Course guide
230565 - ULTRA - Ultrafast and Ultraintense Laser Light

Last modified: 19/06/2024

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).

Academic year: 2024 **ECTS Credits:** 3.0 **Languages:** English

LECTURER

Coordinating lecturer: Consultar aquí / See here:

Others: Consultar aquí / See here:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE2. Demonstrate the understanding of the peculiarities of the quantum model for light-matter interaction.
CE4. Demonstrate knowledge of the fundamentals of image formation, propagation of light through different media and Fourier Optics.
CE9. Ability to synthesize and present photonics research results according to the procedures and conventions of scientific presentations in English.

Generical:
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.

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. 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

LEARNING OBJECTIVES OF THE SUBJECT

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

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

Total learning time: 75 h

CONTENTS

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:
- 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.
- Milonni, P.W.; Eberly, J.H. Lasers physics. Hoboken, NJ: John Wiley & Sons, 2010. ISBN 9780470387719.
- Trebino, R. Frequency-resolved optical gating : the measurement of ultrashort laser pulses. Boston: Kluwer Academic, 2000. ISBN 9781402070662.