Bachelor in Physics
(Academic Year 2021-22)

Photonics		**Code**	800526	**Year**	4th	**Sem.**	1st
Module	Applied Physics	**Topic**	Obligatory of Applied Physics	**Character**	Optional		

	Total	**Theory**	**Exercises/Lab**
ECTS Credits	6	4.2	1.8
Semester hours	43	30	10 | 3

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

- *Know the fundamentals of Photonics.*
- *Understand and manage the phenomena associated with anisotropy and polarization: birefringence, dichroism, etc.*
- *Understand the processes and devices involved in the emission and radiation of light*

Brief description of contents

Light propagation in matter; birefringence, dichroism and phenomena associated with polarization; radiation emitters and detectors; introduction to laser; photonic devices.

Prerequisites

It is recomended to have taken the subject of Optics, Electromagnetism II and the Laboratory of Physics III.

Coordinator	Oscar Martinez Matos		**Dept.**	Optics
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Theory/Exercises – Schedule and Teaching Staff

Group	Lecture Room	Day	Time	Professor	Period/ Dates	Hours	T/E	Dept.
B	7	Tu,Th	14:00-15:30	Laura Martinez Maestro	Whole semester	40	T	Optics

T: Theory, E: Exercises

Office hours

Group	Professor	Schedule	E-mail	Location
B	Laura Martinez Maestro	Mo: 10:00-12:00 Th: 15:00-17:00 Fr: 15:00-17:00	Lauram40@ucm.es	O1-D14

Teaching Labs – Schedule and Teaching Staff					
Group	**Lecture Room**	**Sessions**	**Professor**	**Hours**	**Dept.**
L2	205.A	Tu 14/12/2021; 14:00-15:30 Th 16/12/2021; 14:00-15:30	Laura Martinez Maestro	30	Optics

Syllabus

• Introduction.

• Propagation and interaction of light in material media:

- Measurable parameters.
- Temporary dispersion. Kramers-Krönig relations.
- Anisotropic media. Birefringence and dichroism. Applications (phase shifting films and polarizers).
- Optically active media.
- Induced anisotropies: Faraday Effect, Spatial Light Modulators, etc.
- Non-linear optics effects: Optical Kerr effect.

• Waveguides and optical fibers: modes, propagation speed, dispersion, attenuation.

• Emitters and radiation properties:

- Spontaneous and stimulated emission.
- Spectral line profile.
- Types of light sources.
- Statistics of photons in types of laser, thermal, quantum radiation.
- The laser: Equations of balance, gain, threshold, resonators, types of lasers.

• Photodetectors: Types and characteristics.

Bibliography

- J. M. Cabrera, F. J. López y F. Agulló. Óptica Electromagnética, Addison-Wesley Iberoamericana, Wilmington 1993.
- J. M. Cabrera, F. Agulló y F. J. López, Óptica Electromagnética Vol. II: Materiales y Aplicaciones, Addison Wesley/Universidad Autónoma de Madrid 2000.
- W. Demtröder, Atoms, Molecules and Photons. Springer 2006.
- G. R. Fowles, Introduction to Modern Optics, Dover, New York 1989.
- A. Ghatak, Optics,Mc Graw Hill, 2010
- M. Fox, Quantum Optics. An Introduction, Oxford Univ. Press 2006.
- D. J. Hagan, P.G. Kik, Light-Matter Interaction. Document Open Access 2013- OSE5312.
- F. G. Smith, T. A. King and D. Wilkins, Optics and Photonics. An Introduction, Wiley 2007.
- B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons 2007.

Online Resources

- The teaching material (notes, presentations, videos, links, etc.) used in the classes of theory and practices will be available on the Virtual Campus.

- The tutorials can be carried out by videoconference, through the Virtual Campus of the subject, by email or through any other procedure, prior communication to the teacher or professor.

Methodology

On-campus teaching 100% (Scenario 0)

• Theory lessons where the main concepts of the subject will be explained, including examples and applications.

• Practical classes of problems and directed activities.

• Seminars on current topics.

• Laboratory experiments.

• Specialized works on specific topics will be proposed to be carried out in a group or individually.

• Exams from previous calls will be provided.

• Series of problem statements will be provided in advance of their resolution in class. Likewise, the delivery of resolved problems will be promoted.

• A bibliography available in the Faculty Library will be provided.

• The Virtual Campus will be used.

Semi-online teaching (Scenario 1)

THEORETICAL-PRACTICAL CLASSES IN THE CLASSROOM

Classes will be taught in the usual regime, attending in person only one of the student subgroups. The rest of the students will follow the class remotely, rotating weekly each in person subgroup. The class will be taught according to Modality A. The class can be followed remotely in real time through available Internet resources. In addition, additional material will be uploaded to the Virtual Campus such as notes, slides, exercises, etc. Likewise, classes could be recorded so that they are available on the Virtual campus.

TUTORIALS:

They can be done in person, through videoconference or the Virtual Campus of the subject, by email or through any other appropriate procedure, prior communication to the professor.

PRACTICAL CLASSES IN THE LABORATORY

All students will be able to do two practices in person and individually.

Online teaching (Scenario 2)

THEORETICAL-PRACTICAL CLASSES

Support material will be posted on the Virtual Campus to facilitate remote monitoring of the teaching. Classes will be taught during the official schedule through appropriate internet resources so that all students can follow the explanations virtually and make questions.

The class may be synchronous or explanations recorded in advance will be uploaded. In the second case class time will be dedicated to clarifying concepts and solving doubts and exercises. They could also Classes should be recorded so that they are available on the Virtual campus.

PRACTICAL CLASSES IN THE LABORATORY

The two practices would be done at home using demonstration videos of the same, as well as data provided by teachers and additional explanations if necessary.

TUTORIALS:

They may be carried out by videoconference, through the Virtual Campus of the subject, by email or through any other appropriate procedure, prior communication to the professor.

Evaluation Criteria		
Exams	**Weight:**	70%
Mandatory final exam		
Other Activities	**Weight:**	30%
The following activities will be valued: -Delivery of proposed problems. -Possible exercises of short duration carried out during class hours and which will be online presence is not possible. -Laboratory practices. There will be two laboratory practices at the end of the semester of individually as already indicated. - Other activities		
Final Mark		
A = Final exam grade on a scale of 0-10 B = Score of other evaluation activities on a scale of 0-10 The final grade C will be the maximum between the continuous assessment grade, C = 0.7 A + 0.3 B, and the final exam grade, C = A. Only the percentages of the continuous evaluation can be applied when the A grade is equal to or greater than 4.5. To pass the course it will be necessary to obtain a final grade equal to or greater than C = 5. The qualification of the extraordinary call will be obtained following the same procedure of evaluation.		