Optoelectronic systems

Academic Year: (2023 / 2024) **Review date: 09-01-2024**

Department assigned to the subject: Electronic Technology Department

Coordinating teacher: SANCHEZ PENA, JOSE MANUEL

Type: Electives ECTS Credits : 6.0

Year : 4 Semester :

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Electronic Instrumentation
Electronic Instrumentation Systems

OBJECTIVES

By the end of this content area, students will be able to have:

1. A coherent knowledge of their branch of engineering including some at the forefront of the branch in optoelectronic instrumentation.
2. The ability to apply their knowledge and understanding of optoelectronic instrumentation to identify, formulate and solve engineering problems using established methods.
3. The ability to apply their knowledge and understanding to develop and realise designs to meet defined and specified requirements.
4. An understanding of design methodologies, and an ability to use them in the design of optoelectronic systems.
5. The ability to design and conduct appropriate experiments, interpret the data and draw conclusions.
6. Workshop and laboratory skills.
7. The ability to select and use appropriate equipment, tools and methods.
8. The ability to combine theory and practice to solve problems of optoelectronic instrumentation.
9. An understanding of applicable techniques and methods in optoelectronic instrumentation, and of their limitations.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction to light. Basic magnitudes. Basic laws of optics

2. Optical sources. Semiconductor devices. Electronic circuits. VLC systems
2.1 Working principle of optical emitters based on semiconductors; Energy bands. Absorption, emission processes spontaneous and stimulated emission
2.2 Types of optical emitters: LED and LASER. Comparison of basic characteristics. Efficiencies
2.3 Electrooptic characteristic curves; Optical power-current curve; Spectral response curve. Bandwidth; Operation dependence on temperature
2.4 Application circuits
2.5 LED-based VLC systems: basic principles
2.6 Mono and multicarrier modulations
2.7 Applications in different environments: vehicles, infoentretainment, etc.

3. Photodetectors and optocouplers. Electronic conditioning circuits
3.1 Absorption process in sc. Principle of operation of photodetectors
3.2 Types of photodetectors: p-n, pin, APD, phototransistors
3.3 Responsivity and efficiency. Spectral and E/O characteristic curves
3.4 Concept of noise in photodetectors: types and evaluation
3.5 Conditioning circuits in photodetectors

4. Electro-optical materials, optical and electrical properties. Devices. Applications
4.1 Electro-optical effects on radiation / matter interaction
4.2 E / O materials: Liquid crystals, Electrochromic and Electrophoretic. Operating principles and characteristic E/O curves
4.3 Electrical equivalent circuits.
4.4 Applications: sensing, privacy control, communications, biomedical, etc.

5. Propagation of light. Optical Fibers: Attenuation and Dispersion
5.1 Propagation in guided media: wave equation
5.2 Characteristic parameters F.O: Singlemode and multimode fibers
5.3 Attenuation in F.O. Communications windows
5.4 Dispersion in F.O.: intermodal, chromatic and PMD
5.5 Bandwidth

6. Optical sensors and fiber optic sensors. Applications
6.1 Introduction. General characteristics of optical sensors.
6.2 Types of sensors depending on the magnitude: T, pressure, stress, etc.

7. Optoelectronic instrumentation systems in industrial applications.
7.1 Basic components of instrumentation systems
7.2 S.I. for applications in environment, space, etc.

LEARNING ACTIVITIES AND METHODOLOGY

The teaching methodology will include:
- Magisterial Classes, where the students will be presented with the basic knowledge they must acquire. Students will be supplied with lecture notes and key reference texts which will enable them to complete and acquire a more in depth knowledge of the subject.
- Problems Classes, these are aimed at the solving of exercises and examples within the context of real case studies. These classes will be complimented with the resolution of practical exercises on behalf of the student.
- Laboratory Practical Sessions
- Tutorials

ASSESSMENT SYSTEM

FINAL EXAM. Global assessment of knowledge, skills and capacities acquired throughout the course.
CONTINUOUS EVALUATION. Assesses papers, projects, class presentations, debates, exercises, internships and workshops throughout the course.

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

BASIC BIBLIOGRAPHY

- B.E.A. Saleh , M.C. Teich Fundamentals of Photonics, Wiley - Interscience, 2007
- R.P. Khare Fiber Optics and Optoelectronics, Oxford, 2004

ADDITIONAL BIBLIOGRAPHY

- Edel Uiga Optoelectronics, Prentice Hall, 1995