SUBJECT TEACHING GUIDE

1021 - Light-Material Interaction

University Master's Degree in the Science and Engineering of Light

Academic year 2024-2025

1. IDENTIFYING DATA					
Degree	University Master's Degree in the Science and Engineering of Light			Type and Year	Compulsory. Year 1
Faculty	School of Industrial Engineering and Telecommunications				
Discipline					
Course unit title and code	1021 - Light-Material Interaction				
Number of ECTS credits allocated	6	Term		Semester based (1)	
Web					
Language of instruction	Spanish	English Friendly	Yes	Mode of delivery	Face-to-face

Department	DPTO. FISICA APLICADA
Name of lecturer	PABLO ALBELLA ECHAVE
E-mail	pablo.albella@unican.es
Office	Facultad de Ciencias. Planta: + 3. INVESTIGADOR P. RAMON Y CAJAL (3028)
Other lecturers	YAEL GUTIERREZ VELA

3.1 LEARNING OUTCOMES
- - The student will be able to understand the classical and semiclassical theories of Radiation-Matter interaction.
- - The student will know the basic concepts of polarimetry.
- - The student will know the basic techniques of classical spectroscopy of atoms, molecules and solids.
- - The student will become familiar with the recent field of nanophotonics and its current applications.
- - The student will be able to use numerical-computational techniques for modeling and solving real problems involving light-matter interaction.

4. OBJECTIVES
The objective of the course is to understand the classical and semi-classical theories of light-matter interaction and their application in different fields. The student will learn the basic concepts of polarimetry and some of the techniques of classical spectroscopy. The student will be introduced to the field of nanophotonics and the area of plasmonics, which are topics of high scientific importance and technological relevance that require advanced knowledge of the interaction of light with matter at the nanoscale level. Finally, the student will learn numerical-computational techniques that will allow him/her to model and solve real problems involving light-matter interaction.

6. SUBJECT PROGRAM	
CONTENTS	
1	1 INTRODUCTION/REVIEW: 1.1 What is light? 1.2 Description and characterization of the matter. 1.3 Electromagnetic theory (Maxwell's equations and their meaning) and their meaning) 1.4 Ligtht Scattering
2	2 CLASSICAL MODELS OF INTERACTION LIGHT-MATTER INTERACTION: 2.1 Lorentz theory 2.2 Lorentz-Lorenz model. 2.3 Drude-Lorentz.
3	3 POLARIZATION THEORY: 3.1 Specification of Polarized light. 3.2 Jones matrix 3.3 Stokes parameters. 3.3 Mueller matrix.
4	4 INTERFEROMETRY AND SPECTROSCOPY: 4.1 Introduction (concept of coherence, diffraction and interference). 4.2 Interferometry (by division of front, amplitude or multi-wave) 4.3 Classical spectroscopy techniques (atomic and molecular, molecular molecular, emissionand absorption)
5	5 INTRODUCTION TO NANOPHOTONICS 5.1 Modern optics 5.2 Mie theory 5.3 Plasmonics 5.4 Applications of plasmonics
6	6 NUMERICAL/COMPUTATIONAL TECHNIQUES FOR SOLVING ELECTROMAGNETIC ELECTROMAGNETIC PROBLEMS: 6.1 Discrete Coupled Dipole Method (DDA) 6.2 Finite Difference in the Time Domain (FDTD)

7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
Submitting Reports about projects related to the items of the subject.	Work	No	Yes	60,00
Exam	Written exam	Yes	Yes	20,00
Performing lab experiments.	Others	No	No	20,00
TOTAL				100,00

Observations

- In order to pass the course, students must complete/submit all the required work.
- In case the student does not pass the course in the ordinary period, he/she will have to take an exam in the extraordinary period, in which 80% of the grade will correspond to the exam and the remaining 20% to the work and lab experiments carried out throughout the course.

Notice that: It is foreseen the remote evaluation of the works, laboratory practical exercises and written tests, in the case of a medical alert makes it impossible to carry out the evaluation in person.

Observations for part-time students

- Time Schedules will be adapted, as far as possible, to facilitate the realization of both, the laboratory experiments and the exams.

8. BIBLIOGRAPHY AND TEACHING MATERIALS

BASIC

- J. Casas, “Óptica”, Librería Pons. Zaragoza (1994).
- E. Hecht “Óptica”, 3ª Edición. Adison-Wesley Iberoamericana. Madrid (2000).
- L. Novotny and B. Hecht, "Principles of Nano-Optics", Cambridge University Press, (2012).
- B.E.A. Saleh y M.C. Teich “Fundamentals of Photonics”, John Wiley & sons. New York (1991).