Last update: 15-07-2016

230572 - MANAGL - Managing Light with Devices

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 731 - OO - Department of Optics and Optometry
Academic year: 2016
Degree: MASTER'S DEGREE IN PHOTONICS (Syllabus 2013). (Teaching unit Optional)
ECTS credits: 3 Teaching languages: English

Teaching staff

Coordinator: María S. Millán (UPC)

Others: Elisabet Pérez Cabré (UPC)

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:

CE3. (ENG) Màster en Fotònica:
Conocer los fundamentos de la física del láser, los tipos de láser y sus principales aplicaciones

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.

CE7. (ENG) Màster en Fotònica:
Capacidad de entender la ingeniería óptica como una actividad económica y empresarial considerando, entre otros, aspectos sociales, éticos y de sostenibilidad

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

CG2. (ENG) Màster en Fotònica:
Capacidad para la modelización, cálculo, simulación, desarrollo e implantación en centros de investigación, centros tecnológicos y empresas, particularmente en tareas de investigación, desarrollo e innovación en todos los ámbitos relacionados con la Fotónica.

CG4. (ENG) Màster en Fotònica:
Capacidad para entender el carácter generalista y multidisciplinario de la fótonica viendo su aplicación por ejemplo a

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la medicina, biología, energía, comunicaciones o la industria

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.
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.
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.
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

Learning objectives of the subject

This course aims to provide the students with fundamental and practical knowledge of the devices that can be used to generate (light sources), modulate (illumination systems, optical modulators, adaptive optical devices and displays) and detect optical signals (sensors and cameras), focusing on their most relevant applications to the industrial and research environments. The fundamentals of radiometry, photometry and colourimetry are reviewed. Useful tips to choose the most appropriate device to a given application will be provided. Some specific applications in machine vision are described. Lasers are not included as they are considered in other courses. Basics of optics (such as geometrical and electromagnetic optical models, and polarization), which are considered in the courses Introduction to Photonics and Beam Propagation, are assumed to be part of the background knowledge of the student.

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. Characterizing light: Spatial and spectral measurements

Learning time: 2h
Theory classes: 2h

Description:
1.1. Review of radiometric and photometric magnitudes and unities
1.2. Radiation pattern. Power/Flux and intensity. Illuminance and Luminance
1.3. Mathematical relationships between photometric magnitudes
1.4. Spectral power distribution and colour. Colourimetry.
1.5. Spectrometers and colorimeters. Measurement geometries
1.6. Practical case.

2. Light Sources

Learning time: 2h
Theory classes: 2h

Description:
2.1. Spectral and spatial characterization, luminous efficacy. Incandescent and electroluminescent sources.
2.2. LED, OLED and LEP.
2.3. Illumination systems and characterization.
2.4. Practical case with personal smartphone screens

3. Optical modulation (I) based on the acousto-optic effect

Learning time: 2h
Theory classes: 2h

Description:
3.1. Acousto-optic effect.
3.2. Devices and characteristics

4. Photodetectors

Learning time: 2h
Theory classes: 2h

Description:
4.1. Electro-optic effect
4.2. Devices and characteristics
4.3. Optical couplers

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5. Optical modulation (III) and displays	Learning time: 2h Theory classes: 2h

Description:
5.1. Adaptive optical devices
5.2. Liquid crystal devices (LCD), Liquid crystal??? spatial light modulators and displays
5.3. Other displays (CRT, LED and Plasma displays). Characterization.

6. Optical sensors and Cameras.	Learning time: 4h 30m Theory classes: 4h 30m

Description:
6.1. Power meters, array sensors and image sensors
6.2. CCD and CMOS cameras
6.3. Colour and multispectral cameras.
6.4. NIR camera
6.5. Practical case

Planning of activities

Visit to CD6 laboratories	Hours: 2h 18m Guided activities: 2h 18m

Description:
One or more practical sessions applying the course?s contents will be arranged in the research labs at CD6.

Qualification system

- Exam(60%).
- Practical task and Work (30%)
- Attending seminars and visits, class attendance and participation(10%)

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Bibliography

Basic:

Liu, J.M. Photonic devices. Cambridge: Cambridge University Press, 2005. ISBN 0521551951.

Saleh, B.E.A.; Teich, M.C. Fundamentals of photonics. 2ns ed. New York: John Wiley & Sons, 2007. ISBN 9780471358329.

Chigrinov, V.G. Liquid crystal devices. Boston: Artech House, 1999. ISBN 0890068984.

Holst, G.C. CCD arrays, cameras, and displays. 2. Winter Park, FL : JCD ; Bellingham, Wash., USA: SPIE Optical Engineering, 1998. ISBN 0964000040.

Tyson, R.K. Introduction to adaptive optics [on line]. Washington: SPIE Press, 2000 [Consultation: 13/04/2016]. Available on: <http://site.ebrary.com/lib/upcatalunya/docDetail.action?docID=10561590>. ISBN 0819435112.