Photonics

Academic Year: (2022 / 2023) **Review date: 16-05-2022**

Department assigned to the subject: Department of Electronic Technology

Coordinating teacher: ACEDO GALLARDO, PABLO

Type: Compulsory ECTS Credits : 6.0

Year : 3 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, ¿
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 mustacquire. 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%

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

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