230570 - LASERS - Laser Systems and Applications

Coordinating unit:	230 - ETSETB Barcelona School of Telecommunications Engineering
Teaching unit:	721 - FEN - Department of Physics and Nuclear Engineering
Academic year:	2015 - 2016
Degree:	Master's Degree in Photonics
	Erasmus Mundus Master's Degree in Photonics Engineering, Nanophotonics and Biophotonics
ECTS credits: 3	**Teaching languages:** English

Academic staff

Coordinator:	Cristina Masoller (UPC)	cristina.masoller@upc.edu
Other professors:	Fidel Vega (UPC)	fvega@oo.upc.edu
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Degree competences to which the subject contributes

Transversal:

1. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

2. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

3. ENTREPRENEURSHIP AND INNOVATION: Being aware of and understanding how companies are organised and the principles that govern their activity, and being able to understand employment regulations and the relationships between planning, industrial and commercial strategies, quality and profit.

4. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

Teaching methodology

Lectures
Activities:
- Visits to industry and academic laboratories.
- Hands-on training sessions on laser model simulations, where the students will simulate a simple laser model using the programming language that they are familiar with (such as matlab, fortran or c).

Objectives and short description of the course

The aim of this course is to provide the students a broad overview of the various laser systems currently being used in both scientific and industrial fields. Specific attention will be paid to cutting-edge applications such as diode lasers for telecoms and excimer and femtosecond lasers for micromachining and biomedical applications. This course also includes complementary activities such as hands-on computing sessions and visits to nearby industries which use lasers systems for material processing and laser-equipment for biomedical applications.
The course is given in the second semester.

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Study load

Total learning time: 75h	Hours large group:	22.5h	30%
	Hours medium group:	0h	0%
	Hours small group:	0h	0%
	Guided activity:	2.25h	3%
	Self study:	50.25h	67%

Course index

1. **Low-power laser systems for communications and information processing**
   1.1 Semiconductor laser physics.
   1.2 Types of semiconductor lasers and models.
   1.3 Applications in communications and information processing.

2. **Laser systems for high power applications**
   2.1 Laser-based material processing. Requirements to take into account for different processes: cutting, welding, drilling, marking, surface treatment, rapid prototyping (3D printing or additive manufacturing).
   2.2 Laser systems with minimum thermal load (excimer lasers and femtosecond lasers). Non-thermal ablation and micromachining.
   2.3 Examples of applications, photonic components production based on laser manufacturing (waveguides, beam-splitters).
   2.4 Laser safety.

3. **Laser systems for biomedical applications**
   3.1 Laser surgery.
   3.2 Laser patterning in biomaterials.
   3.3 Optogenetics.
   3.4 Lab-on-a-chip devices.

Qualification system

Oral or written presentation. The student will be able to chose to either give an oral presentation on a topic that he/she will chose among a list of topics proposed by the professors, or, to present a written report on the subject, in the same format as a journal article –with abstract, introduction, results, conclusions and bibliography (50%)
Exam (30%)
Attending classes, lab visits and hands-on sessions (20%)

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Bibliography

The course will only include parts of these references, at an appropriate level:
- Fundamentals of Photonics, B. E.A. Saleh and M.C. Teich (Wiley, 2nd ed., 2007).
- Photonic devices, J.-M. Liu (Cambridge University Press, 2005).
- Semiconductor Lasers: Stability, Instability and Chaos, J. Ohtsubo (Springer, 2006).
- Laser Processing of Materials, P. Schaaf ed. (Springer, 2010).
- Femtosecond laser pulses: principles and experiments, C. Rulliere (Springer 1998).