

Subject:	Nanophotonics
Semester:	Spring
Credits ECTS:	2.5
Professors:	Dr. Mario Montes Usategui mario_montes@ub.edu Dr. Ignasi Juvells Praderas ignasi.juvells@ub.edu
Department / Faculty:	Dept. Optics and Applied Physics Physics Faculty UB.

Objectives:

The objective of the subject is to give a clear idea of the photonics and optics capabilities in the nanometric scale, both scientific and technologic. The student will learn to recognize this two areas and will get familiar with the optical phenomena that is produced at under the wavelength due to the intrinsic possibility of supply techniques and tools to other areas of Nanoscience.

Recommendations / Requisites and Background:

There are no limitation or requisites. However is convenient that the student holds a basic background of optics, electromagnetism and solid state physics.

Contents:

1. Introduction to the Photonics:

Review of the basic concepts from electromagnetism and Geometrical optics. Lasers Introduction. Diffraction. Abbe-Rayleigh resolution limit.

2. Near-field Optics:

Total Deflexion. Evanescent waves. TIRF Microscopy. Plane-wave spectrum: propagating and evanescent plane waves. Super resolution. Scanning near-field optical microscope. (SNOM), Photon scanning tunnelling microscopy (PSTM).

3. Nanophotonics in semiconductors, Quantum confinement:

Quantum Wells, wires and dots. Optical Properties and Applications.

4. Nanophotonics in metals:

Basic metallic optics. Plasma frequency. Surface Plasmon and Polaritons. Generation and propagation. Plasmonics: devices and nano optic circuits.

5. Photonic Crystals:

Photonic bandgap (PBG). PBG structures. Construction methods. Applications: wave guides and photonic crystals fibres, optical microcavities.

6. Biophotonics:

Photons and momentum. Optical traps and vortex. Optic nanomanipulation technology. Calibration methods and force measurement. Single molecule experiments.

Plan:

Lecture sessions:	20 h.
Independent work:	14 h.
Study :	35 h.

The course topics will be taught along the 20 hours of lectures sessions. Also the student should solve between 3 and 4 practical exercises during the course. Additionally the student should do a individual presentation about one of the topics of the course and make a public presentation of this work at the end of the semester.

Bibliography

1. "Fundamentals of Photonics", B. E. A. Saleh and M. C. Teich, Wiley Interscience (1991)
2. "Near Field Microscopy and Near Field Optics", D. Courjon, Imperial College Press (2003)
3. "Nanophotonics", P. N. Prasad, Wiley Interscience (2004)
4. "Surface plasmon subwavelength optics", W. L. Barnes, A. Dereux, and T. Ebbesen, Nature 424, 824-830 (2003)
5. "Photonic Crystals", J. D. Joannopoulos, R. D. Meade, and J. N. Winn, Princeton University Press (1995)
6. "Introduction to Biophotonics", P. N. Prasad, Wiley Interscience (2003)