# GENERAL INFORMATION

## Data of the subject

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| **Subject name** | Optical Communications |
| **Subject code** | DEAC-MIT-522 |
| **Mainprogram** | Official Master´s Degree in Telecommunications Engineering |
| **Involved programs** | Máster Universitario en Ingeniería de Telecomunicación y Mást. Univ. en Administración de Empresas [First year]<br>Máster Universitario en Ingeniería de Telecomunicación [First year]<br>Máster Universitario en Ingeniería de Telecomunicación y Máster en Ciberseguridad [First year]<br>Máster Universitario en Ingeniería de Telecomunicación + Máster in Smart Grids [First year] |
| **Level** | Posgrado 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

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|---|---|
| **Teacher** | |
| **Name** | Luis Cucala García |
| **Department** | Department of Electronics, Control and Communications |
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| **Teacher** | |
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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** Electroluminiscent 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

The use of AI to produce full assignments or substantial parts thereof, without proper citation of the source or tool used, or without explicit permission in the assignment instructions, will be considered plagiarism and therefore subject to the University's General Regulations.

### 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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