



GENERAL INFORMATION

Data of the subject	
Subject name	Optical Communications
Subject code	DEAC-MIT-522
Main program	Máster Universitario en Ingeniería de Telecomunicación por la Universidad Pontificia Comillas
Involved programs	Grado en Administración y Dirección de Empresas y Máster Univ. en Ingeniería de Telecomunicación [Fifth year] Máster Universitario en Ingeniería de Telecomunicación y Mást. Univ. en Administración de Empresas [First year] Máster Universitario en Ingeniería de Telecomunicación [First year] Máster Universitario en Ingeniería de Telecomunicación y Máster en Ciberseguridad [First year] Máster Universitario en Ingeniería de Telecomunicación y Mást. Univ. en Administración de Empresas [First year] Máster Universitario en Ingeniería de Telecomunicación + Máster in Smart Grids [First year]
Level	Postgrado Oficial Master
Quarter	Semestral
Credits	6,0 ECTS
Type	Obligatoria
Department	Department of Electronics, Control and Communications
Coordinator	Luis Cucala García
Office hours	To be agreed

Teacher Information	
Teacher	
Name	Luis Cucala García
Department	Department of Electronics, Control and Communications
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DESCRIPTION OF THE SUBJECT

Contextualization of the subject
Prerequisites
Students willing to take this course should be familiar with electromagnetism, complex variable calculations, differential calculus, information theory and linear systems. It is also recommended to be familiar with time-frequency transformations.

Course contents

Contents
Block 1. Introduction

Chapter 1. Introduction to optical communication

- 1.1 Introduction.
- 1.2 Historic evolution of optical communications.
- 1.3 Properties and main characteristics of fiber optic.
- 1.4 Introduction to optical devices.
- 1.5 Structure of an optical communication system.

Block 2. Transmission in an optical medium

Chapter 2: Propagation in fiber optics

- 2.1 Analysis of the propagation using optic geometry.
- 2.2 Analysis of the propagation using mode theory for step index fibers.
- 2.3 Analysis for the monomode case.

Chapter 3: Attenuation in fiber optics

- 3.1 Intrinsic losses.
- 3.2 Extrinsic losses.
- 3.3 Total losses. Transmission windows.

Chapter 4: Dispersion in fiber optics

- 4.1 Dispersion in fiber optics.
- 4.2 Wave propagation in dielectrics and pulse distortion.
- 4.3 Gaussian pulse propagation in monomode fibers.
- 4.4 Dispersion minimization in monomode fibers.

Chapter 5: Optical sources: fundamentals, LED and LD

- 5.1 Introduction.
- 5.2 Radiation-matter interaction
- 5.3 Semiconductor's theory.
- 5.4 Electroluminescent Diodes (LED).
- 5.5 Semiconductor LASER.
- 5.7 Analysis of the rate equations for the semiconductor LASER.

Chapter 6: Optical detectors

- 6.1 Introduction.
- 6.2 Optical detection.



6.3 Responsivity.

6.4 PIN photodiodes.

6.5 APD photodiodes.

6.7 Receiver for optical communications.

6.8 Noise in optical communications.

6.9 Error probability in optical detection.

Block 3: Optical Components

Chapter 7: Optical components

7.1 Introduction.

7.2 Polarizers.

7.3 Directional couplers.

7.4 Attenuators.

7.5 Circulators.

7.6 Optical filters.

7.7 Modulators.

7.8 Array Wave Guides (AWG).

7.9 Semiconductor Optical Amplifier (SOA).

7.10 Erbium-Doped Fiber Amplifier (EDFA).

Block 4: Optical Communication Systems

Chapter 8: Optical communication systems

8.1 Introduction.

8.2 Power budget.

8.3 Time budget.

Chapter 9: Introduction to optical communication networks

9.1 Introduction.

9.2 Topology and applications.

9.3 Network classification.

9.4 First and second generation networks.

Laboratory

- 1 Helmholtz Modeling (3 sessions)
2. Propagation fundamentals and laser diode driver
- 3 Characterization of analog devices for Plastic Optic Fiber (POF)
- 4 Characterization of digital devices for Plastic Optic Fiber (POF)
- 5 Optical Time-Domain Reflectometer and fiber splicing
- 6 Characterization of passive components.

EVALUATION AND CRITERIA

Grading

Theory will account for 75%, of which:

- Mid-term: 25 %
- Final exam: 50 %

Lab will account for the remaining 25%, of which:

In order to pass the course, the mark of the final exam must be greater or equal to 5 out of 10 points and the mark of the laboratory work must be at least 5 out of 10 points. Otherwise, the final grade will be the lower of the two marks.

If the lab mark is below 5 points, a specific exam will be requested , comprising written and practical activities related with the labs sessions.

BIBLIOGRAPHY AND RESOURCES

Basic References

Basic bibliography

- Notes prepared by the lecturer (available in Moodle).

Complementary bibliography

- Agrawal, G. P. (2010). Fiber-optic communication systems (4th ed.). Wiley.
- Capmany, J., & Francoy, J. C. (2003). Problemas de comunicaciones Ópticas. Editorial de la UPV.
- Capmany, J., Peláez, F. J. F., & Martí, J. (1999). Dispositivos de comunicaciones ópticas. Síntesis.
- Capmany, J. (1998). Fundamentos de comunicaciones ópticas. Síntesis.
- Saleh, B. E. A., & Teich, M. C. (2007). Fundamentals of Photonics. Wiley.
- Coldren, L. A., Corzine, S. W., & Mashanovitch, M. L. (2012). Diode Lasers and Photonic Integrated Circuits.



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