

## 230562 - MATMETA - Photonics Materials and Metamaterials

Coordinating unit:	230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit:	1004 - UB - (ENG)Universitat de Barcelona
Academic year:	2015
Degree:	ERASMUS MUNDUS MASTER'S DEGREE IN PHOTONICS ENGINEERING, NANOPHOTONICS AND BIOPHOTONICS (Syllabus 2010). (Teaching unit Optional) MASTER'S DEGREE IN PHOTONICS (Syllabus 2013). (Teaching unit Optional)
ECTS credits:	3
Teaching languages:	English

### Teaching staff

Coordinator:	Frank Güell, UB ( coord.)
Others:	Blas Garrido, UB. Ramon Herrero, UPC.

### Opening hours

Timetable:	frank@el.ub.edu (coordinator) blas.garrido@ub.edu ramon.herrero@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. 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.
3. 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.
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

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### Learning objectives of the subject

"Photonic materials and metamaterials " aims to provide the students with a solid background in fundamental concepts and mechanisms present in photonic materials. Materials are the first link in the chain of applied photonics. Their optical properties will be introduced and related with electronic band structure. These fundamental properties will serve to describe and understand the physics and technology of elemental photonic and optoelectronic structures.

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### 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

### Study load

Total learning time: 75h	Theory classes:	22h 30m	30.00%
	Practical classes:	0h	0.00%
	Laboratory classes:	0h	0.00%
	Guided study:	2h 15m	3.00%
	Self study:	50h 15m	67.00%

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### Content

#### 1. Structure and optical processes in solids

Degree competences to which the content contributes:

Description:

- 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

Degree competences to which the content contributes:

Description:

- 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

Degree competences to which the content contributes:

Description:

- 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.

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Degree competences to which the content contributes:

### Qualification system

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

### Bibliography