230571 - OPTOMECH - Building Optomechanical Systems

Coordinating unit:	230 - ETSETB Barcelona School of Telecommunications Engineering
Teaching unit:	731 - OO - Department of Optics and Optometry
Academic year:	2015 - 2016
Degree:	Master's Degree in Photonics
	Erasmus Mundus Master's Degree in Photonics Engineering, Nanophotonics and Biophotonics
ECTS credits: 3	**Teaching languages:** English

Academic staff

Coordinator: Josep Arasa (UPC)   arasa@oo.upc.edu

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.

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.

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

Objectives and short description of the course

This course is focused in the optical design process, covering the opto-mechanical aspects, starting in the concept and finishing just before manufacture. The course also covers the constraints in the design process produced by mechanical, detectors, emitters and materials. The influence in the optical system is linked through the merit function. Related topics like testing are introduced only from the point of view of the proper election in the system design. Knowledge from ISO norm and optical software are also provided. The index cover the course items however the course sequence is adapted to student's software knowledge.

Study load

Total learning time: 75h	Hours large group:	22.5h	30%
	Hours medium group:	0h	0%
	Hours small group:	0h	0%
	Guided activity:	2.25h	3%
	Self study:	50.25h	67%

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Course index

1. Optical design

1.1. Conceptual design and paraxial approach. Starting from geometrical optics (considered in the course "Beam propagation & Fourier Optics") the two first stages of the design are introduced; Conceptual design & paraxial approach. Four examples of imaging optical systems are used to fix troubles.

1.2. Photometric, pupils and field apertures as design elements are introduced. Once the general design basis is fixed, the photometric weight is considered; the same four examples are updated.

1.3. Design aberration base. Seidel aberration are developed (taking as starting point course "Beam propagation & Fourier Optics") and the requirement of the Merit function concept is introduced.

2. Mechanical and building constrains

2.1. Material constrains. Introduction of the material used to build lenses. Chromatic aberration is used to explain how to select the right material, prior merit function is updated with the new constrains.

2.2. Manufacturing and testing constrains. The manufacturing process and the testing process, itself, force to skip a large number of solutions, the course is stopped in the building process at this level.

2.3. Emitters and receivers constrains. Emitters and receivers, also, introduces restrictions in the performances that can be achieved, these constrains must be interpreted as changes in the merit function.

3. Detailed opto-mechanical design

3.1. Redesign process. A full optimization process of the optical system is carried out,

3.2. Fitting the optical design with the manufacturer availability surface test plates.

3.3. Tolerance analysis and assembling. Index of manufacturing processes. Uses of compensators

4. Delivering ready to print opto-mechanical design

4.1. ISO 10110 norm. The international drawing norm for optical designs

4.2. Additional information required

5. Optical software

5,1. Optical software. Optical software capabilities are explained along all the course. Software is not provided by the course

Qualification system

Exam (40%)
Homework (set of 4 exercises to be delivered) (60%)
To pass the course will require a quite accessible level of knowledge but high final grades will be obtained only by demonstrating enough proficiency.

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Bibliography

The course will include only parts of these references, at an appropriate level:

- Hetch, E., Optics, Addison Wesley Longman, Inc., 1998.
- Born, M. and Wolf, E., Principles of Optics, Cambridge Univ. Press, 1999.
- Smith, W.J., Modern Optical Engineering, Spie Press – McGraw-Hill, 2000.
- P.R.Yoder Jr., Opto-mechanical System Design, Taylor and Francis 2006.
- H.H.Karow, Fabrication of optical elements, Wiley 1993.
- S.Baumer, Handbook of plastic optics, Wiley 2005.