

Course guide

230572 - MANAGL - Managing Light with Devices

Last modified: 30/05/2025

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 731 - OO - Department of Optics and Optometry.

Degree: MASTER'S DEGREE IN PHOTONICS (Syllabus 2013). (Optional subject).

Academic year: 2025 **ECTS Credits:** 3.0 **Languages:** English

LECTURER

Coordinating lecturer: FRANCISCO JAVIER BURGOS FERNÁNDEZ

Others: SANTIAGO ROYO ROYO
MERITXELL VILASECA RICART

PRIOR SKILLS

25

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

CE3. Know the fundamentals of laser physics, the types of lasers and their main applications.
CE4. Demonstrate knowledge of the fundamentals of image formation, propagation of light through different media and Fourier Optics.
CE7. Ability to understand optical engineering as an economic and business activity considering, among others, social, ethical and sustainability aspects
CE9. Ability to synthesize and present photonics research results according to the procedures and conventions of scientific presentations in English.

General:

CG1. Ability to project, design and implement products, processes, services and facilities in some areas of photonics, such as photonic engineering, nanophotonics, quantum optics, telecommunications and biophotonics.
CG2. Ability to modeling, calculate, simulate, develop and implement in research and technological centers and companies, particularly in research, development and innovation tasks in all areas related to Photonics.
CG4. Ability to understand the generalist and multidisciplinary nature of photonics, seeing its application, for example, to medicine, biology, energy, communications or industry

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.

Basic:

CB6. Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context

CB7. Students should know how to apply the knowledge acquired and their problem-solving ability in new or little-known environments within broader (or multidisciplinary) contexts related to their area of study.

CB8. Students should be able to integrate knowledge and face the complexity of formulating judgments based on information that, being incomplete or limited, includes reflections on the social and ethical responsibilities linked to the application of their knowledge and judgment.

CB10. Students should possess the learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous.

TEACHING METHODOLOGY

- Lectures
- Activities: practical activities in class and/or during visits to laboratories/research center. Oral presentations and/or discussions about topics related to the course.

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, filters, adaptive optical devices and displays), direct (scanners, optical couplers, interconnects), and detect optical signals (sensors and cameras, analysers), as well as of the combined (customized) optical systems. Focus on their most relevant applications to the industrial and research environments. To provide tips to choose the most appropriate device for a given application. Low-cost, smartphone-based optical instruments. Fundamentals of radiometry and photometry. Development of some specific applications, such as programmable optical components and machine vision. Development of critical thinking and reasoning.

STUDY LOAD

Type	Hours	Percentage
Hours large group	24,0	32.00
Self study	51,0	68.00

Total learning time: 75 h

CONTENTS

Characterizing light: Radiometry and Photometry

Description:

- 1.1. Review of radiometric and photometric magnitudes and units.
- 1.2. Mathematical relationships between photometric magnitudes.
- 1.3. Spectrometers and measurement geometries.
- 1.4. Practical cases.

Related activities:

Exercises and practical cases.

Full-or-part-time: 2h 30m

Theory classes: 2h 30m

Light sources and illumination systems

Description:

- 2.1. Spectral and spatial characterization. Luminous efficacy.
- 2.2. Incandescent and electroluminescent sources.
- 2.3. LED, OLED and LEP.
- 2.4. Illumination systems and its characterization.

Related activities:

Exercises and practical cases.

Full-or-part-time: 2h 30m

Theory classes: 2h 30m

Photodetectors

Description:

- 3.1. Introduction to photodetectors.
- 3.2. Photodiodes.
- 3.3. Photomultipliers.

Related activities:

Exercises and practical cases.

Full-or-part-time: 2h 30m

Theory classes: 2h 30m

Image sensors

Description:

- 4.1. CCD and CMOS technology.
- 4.2. Noise sources.
- 4.3. InGaAs sensors.
- 4.4. Characterization of image sensors.

Related activities:

Exercises and practical cases.

Full-or-part-time: 2h 30m

Theory classes: 2h 30m

Introduction to active imaging

Description:

- 5.1. Fundamentals of active imaging.
- 5.2. Key technologies.
- 5.3. Main applications.

Related activities:

Exercises and practical cases.

Full-or-part-time: 2h 30m

Theory classes: 2h 30m



Electro-optical modulators

Description:

- 6.1. The electro-optic effect.
- 6.2. Devices and characteristics.
- 6.3. Applications.

Related activities:

Exercices and practical cases.

Full-or-part-time: 2h 30m

Theory classes: 2h 30m

Magneto-optical modulators

Description:

- 7.1. The magneto-optic effect.
- 7.2. Devices and characteristics.
- 7.3. Applications.

Related activities:

Exercices and practical cases.

Full-or-part-time: 2h 30m

Theory classes: 2h 30m

Liquid crystal modulators

Description:

- 8.1. Liquid crystals
- 8.2. Types of liquid crystals
- 8.3. Spatial light modulators (intensity and phase modulators)
- 8.5. Applications

Related activities:

Exercices and practical cases.

Full-or-part-time: 2h

Theory classes: 2h

Active optical elements: deformable mirrors and liquid lenses.

Description:

- 9.1. Wavefront management using deformable mirrors. Types of deformable mirrors.
- 9.2. Focus management using liquid lenses. Types of liquid lenses.
- 9.3. Adaptive optical systems.
- 9.4. Applications.

Related activities:

Exercices and practical cases.

Full-or-part-time: 2h 30m

Theory classes: 2h 30m



GRADING SYSTEM

- Homework assessments, oral presentations and scientific and technical paper reviews and discussion. (50%)
- Written exam (50%)

BIBLIOGRAPHY

Basic:

- Liu, J.M. Photonic devices. Cambridge: Cambridge University Press, 2005. ISBN 0521551951.
- Saleh, B.E.A.; Teich, M.C. Fundamentals of photonics. 2nd ed. Hoboken: John Wiley & Sons, 2019. ISBN 9781119506874.
- Chigrinov, V.G. Liquid crystal devices: physics and applications. Boston: Artech House, 1999. ISBN 0890068984.
- Holst, G.C. CCD arrays, cameras, and displays. 2nd ed. Winter Park, FL : JCD ; Bellingham, Wash., USA: SPIE Optical Engineering, 1998. ISBN 0964000040.
- Fiete, R.D. Modeling the imaging chain of digital cameras [on line]. Bellingham, Washington: SPIE Press, 2010 [Consultation: 10/07/2019]. Available on: <https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=728496>. ISBN 9780819483362.

RESOURCES

Other resources: