SUBJECT TEACHING GUIDE

G851 - Optical Communications

Degree in Telecommunication Technologies Engineering
First Degree in Telecommunication Technologies Engineering

Academic year 2024-2025

1. IDENTIFYING DATA					
Degree	Degree in Telecommunication Technologies Engineering First Degree in Telecommunication Technologies Engineering			Type and Year	Optional. Year 3 Optional. Year 3
Faculty	School of Industrial Engineering and Telecommunications				
Discipline	Subject Area: Optical Communications				
Course unit title and code	G851 - Optical Communications				
Number of ECTS credits allocated	6	Term		Semester based (2)	
Web					
Language of instruction	Spanish	English Friendly	Yes	Mode of delivery	Face-to-face

Department	DPTO. TECNOLOGIA ELECTRONICA E INGENIERIA DE SISTEMAS Y AUTOMATICA
Name of lecturer	OLGA MARIA CONDE PORTILLA
E-mail	olga.conde@unican.es
Office	Edificio Ing. de Telecomunicación Prof. José Luis García García. Planta: - 3. DESPACHO PROFESORES (S324)
Other lecturers	ADOLFO COBO GARCIA MARIA ANGELES QUINTELA INCERA

3.1 LEARNING OUTCOMES
- To name advantages and disadvantages of optical transmission technology compared to other technologies . It assesses the degree of use of optical communications in different types of communication networks and their projection for the future.
- To interpret the signals involved in the domain of time and frequency . To apply models that calculate the propagation of the signals along the components of the system . To explain the limitations of optical transmission , its origin and impact on benefits.
- To name typical values of system, sub-systems and components providing a definition and proposing typical values. To apply system design strategies based on the mathematical modeling of the sub -systems and components and in the calculation of the limitations by attenuation, dispersion and non-linearities. To describe basic and advanced architectures for an optical communications system , for an optical transmitter, channel, receiver and amplifier. To choose the architecture, components and parameters to solve efficiently (technically and economically) a given transmission problem.
- To name commercial types of optical fiber, the recommendation to which it is accepted, its differentiating characteristics with respect to others, the values of its relevant parameters, and the typical application scenario. To describe the manufacturing process of optical fiber .
- To define the attenuation phenomenon, its physical origin and impact on benefits. To calculate power balance.
- To perform calculations with attenuation models to assess their impact on the system . To perform calculations with dispersion models (chromatic, intermodal and PMD) in the channel to assess their impact on the system. To implement fiber optic dispersion management strategies . To make time balance to evaluate the dispersion phenomenon of the channel and the dynamic limitation of other components. To identify the transmission windows of the channel and its attenuation and dispersion characteristics .
- To list different nonlinear effects in the channel and to quantify their impact on performance , indicating a typical threshold power value for each. To propose strategies to minimize the effect of attenuation , dispersion and non-linear effects.
- To explain the fundamentals of light emission in semiconductors . To name different relevant light sources and their differences and propose typical application scenarios for each one . To enumerate the typical parameters of a transmitter and gives for each of them a definition , a typical value, and relates it to the performance of the global system. To describe the architecture of a transmitter based on direct modulation and with external modulation . To define the spontaneous emission, the stimulated emission and the width of the "gap", and to relate it to the parameters of a light source.
- To explain the fundamentals of light detection , particularly in semiconductor junctions. To name different types of detectors and their differences and to propose typical application scenarios for each one . To list the typical parameters of a receiver and gives each one a definition , a typical value, and to relate it to the performance of the global system. To describe the architecture of a receiver based on direct detection . To calculate the sensitivity of an optical receiver , including or not optical amplification. To calculate the signal to noise ratio at the output of a system .
- To explain technologies for making optical amplifiers , the architecture of each one, and to compare them in technical terms. To identify the conditions in which the optical amplification improves the performance of the system and to propose the type of amplifier, its parameters and its optimal placement.
- To list passive devices used in optical communications and to describe their usefulness and the technology on which they can be based. To identify the relevant parameters of the passive devices used in optical communications .

- To list the different approaches for the design of systems (analytical, simulation and prototyping) and their advantages and disadvantages.
- To define the basic requirements of a system. To design a basic system (intensity modulation and direct detection) to meet certain requirements, with technical and economic criteria.
- To explain the motivation for WDM technology and the advantages and disadvantages it brings. To describe the architecture of a WDM system and to apply the guidelines for its correct design.
- To explain the desirable characteristics of FTTH systems and describes their possible architectures. To design a FTTH system.
- To handle technical information in English related to optical communications.

4. OBJECTIVES
To compare the optical transmission with other transmission technologies.
To perform calculations with component models and subsystems to evaluate the propagation of signals throughout the system.
To identify the limitations to transmission and to relate them to the performance of the systems.
To name, define and propose typical values for all the parameters and magnitudes involved.
To implement strategies for the analysis and design of systems.
To know and to compare basic and advanced architectures for systems and subsystems: transmitter, channel, receiver, optical amplifier and passive devices.
To choose a type of system, subsystem or component for a particular application.
To know the commercially available optical fibers, their typical parameters, relevant characteristics and application scenarios.
To explain the phenomena of attenuation, dispersion and nonlinear in the transmission media at optical frequencies, and to calculate the limitations in performance due to the attenuation, dispersion and non-linear effects.
To explain the emission of light in semiconductors and to describe the most relevant differences between light sources.
To base the detection of light in semiconductors and to describe the most relevant differences between PIN and APD photodiodes.
To know passive optical devices and other components used in systems.
To explain and to compare different optical amplification technologies and their impact on the performance of the system.
To know the motivation of WDM technology, the architecture of these systems, their advantages and disadvantages and design particularities.
To know the motivation of the FTTH systems, their architecture and design particularities.
To search and interpret technical information.

6. SUBJECT PROGRAM	
CONTENTS	
1	Optical communications networks
2	The optical transmission channel
3	The optical transmitter and light sources
4	The optical receiver and the light detectors
5	Other devices for optical communications
6	Design of advanced and commercial optical communications systems

7. ASSESSMENT METHODS AND CRITERIA				
Description	Type	Final Eval.	Reassessn	%
Design project of an optical communications network that contemplates the integration of MAN, LAN and FTTH technologies.	Work	No	Yes	30,00
Continuous evaluation activities with deliverables	Others	No	Yes	55,00
Continuous evaluation activities in the laboratory with deliverables	Laboratory evaluation	No	Yes	15,00
Written exam	Written exam	Yes	Yes	0,00
Laboratory exam	Laboratory evaluation	Yes	Yes	0,00
TOTAL				100,00

Observations
The remote evaluation of the works, laboratory practical exercises and written tests is foreseen in the event that a new health alert by COVID-19 makes it impossible to carry out the evaluation.

Observations for part-time students
Part-time students will be provided with information so that they can do some of the laboratory practices, those related to computing, in person and deliver the different reports. The part of continuous evaluation activities and visits will be evaluated in a final exam.

8. BIBLIOGRAPHY AND TEACHING MATERIALS
BASIC
Agrawal, Govind P. “Fiber-optic communication systems”, 3rd ed. , John Wiley & Sons, Inc. (2002)
Pastor Abellán, Daniel y otros, “Sistemas de comunicaciones ópticas”, Ed. Univ. Politéc. Valencia, (2007)
Keiser, Gerd E. “Optical fiber communications” , 3rd Ed, McGraw-Hill, Boston (2000)
Martín Pereda, José Antonio. “Sistemas y redes ópticas de comunicaciones”, Prentice Hall (2004)
Diversas fuentes de información en Internet