Last update: 06-05-2019

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: 2019

Degree: MASTER'S DEGREE IN PHOTONICS (Syllabus 2013). (Teaching unit Optional)
ERASMUS MUNDUS MASTER'S DEGREE IN PHOTONICS ENGINEERING, NANOPHOTONICS AND BIOPHOTONICS (Syllabus 2010). (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 and information in the chosen area of specialisation and critically assessing the results obtained.

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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 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:	24h	32.00%
	Self study:	51h	68.00%

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Content

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

Description:
1.1 Bulk structure, electronic levels and defects.
1.2 Elementary excitations in solids: excitons and phonons.
1.3 Optical properties of semiconductor materials.

2. Functional photonic materials.	Learning time: 7h 30m Theory classes: 7h 30m

Description:
2.1 Low dimensional materials: quantum wells, wires and dots.
2.2 Solid-State-Laser materials.
2.3 Materials and structures for solid state lighting and photovoltaic applications.

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.