

## Course guides

# 230582 - VOB - Visual Optics and Biophotonics

Last modified: 03/06/2020

**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).  
ERASMUS MUNDUS MASTER'S DEGREE IN PHOTONICS ENGINEERING, NANOPHOTONICS AND BIOPHOTONICS (Syllabus 2010). (Optional subject).

**Academic year:** 2020    **ECTS Credits:** 3.0    **Languages:** English

### LECTURER

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**Coordinating lecturer:** Pujol Ramo, Jaume

**Others:** Vilaseca Ricart, Meritxell

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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#### 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:

Mostrar 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.

CE6. (ENG) Màster en Fotònica:

Haber realizado un conjunto de prácticas de laboratorio de nivel avanzado, similar al de futuros trabajos experimentales de investigación

CE9. (ENG) Màster en Fotònica:

Capacidad para sintetizar y exponer los resultados de investigación en fotonica 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

CG4. (ENG) Màster en Fotònica:

Capacidad para entender el carácter generalista y multidisciplinario de la fotonica viendo su aplicación por ejemplo a la medicina, biología, energía, comunicaciones o la industria

#### Transversal:

CT4. (ENG) Màster en Fotònica:

USO SOLVENTE DE LOS RECURSOS DE INFORMACIÓN. Gestionar la adquisición, la estructuración, el análisis y la visualización de datos e información en el ámbito de la especialidad y valorar de forma crítica los resultados de esta gestión.

CT1. (ENG) Màster en Fotònica:

EMPREDIMIENTO E INNOVACIÓN. Conocer y entender los mecanismos en que se basa la investigación científica, así como los mecanismos e instrumentos de transferencia de resultados entre los diferentes agentes socioeconómicos implicados en los procesos de I+D+i.

CT5. (ENG) Màster en Fotònica:

INGLÉS. Acreditar un nivel adecuado de este idioma, tanto de forma oral como por escrito, en consonancia con las necesidades que tendrán las tituladas y los titulados.

CT3. (ENG) Màster en Fotònica:

TRABAJO EN EQUIPO. Ser capaz de trabajar como miembro de un equipo interdisciplinar ya sea como un miembro más, o realizando tareas de dirección con la finalidad de contribuir a desarrollar proyectos con pragmatismo y sentido de la responsabilidad, asumiendo compromisos teniendo en cuenta los recursos disponibles

**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.

**TEACHING METHODOLOGY**

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- Lectures
- Activities: - Laboratory and vision center visits
- Seminars

The student will have the possibility of performing measurements using experimental setups and commercial instruments.

**LEARNING OBJECTIVES OF THE SUBJECT**

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Visual optics and biophotonics is an innovative and multidisciplinary area that uses light-based technologies to image, examine and treat the eye and its visual performance, improving diagnosis, therapy, and follow-up care of certain diseases. Therefore, it plays a crucial role for a better visual healthcare. Examples include lasers being used routinely in laser-refractive surgery, clinical instruments developed to measure aberrations and retinal image quality, and advanced image techniques such as optical coherence tomography (OCT) and others using adaptive optics, which can provide high resolution images of the ocular structures. The course focuses on the new methods for ocular refraction correction, such as intraocular lenses and refractive surgery, the evaluation of the ocular aberrations and retinal image quality, the study of optical and photonic tools currently used for the diagnosis of diseases related with ocular structures (cornea, lens and retina), such as the Scheimpflug camera and the OCT, the last one very used in the diagnosis of glaucoma, and concludes with the study of therapeutic lasers used in ophthalmology (excimer laser for refractive surgery, femtosecond laser for cataract surgery, Nd:YAG for retinal photocoagulation etc.).

**STUDY LOAD**

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

**Total learning time:** 75 h



## CONTENTS

### Visual optics and biophotonics

#### Description:

1. Introduction to visual optics and biophotonics. An overview of the human eye. (2h)
2. Schematic and advanced eye models. (1.5h)
2. Refractive anomalies and accommodation. Presbyopia. Means of correction: ophthalmic, contact, and intraocular lenses. Refractive surgery. (4h)
3. Human eye aberrations and measurement techniques. Evaluation of ocular aberrations. Wavefront sensors for the eye: Hartmann-Shack Wavefront sensor and Laser Ray tracing. (2h)
4. Retinal image quality measurement. Double pass technique and intraocular scatter measurements. (2h)
5. Adaptive Optics for vision. Customized vision correction. (3h)
6. Measurement of the optical properties of the cornea and lens. Basic optical instrumentation. Corneal topography, Scheimpflug and Purkinje images. (2h)
7. Conventional and high resolution retinal imaging. Ophthalmoscopy, scanning laser ophthalmoscope (SLO) and Optical Coherence Tomography (OCT). (2h)
8. Lasers in Ophthalmology. (4h)

#### Related activities:

Laboratory and vision center visits, seminars

**Full-or-part-time:** 22h 30m

Theory classes: 22h 30m

## GRADING SYSTEM

- Homework assessments (35%)
- Written exam (50%)
- Oral presentation of a scientific journal paper (15%)

## BIBLIOGRAPHY

#### Basic:

- Porter, Jason. Adaptive optics for vision science : principles, practices, design and applications. Canadà: Wiley-Interscience, 2006. ISBN 9780471679417.
- Goss, David A; West, Roger W. Introduction to the optics of the eye. Boston [etc.]: Butterworth-Heinemann, 2002. ISBN 075067346X.
- Atchison, David A; Smith, George. Optics of the human eye [Recurs electrònic] [on line]. Oxford [etc.]: Butterworth Heinemann, 2000 [Consultation: 21/04/2017]. Available on: <http://www.sciencedirect.com/science/book/9780750637756>. ISBN 0750637757.
- Popp, Jürgen. Handbook of biophotonics. Weinheim, Germany : [Chichester: Wiley-VCH ; John Wiley, distributor, cop. 2011-. ISBN 9783527410484.
- Henson, David B. Optometric instrumentation. 2nd ed. Oxford [etc.]: Butterworth-Heinemann, cop. 1996. ISBN 0750607270.
- Rabbetts, Ronald B; Bennett, Arthur G. Clinical visual optics. 4th ed. Edinburgh [etc.]: Elsevier/Butterworth Heinemann, 2007. ISBN 9780750688741.
- Schwartz, Steven H. Geometrical and visual optics : a clinical introduction. New York: McGraw-Hill, cop. 2002. ISBN 0071374159.

House Style Guide. QC Memos. About Us. Company Information. Springer Nature Pleiades Press Release. Careers. Commercial Services. Atmospheric and Oceanic Optics. Editor-in-Chief: Igor V. Ptashnik Publisher: Pleiades Publishing, Ltd. Volume 34 (6 issues) is published in 2021. The journal is available online from <http://springer.com/journal/12605>. Subscription Rates, Orders, Inquiries. For information on subscription rates please contact Springer Nature Customer Service Center: [customerservice@springer.com](mailto:customerservice@springer.com). In the Americas: Springer Nature Customer Service Center LLC, Harborside Plaza II, 200 Hudson Street, Jersey City, NJ 07302, USA. Are you ready to see the optics of a long range scope explained? How Does a Long-Range Scope Work? When you pick up a rifle that is capable of firing over a long distance, you will have a lot of different things to consider before firing. Smoking may also damage optic nerves and promote macular degeneration. If you feel that your eyes are not working as well today as they did when you were younger, you can visit your eye doctor to see what is going on. The same is true if you are working outdoors and feel that your eye got scratched by some type of debris, even with your goggles in place. BioPhotonics is the global resource for research, business and product news and information for the biophotonics community and the industry's only stand-alone print and digital magazine. Stay current with a FREE subscription, and expand your knowledge of light and the life sciences through our extensive, industry-specific archives. She has covered optics, photonics, physics, and astronomy for a variety of industry and academic publications since 2000. Contributing Editor Hank Hogan holds a Bachelor of Science degree in physics from the University of Texas at Austin. He worked in the semiconductor industry and now writes about science and technology. Optical properties of tissues in the visible-NIR spectral range Alexey N. Bashkatov, E. A. Genina, V. V. Tuchin Research-Educational Institute of Optics and Biophotonics, Saratov State University; Interdisciplinary Laboratory of Biophotonics, Tomsk State University, Russia. 16. September 25, Friday. Novgorod, Russia; 3University of Toronto, Canada. JOINT INVITED LECTURE/ORAL SESSION MICROSCOPY AND LOW-COHERENCE METHODS/ PALS V (Building 10, Main Conference Hall). Chair: Kirill V. Larin, University of Houston, USA. It includes courses on photonic materials science, nanophotonics, quantum optics, optical engineering, biomedical microscopy and photonics, spectroscopy and renewable energy. Students can go on work placements and apply for Erasmus Mundus grants. Show full content. Guided Optics 3. Image Processing in Biophotonics 3. Industry Internship- Introduction 7. Industry Internship- Specialization and Report 5. Visual Optics and Biophotonics 3. Second course. Active and Adaptive Optics 2.5.