sessions, simple illustrative experiments are carried out (in the classroom), using laser, etc. Finally, further experiments are observed orperformed in a laboratory, and also two detailed visits are performed: one to a research laboratory and another to an engineering center in photonics R+D located in Terrassa Campus.

The students independently work on the materials provided by the professor, as well as on exercises or designs or works proposed, in order to determine and assimilate the concepts.
The professor provides the curriculum and monitoring of activities (in person and through ATENEA virtual platform).

Learning objectives of the subject

The course intends to provide the student with a minimum background about lasers and modern photonic technologies in general and their applications. Photonics is, nowadays, one of the most active and rapidly progressing branches of science and technology, with a transverse interdisciplinary character that makes it increasingly useful in different fields and sectors. The European Union has selected photonics as one of the five KET ("Key-Enabling Technologies"), "crucial for ensuring the competitiveness of European industries in the knowledge economy". Getting knowledge and skills on photonics is becoming increasingly important for engineering.

The student will learn about: (i) the basic processes of photonics -from a practical point of view-; (ii) the main elements, devices and materials for photonics (LEDs, Lasers of different types, sensors, imaging elements, etc.); and (iii) the main present applications in engineering (in sensing, metrology, materials processing -from cutting to 3D printing-, imaging, energy saving, communications, nanophotonics, biophotonics,...) and future perspectives. Numerous experimental demonstrations in class, as well as two detailed visits (to the laboratory of the Research group DONLL and to the technological research center CD6, in Campus de Terrassa) will be organized.

With that, the future engineer will be able to estimate what are the possibilities offered by photonics devices and systems when addressing technological problems or elaborating projects, along his/her professional career.

Study load

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

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Content

Module 1: Lasers and Photonic Technologies	Learning time: 75h Theory classes: 30h Self study : 45h

Description:

1.- General concepts:
- Properties of light. Why is it useful?. Photons vs electrons.
- Light propagation phenomena and imaging.
- Light interacting with matter: variety of phenomena.

2.- Main elements, devices and materials in photonics:
- Light sources: LEDs. Lasers: how do they work, different types of lasers (low & high power), performances. Others.
- Photomodulators, displays, photodetectors. Solar panels. Image detectors. Sensors.
- Elements for controlling light propagation. Optical fibers. Micro- & nano-structures.

3.- Applications of lasers and photonics, especially in engineering:
- Reading, measuring, and sensing with light. Micro- and nano-resolution microscopy. Image, 3D vision.
- Material processing with lasers: cutting, welding, drilling, marking, surface treatment, and 3D prototyping and printing.
- Energy: green photonics: efficient lighting, solar cells. Power beaming: aircraft propulsion by laser.
- New fields: biophotonics (for biomedicine) and nanophotonics.
- Other applications: Optical communications, remote sensing, analysis and contamination monitoring, etc.

Related activities:

-Experimental demonstrations, in class and in the laboratory
-Detailed visit to DONLL scientific research laboratory and to CD6 photonics engineering research center, in Campus de Terrassa.

Specific objectives:

(See the learning objectives of the course)

Qualification system

The final grade is based on the following evaluation criteria:

- Work done by the student:
  - Written homework about basic examples of applications and some summaries or exercises: 30%
  - Written homework about examples of more advanced photonics applications: 30%
  - Report on a specific topic (with possible oral presentation, if applicable): 15%
- Experiments in three laboratories (two of them are research labs) and experiments in class: 25%.
- (No examination will take place)

Bibliography