Nanophotonics

Academic Year: (2019 / 2020) **Review date: 29/04/2020 11:13:38**

Department assigned to the subject:

Coordinating teacher: GARCIA CAMARA, BRAULIO

Type: Electives ECTS Credits : 3.0

Year : 1 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

The students are expected to have attended the mandatory courses of the Master. It is also highly recommended to have skills in physics, optics and electromagnetism.

OBJECTIVES

Basic Skills

- Knowledge and understanding that provide a basis or opportunity for originality in developing and / or applying ideas, often in a research context.
- That the students can apply their knowledge and ability to solve problems in new or unfamiliar in wider or multidisciplinary environments related to their field of study.
- That the students can integrate their knowledge, as well as handle the complexity of making judgements from an incomplete or limited information, but which could include reflections about the social and ethic responsibilities that could be linked to the application of their judgements and knowledge.
- That the students possess learning skills that allow them following their long-life learning in a self-conducted and self-sufficient way.

General Skills

- Ability to propose, design, implement and maintain a system with photonic components for a specific application

Specific Skills

- Handling of tools aiming to design photonic devices and systems.
- To be aware of the current trends in different applications of photonic technologies and learned experiences from real cases.
- Capacity of selecting novel photonic components, technologies and subsystems.
- Capacity of designing photonic devices, passive and active, and of evaluating its performance
- Capacity of effectively searching information, as well of identifying the state of the art in a technological problem in the field of photonic devices and systems.

DESCRIPTION OF CONTENTS: PROGRAMME

T1. Basic Concepts. Definition of near- and far-field. Evanescent waves. Optical response of subwavelength structures. Diffraction limit.
T2. Light-matter interaction at the nanoscale. Scattering. Absorption. Extinction. Mie theory.
T3. Fabrication techniques of nanophotonic structures. Top-down (nanolithography, nanoimprint, etc.) and bottom-up (self-assembly) techniques.
T4. Characterization techniques. Near-field optical microscopy (NOM), confocal microscopy, Atomic-force microscopy (AFM).
T5. Plasmonics and Resonant Dielectric Nanoparticles. Surface plasmon resonances (SPRs) and localized surface plasmon resonances (LSPRs): concept and applications. High refractive index dielectric nanoparticles: electric and magnetic response.

T6. Non-linear nanophotonics. Second and third harmonic generation.
T7. Photonic Crystals and Nanostructured Optical Fibers.
T8. Single-photon emitters. Nanoparticles and quantum dots.
T9. Metamaterials. Engineered optical properties, Left-handed materials, artificial magnetism, chirality.
T10. Nanophotonics at the Marketplace. Applications: Sensing, solar energy, biomedical applications , etc.

LEARNING ACTIVITIES AND METHODOLOGY

Learning activities

-Lectures
-Work using numerical tools, demonstration of experiments in the lab.
-Individual work developing a work that will be presented in class and discussed in group.

Methodology

- Exhibitions in class with teacher support and audiovisual media, in which the main concepts of matter are developed and the literature is provided to supplement student learning.
- Critical reading of subject texts recommended by the teacher: newspaper articles, reports, manuals and / or academic papers, either for later discussion in class, either to expand and consolidate the knowledge of the subject.
- Resolution of practical cases, problems, etc. posed by the teacher individually or in groups.
- Preparation and defense of papers and reports individually or in groups.

ASSESSMENT SYSTEM

% end-of-term-examination/test:	40
% of continuous assessment (assigments, laboratory, practicals…):	60

Ordinary Call:
- The attendance and class participation will be evaluated by solving problems (10%).
- The student will develop a work during the course. The results will be presented in class and discussed by all the students (50%).
- At the end of the course the students will have to fill a brief questionnaire about the topics of the subject (40%).

Extraordinary Call:
- The student may follow the continuous evaluation procedure with the same structure as in the ordinary call, or go for a final exam (100% of the final grade).

BASIC BIBLIOGRAPHY

- L. Novotny, B. Hecht Principles of Nano-optics, Cambridge University Press, 2012

- P.N. Prasad Nanophotonics, Wiley Interscience, 2004

ADDITIONAL BIBLIOGRAPHY

- C. Bohren, D.R. Huffman Absorption and scattering of light by small particles. , John Wiley and sons, 1983

- M. Ohtsu, H.Nori Near-field nano-optics, Klumer Academics, 1999