Last update: 08-07-2016

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: 2016

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: Ramon Herrero, UPC.

Opening hours

Timetable: frank@el.ub.edu (coordinator)
ramon.herrero@upc.edu

Degree competences to which the subject contributes

Basic:

CB6. (ENG) Poseer y comprender conocimientos que aporten una base u oportunidad de ser originales en el desarrollo y/o aplicación de ideas, a menudo en un contexto de investigación

CB7. (ENG) Que los estudiantes sepan aplicar los conocimientos adquiridos y su capacidad de resolución de problemas en entornos nuevos o poco conocidos dentro de contextos más amplios (o multidisciplinares) relacionados con su área de estudio.

CB8. (ENG) Que los estudiantes sean capaces de integrar conocimientos y enfrentarse a la complejidad de formular juicios a partir de una información que, siendo incompleta o limitada, incluya reflexiones sobre las responsabilidades sociales y éticas vinculadas a la aplicación de sus conocimientos y juicio.

CB10. (ENG) Que los estudiantes posean las habilidades de aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo.

Specific:

CE2. (ENG) Màster en Fotònica:
Demostrar que comprende las peculiaridades que comporta el modelo cuántico para la interacción luz-materia.

CE4. (ENG) Màster en Fotònica:
Demostrar que conoce los fundamentos de la formación de imagen, de la propagación de la luz a través de los diferentes medios y de la Óptica de Fourier.

CE9. (ENG) Màster en Fotònica:
Capacidad para sintetizar y exponer los resultados de investigación en fótonica según los procedimientos y convenciones de las presentaciones científicas en inglés.

Generical:

CG1. (ENG) Màster en Fotònica:
Capacidad para proyectar, diseñar e implantar productos, procesos, servicios e instalaciones en algunos ámbitos de la fotónica como los relacionados con la ingeniería fotónica, la nanofotónica, la óptica cuántica, las telecomunicaciones y la biofotónica

Transversal:

1. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data

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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

- Lectures

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.

Study load

Total learning time: 75h	Hours large group:	22h 30m	30.00%
	Hours medium group:	0h	0.00%
	Hours small group:	0h	0.00%
	Guided activities:	2h 15m	3.00%
	Self study:	50h 15m	67.00%

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Content

1. Structure and optical processes in solids	Learning time: 7h 30m Theory classes: 7h 30m

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	Learning time: 7h 30m Theory classes: 7h 30m

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	Learning time: 7h 30m Theory classes: 7h 30m

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.

Planning of activities

Activity	Hours: 2h 18m Theory classes: 2h 18m

Qualification system

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

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Bibliography

Basic:

Saleh, Bahaa E.A.; Teich, M.C. Fundamentals of photonics. 2nd. John Wiley & Sons, 2007. ISBN 9780471358329.

Klingshirn, C. F. Semiconductor optics [on line]. 3rd. Springer-Verlag, 2007 [Consultation: 29/04/2016]. Available on: <uhttp://site.ebrary.com/lib/upcatalunya/detail.action?docID=10653171>. ISBN 9783540383451.

Korvink, J.G.; Greiner, A. Semiconductors for micro and nanotechnology: an introduction for engineers. Wiley-Vch, 2002. ISBN 9783527302574.

Fukuda, M. Optical semiconductor devices. John Wiley & Sons, 1999. ISBN 0471149594.

Steiner, T. Semiconductors nanostructures for optoelectronic applications. Artech House, 2004. ISBN 9781580537513.