Bachelor in Physics
(Academic Year 2021-22)

Optics				**Code**	800500	**Year**	2nd	**Sem.**	2nd
Module	General Core	**Topic**	Classical Physics			**Character**	Obligatory		

	Total	**Theory**	**Exercises**
ECTS Credits	7.5	4.5	3
Semester hours	67.5	37	30.5

Learning Objectives (according to the Degree's Verification Document)

1. To get knowledge of the polarized light representations.
2. To understand light propagation in homogenous medium.
3. To understand the coherence concept.
4. To get knowledge of interference and diffraction processes and fundaments in interferometers and diffraction grating.

Brief description of contents

Polarization and electromagnetic waves in vacuum. Light propagation in homogeneous medium. Coherence. Interference. Interferometers. Scalar Diffraction Theory. Resolution power. Diffraction granting.

Prerequisites

Algebra. Calculus. Physics Fundamental.

Coordinator	José A. Rodrigo Martín-Romo			**Dept.**	OP
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Theory/Exercises – Schedule and Teaching Staff

Group	Lecture Room	Day	Time	Professor	Period/ Dates	Hours	T/E	Dept.
B	7	Mo,Tu Fr	10:30-12:00 10:00-12:00	Ángel S. Sanz Ortiz	Full semester	67.5	T/E	OP

T: Theory, E: Exercises

Office hours

Group	Professor	Schedule	E-mail	Location
B	Ángel S. Sanz Ortiz	We, Th: 10:00-13:00h	a.s.sanz@fis.ucm.es	Office O1-D06 First floor

Syllabus

1.- Electromagnetic waves in vacuum: Electromagnetic spectrum. Monochromatic waves. Maxwell's equations. Poynting vector. Electromagnetic plane waves. Characterization of polarization.

2.- Light propagation through homogeneous media: Optical characterization of media. Refractive index. Reflection and refraction of light. Scalar theory of light propagation through homogeneous media.

3.- Interference: Introduction to the Theory of Coherence. Field superposition. Interferometers.

4.- Scalar theory of Diffraction: Fraunhofer and Fresnel approximations. Resolving power of optical instruments. Diffraction gratings. Introduction to spatial-frequency filtering.

Bibliography

Basic:

A. Ghatak, *Optics* (Tata McGraw-Hill, 6th Ed., 2017).

R. Guenther, *Modern Optics* (John Wiley & Sons, 1990).

E. Hetch, *Optis* (Pearson Addison-Wesley, John Wiley & Sons, 2016).

F.L. Pedrotti, L.M. Pedrotti, L.S. Pedrotti, *Introduction to Optics* (Pearson International Edition, 2006).

Supplementary:

M. Born and E. Wolf, *Principles of Optics* (Cambridge University Press, 1999).

R. Feynman, *The Feynman lectures on Physics* (New Millenium edition, 2006).

K. K. Sharma, *Optics. Principles and Applications* (Academic Press, 2006).

Online Resources

- Teaching material (notes, presentations, videorecordings, web links with pedagogical interest, etc.) used in theory lectures and practice sessions will be made available through the Virtual Campus.
- Online tutoring/mentoring, either individual or group sessions, with the format of video conferences (through Microsoft Teams, Google Meet, Zoom) upon prior appointment, or by email.

Methodology

On-campus teaching 100% (Scenario 0)

The course includes the following training activities:

– Theory lectures, where the contents of the course will be presented and discussed, illustrated by means of examples and applications.

– Practice sessions, aimed at problem solving and where teaching experiences may also be delivered, as well as other activities, e.g., focused discussions, oral presentations, etc.

– Tutorials, aimed at discussing and solving technical questions either at a personal level or in small groups.

In the classroom, the teacher may make use of the blackboard, multimedia resources (e.g., projected presentations), computer simulations, etc.

The Virtual Campus will be used to promote and support both the contact and the exchange of information with students.

Semi-online teaching (Scenario 1)
Modality "A": - Theory lectures and practice sessions (problem solving, experimental demonstrations) will be delivered in person for part of the students. These contents are synchronously broadcast by the telematic means habilitated for the purpose, so that they can also be followed in real time, at a distance, by the other part of the students. All classes will be recorded, so that any student may revisit the contents at any later time. - Tutoring activities will be face to face or online, either with the format of video conferences (through Microsoft Teams, Google Meet, Zoom) upon prior appointment, or by email.
Online teaching (Scenario 2)
- Theory lectures and practice sessions (problem solving and, whenever possible, experimental demonstrations) will be live broadcast, in substitution of all in person teaching activities. All classes will be recorded, so that any student may revisit the contents at any later time. - Given the difficulties entailed by this fully online learning methodology, in case it is needed, an alternative (online) flipped-learning methodology will be implemented instead in order to favor and reinforce the understanding and handling of the physical concepts introduced. To this end, theory will be introduced through pre-recorded shorts, which online classes will be rather devoted to solve practical applications (in the form of problems) and discussions of phenomena and experiments. - All tutoring activities will be online either with the format of video conferences (through Microsoft Teams, Google Meet, Zoom) upon prior appointment, or by email.

Evaluation Criteria		
Exams	**Weight:**	55 %
There will be a written final exam.		
Other Activities	**Weight:**	45 %
Along the term, there might be 2 or 3 written midterm examinations during teaching hours, as well as other supplementary activities, such as delivery of problems and exercises proposed by the teacher, activities through the Virtual Campus, etc.		
Final Mark		

The final mark will comprise the following contributions:

* A written final examination covering all the contents delivered in the course, with two independent parts: either a quiz or a test with brief questions, and a problem solving exam.

* A summative assessment coming up from two contributions:
  - Written midterm examinations, each consisting of either a quiz or a test with brief questions.
  - Other activities performed either in the classroom or outside.

The final mark, on a 0-10 scale, will be:

$$F = 0.55\ F2 + \mathrm{Max}(0.45\ F1,\ 0.35\ ME + 0.1\ OA)$$

F = Final mark.
F1 = Final written examination: part concerning the quiz or brief questions.
F2 = Final written examination: part concerning the problem solving.
ME = Average arising from the written midterm examinations.
OA = Other activities.
Any mark in the equation is on a 0-10 scale.
Should the score obtained from the summative assessment be ME > 5, the part of the final mark concerning the quiz or brief questions F1 can be skipped. Yet the student might carry it out in order to get a higher score.
The marks ME and OA considered in the May-June ordinary final exam will also be kept, would it be the case, for the July extraordinary final exam.