



## Course guides

# 230565 - ULTRA - Ultrafast and Ultraintense Laser Light

Last modified: 11/06/2020

**Unit in charge:** Barcelona School of Telecommunications Engineering  
**Teaching unit:** 748 - FIS - Department of Physics.

**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:** Jose Trull, UPC

**Others:** Jens Biegert, ICFO

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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#### Specific:

CE2. (ENG) Màster en Fotònica:

Demostrar que comprende las peculiaridades que comporta el modelo cuántico para la interacción luz-materia.

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.

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

#### 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. 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.

3. 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. (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

**LEARNING OBJECTIVES OF THE SUBJECT**

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The course will give an overview on the challenges to produce ultra-short and ultra-intense laser light as well as highlight the different physical effects and possibilities pertaining to their usage. We will highlight state of the art methods and novel possibilities at the frontier of science

**STUDY LOAD**

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

**Total learning time:** 75 h

**CONTENTS**

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**1- Ultrashort laser and X-ray pulses (J. Biegert)**

**Description:**

- 1.1. Basic concepts for ultrabroadband pulses
- 1.2. Issues in amplification / OPCPA
- 1.3. Few-cycle pulse propagation
- 1.4. Few-cycle pulses / the absolute phase / frequency combs
- 1.5. High-harmonic generation, X-ray and Attosecond pulse generation

**Full-or-part-time:** 11h 15m

Theory classes: 11h 15m



## 2- Pulse characterization (J. Trull)

### Description:

- 2.1. General issues
- 2.2. Short pulse characterization
- 2.3. Reconstructions methods
- 2.4. Spatio-temporal characterization
- 2.5. Pulse shaping techniques

**Full-or-part-time:** 11h 15m

Theory classes: 11h 15m

## ACTIVITIES

### Visit to the Attoscience lab at ICFO during the activities week

**Full-or-part-time:** 2h 18m

Theory classes: 2h 18m

## GRADING SYSTEM

- Homework + exam (70% + 30%)

Homework will be given for the three main sections of the course plus a final exam. Active participation in the class is an important aspect and will influence the final grades significantly.

## BIBLIOGRAPHY

### Basic:

- Trebino, R. Frequency-resolved optical gating : the measurement of ultrashort laser pulses. Boston: Kluwer Academic, 2000. ISBN 9781402070662.
- Milonni, P.W.; Eberly, J.H. Lasers physics. Hoboken, NJ: John Wiley & Sons, 2010. ISBN 9780470387719.
- Diels, Jean-Claude. Ultrashort laser pulse phenomena [on line]. 2nd. Academic Press, 2006 [Consultation: 19/05/2016]. Available on: <http://www.sciencedirect.com/science/book/9780122154935>. ISBN 9780122154935.