Bachelor in Physics
(Academic Year 2024-25)

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	45	30	11 | 3

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

- *To know the fundamentals of Photonics.*
- *To understand and manage the phenomena associated with anisotropy and polarization: birefringence, dichroism, etc.*
- *To 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 advisable to have completed the subjects of Optics, Electromagnetism II and Laboratory of Physics III.

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

Group	Lecture Room	Day	Time	Professor	Period/ Dates	Hours	T/E	Dept.
B	14	Tu, Th	14:30-16:00	Rosa Weigand Talavera	Full term	42	T/E	OPT

Office hours				
Group	**Professor**	**Schedule**	**E-mail**	**Location**
B	Rosa Weigand Talavera	Mo, We, Fr 12:00 - 14:00	weigand@ucm.es	01.305.0

Teaching Labs – Schedule and Teaching Staff					
Group	**Lecture Room**	**Sessions**	**Professor**	**Hours**	**Dept.**
L3	205.A	We: 11/12/24 14:30-16:00 Th: 12/12/24 14:30-16:00	Rosa Weigand Talavera	3	Optics

Syllabus

- Introduction.
- Propagation and interaction of light in material media:
  - Measurable parameters. Stokes parameters.
  - Temporal dispersion. Kramers-Krönig relations.
  - Anisotropic media. Birefringence and dichroism. Applications (retarder plates and polarizers).
  - Optically active media.
  - Induced anisotropies: Faraday Effect and Light Modulators
  - Non-linear optical effects: Optical Kerr effect.
- Waveguides and optical fibers: modes, propagation velocity, dispersion, attenuation.
- Emitters and radiation properties:
  - Spontaneous and stimulated emission.
  - Spectral line profiles.
  - Types of light sources.
  - Types of radiation.
  - The laser: Rate equations, 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 (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
The main concepts of the subject with be explained in theory lectures that will include examples and applications. • Practical lectures (problems and guided activities). • Laboratory sessions. • A series of problem statements will be provided prior to their resolution during lectures. • Bibliography available in the Faculty Library will be provided. • Use of the Virtual Campus.

Evaluation Criteria		
Exams	**Weight:**	70%
Mandatory final exam. An intermediate exam, eliminatory of part of the subject, could be taken.		
Other Activities	**Weight:**	30%
The following activities will be valued: - Delivery of proposed problems. - Possible short-duration exercises carried out during lecture hours. - Laboratory sessions. Two laboratory sessions will be carried out at the end of the semester. - 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 For those students who had passed the intermediate exam (mark greater or equal to 5) the mark A is the mean between the mark of the intermediate exam and the second part of the final exam. 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. The percentages of the continuous evaluation can be applied only when the A grade is equal to or greater than 5. A final grade equal to or greater than C = 5 will be necessary to pass the course. The mark of the extraordinary call will be obtained following the same procedure of evaluation.		