

230553 - BEAMFO - Beam Propagation and Fourier Optics

Coordinating unit:	230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit:	1022 - UAB - (ANG) pendent
Academic year:	2015
Degree:	MASTER'S DEGREE IN PHOTONICS (Syllabus 2013). (Teaching unit Compulsory) ERASMUS MUNDUS MASTER'S DEGREE IN PHOTONICS ENGINEERING, NANOPHOTONICS AND BIOPHOTONICS (Syllabus 2010). (Teaching unit Optional)
ECTS credits:	5
Teaching languages:	English

Teaching staff

Coordinator:	Juan Campos, UAB.
Others:	Salvador Bosch, UB.

Opening hours

Timetable:	juan.campos@uab.es sbosch@ub.edu
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Degree competences to which the subject contributes

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.
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.
5. 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.
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

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Learning objectives of the subject

The subject will address the basics of geometrical optics, intermediate topics of electromagnetic optics, polarization of light and anisotropic media, the fundamentals of light beam propagation and elements of Fourier optics, including concepts of digital holography.

The aim is to develop several topics (which are key for the future subjects of the Master) that usually are not covered in previous physics or engineering courses.

BIBLIOGRAPHY:

- Hetch, E., Optics, Addison Wesley Longman, Inc., 1998.

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- Born, M. and Wolf, E., Principles of Optics, Cambridge Univ. Press, 1999.
- Goodman, J. W., Introduction to Fourier Optics. McGraw-Hill, 1968.
- Keigo Iizuka, Elements of Photonics Volume I. John Wiley & Sons. 2002
- Saleh B., Teich M., Fundamentals of Photonics. John Wiley & Sons. 2007
- Novotny L., Hecht B., "Principles of nanooptics", Cambridge University Press, 2006.
- Goldstein D., "polarized light", Marcel Dekker, 2003.

Study load

Total learning time: 125h	Theory classes:	37h 30m	30.00%
	Practical classes:	0h	0.00%
	Laboratory classes:	0h	0.00%
	Guided study:	3h 45m	3.00%
	Self study:	83h 45m	67.00%

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Content

1.- Geometrical optics.

Degree competences to which the content contributes:

Description:

- 1.1.- Basic concepts. Ray tracing.
- 1.2.- Perfect and real optical systems. Aberrations. Seidel and Zernike polynomials.
- 1.3.- Review of image forming instruments.

2.- Electromagnetic optics.

Degree competences to which the content contributes:

3.- Polarization of light and anisotropic media.

Degree competences to which the content contributes:

Description:

- 3.1.- Polarization Ellipse. Jones vectors. Jones matrix. Combinations of polarizing devices.
- 3.2.- Stokes parameters. Mueller matrices. Poincaré sphere.
- 3.3.- Anisotropic media: Susceptibility of an anisotropic media. Wave propagation, normal modes. Index ellipsoid. Effective refraction index.
- 3.4.- Distortion of the index ellipsoid. Pockels effect. Liquid crystals.

4.- Fourier Transform.

Degree competences to which the content contributes:

Description:

- 4.1.- Definition and FT of some functions.
- 4.2.- The FT as a decomposition. Wave Packets. 2D FT of images.
- 4.3.- Convolution and correlation between two functions.
- 4.4.- Linear systems. Impulse response. Transfer function.

-5.- Beam propagation and focalization.

Degree competences to which the content contributes:

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Description:

- 5.1.- Angular spectrum of plane waves.
- 5.2.- Field propagators.
- 5.3.- Gaussian beams. Description and properties. Transmission through a thin lens.
- 5.4.- Other beams with particular polarization (radial, azimuthal,...)
- 5.5.- Focusing of fields through high numerical aperture systems.

6.- Fourier optics.

Degree competences to which the content contributes:

Description:

- 6.1.- Far fields in the angular spectrum representation.
- 6.2.- Coherent optical processing. Point spread function and optical transfer function. Resolving power of optical instruments.
- 6.3.- Holography (basic concepts). Digital holography.

Qualification system

- Homework + exam (>70%).

- Attending seminars, lab visits, class attendance (<20%)

To pass the course will require a quite accessible level of knowledge but high final grades will be obtained only by demonstrating enough proficiency.

Bibliography