

Academic Year: ( 2022 / 2023 )

Review date: 16-05-2022

Department assigned to the subject: Electronic Technology Department

Coordinating teacher: ACEDO GALLARDO, PABLO

Type: Compulsory ECTS Credits : 6.0

Year : 4 Semester : 2

**REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)**

Electromagnetism and Optics  
 Solid State Fundamentals for Engineering  
 Electronic Engineering Fundamentals  
 Statistical Physics

**OBJECTIVES**

To learn the fundamentals of light emission, propagation and detection using photonic devices and components based on the fundamental principles of light-matter interaction.

Introduction to the different fields of application of photonics in science and engineering.

**DESCRIPTION OF CONTENTS: PROGRAMME**

- 1.- Revision: Electromagnetic waves propagation. Light as an electromagnetic wave.
- 2.-Light propagation in free space. Geometrical, undulatory and beam optics concepts. Interference and diffraction. Polarization of light.
- 3.-Light propagation in linear dielectric media. Dispersion. Integrated waveguides. Optical fibers and optical fiber components.
- 4.- Revision: Light as a particle: the photon. The black body radiation spectrum. Light-matter interaction: emission and absorption of light. Introduction to quantum states of light.
- 5.-Coherent emission of light: lasers. Stimulated emission and the laser effect. Working principles of lasers: Rate Equations. Types of lasers. Gas lasers, solid-state lasers, Semiconductor lasers (Edge emitting lasers and VCSELs), Quantum cascade lasers, Fiber optic lasers, Pulsed lasers: mode-locked lasers. Other (non-coherent) light Sources: LEDs.
- 6.- Light detection. Ideal photon detector. Responsivity. Heterodyne or coherent detection. Detection noise and classical detection limit (shot noise). Types of photon detectors: photodiodes, photomultipliers, CCDs,  $\gamma$
- 7.- Other important photonic components: Electro-optics and acousto-optic modulators, Spatial light modulators.
- 8.- Photonics systems and subsystems examples

**LEARNING ACTIVITIES AND METHODOLOGY**

- AF1. THEORETICAL-PRACTICAL CLASSES. Knowledge and concepts students must acquire. Receive course notes and will have basic reference texts. Students partake in exercises to resolve practical problems
- AF2. TUTORING SESSIONS. Individualized attendance (individual tutoring) or in-group (group tutoring) for students with a teacher. Subjects with 6 credits have 4 hours of tutoring/ 100% on-site attendance.
- AF3. STUDENT INDIVIDUAL WORK OR GROUP WORK. Subjects with 6 credits have 98 hours/0% on-site.
- AF8. WORKSHOPS AND LABORATORY SESSIONS. Subjects with 3 credits have 4 hours with 100% on-site instruction. Subjects with 6 credits have 8 hours/100% on-site instruction.
- AF9. FINAL EXAM. Global assessment of knowledge, skills and capacities acquired throughout the course. It entails 4 hours/100% on-site
- MD1. THEORY CLASS. Classroom presentations by the teacher with IT and audiovisual support in which the subject's main concepts are developed, while providing material and bibliography to complement student learning
- MD2. PRACTICAL CLASS. Resolution of practical cases and problem, posed by the teacher, and carried out individually or in a group
- MD3. TUTORING SESSIONS. Individualized attendance (individual tutoring sessions) or in-group (group tutoring sessions) for students with teacher as tutor. Subjects with 6 credits have 4 hours of

tutoring/100% on-site.

MD6. LABORATORY PRACTICAL SESSIONS. Applied/experimental learning/teaching in workshops and laboratories under the tutor's supervision.

#### ASSESSMENT SYSTEM

SE1. FINAL EXAM. 40%

SE2. CONTINUOUS EVALUATION. 60%

First Partial 20%

Second Partial 20%

Laboratory 20%

<b>% end-of-term-examination:</b>	60
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<b>% of continuous assessment (assignments, laboratory, practicals...):</b>	40
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#### BASIC BIBLIOGRAPHY

- Saleh B.E.A. and Teich M.C. Fundamentals of Photonics, John Wiley and Sons Inc., 1991

#### ADDITIONAL BIBLIOGRAPHY

- Born M. and Wolf E. Principles of Optics 7th ed., Cambridge University Press. , 1999

- Iizuka K Engineering Optics 3rd Ed, Springer, 2008

- Kingston R.H. Optical Sources, Detectors, and Systems. Fundamentals and Applications, Academic Press , 1995