



230562 - MATMETA - Photonics Materials and Metamaterials

Coordinating unit:	230 - ETSETB Barcelona School of Telecommunications Engineering
Teaching unit:	1004 - UB - Universitat de Barcelona
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

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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

Objectives and short description of the course

This course aims to introduce to the chemical and physical properties of the most important material platforms in photonics. The emphasis is in studying optical and electro-optical properties which will be related with the more fundamental material characteristics such as composition, bonding, electronic structure and doping. These fundamental properties will serve to describe and understand the physics and technology of a variety of photonic and optoelectronic structures related with lasing, photovoltaics, waveguiding and non-linear optics.

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%

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Course index

1. Structure and optical processes in solids

- 1.1 Bulk and low dimensional materials: structure and electronic levels.
- 1.2 Elementary excitations in solids: electrons and holes, excitons, phonons and plasmons.
- 1.3 Optical and emission properties of semiconductor and dielectrics above and below band-gap.

2. Functional photonic materials

- 2.1 Semiconductor material systems: IV, III-V, II-VI and low dimensional.
- 2.2 Waveguide material systems: glass, ceramic, semiconductor and polymers.
- 2.3 Laser materials: semiconductor and solid state.
- 2.4 Materials and structures for solid state lighting and photovoltaics.

3. Photonic extend material structure

- 3.1 Photonic crystals: dimensionality, photonic band structure and defects.
- 3.2 Linear and non-linear properties of photonic crystal structures.
- 3.3 Metamaterials: electric and magnetic, negative-index.
- 3.4 Properties and applications of metamaterials.

Qualification system

- Evaluation of the presentation on a subject of the lectures (50%)
- Evaluation of the global examination (50%)

Bibliography

- B.E.A. Saleh, M.C. Teich: "Fundamentals of Photonics", Wiley, 2nd ed. 2007
- C. F. Klingshirn: "Semiconductor Optics", Springer-Verlag, 1997, 2nd ed. 2005
- J. G. Korvink, A. Greiner: "Semiconductors for Micro- and Nanotechnology", Wiley-Vch, 2002
- M. Fukuda: "Optical Semiconductor Devices", Wiley, 1999
- T. Steiner, ed.: "Semiconductors Nanostructures for Optoelectronic Applications", Artech, 2004