

## 230566 - FIBERS - Fibers and Telecommunications

Coordinating unit:	230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit:	739 - TSC - Department of Signal Theory and Communications
Academic year:	2015
Degree:	MASTER'S DEGREE IN PHOTONICS (Syllabus 2013). (Teaching unit Optional) ERASMUS MUNDUS MASTER'S DEGREE IN PHOTONICS ENGINEERING, NANOPHOTONICS AND BIOPHOTONICS (Syllabus 2010). (Teaching unit Optional) MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2009). (Teaching unit Optional) MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Teaching unit Optional) MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Teaching unit Optional)
ECTS credits:	3
Teaching languages:	English

### Teaching staff

Coordinator:	José A. Lázaro, UPC ( coord).
Others:	Josep Prat, UPC.

### Opening hours

Timetable:	jose.lazaro@tsc.upc.edu (coordinator) jprat@tsc.upc.edu
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### Degree competences to which the subject contributes

#### Transversal:

1. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.
2. ENTREPRENEURSHIP AND INNOVATION: Being aware of and understanding how companies are organised and the principles that govern their activity, and being able to understand employment regulations and the relationships between planning, industrial and commercial strategies, quality and profit.
3. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.
4. SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.
5. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

### Teaching methodology

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### Learning objectives of the subject

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### BRIEF DESCRIPTION OF THE COURSE:

The course on Fibers and Telecommunications provides an overview of both the fundamental physical phenomena and how different techniques have been developed to reach the nowadays huge optical communication capacity. The subject, on the one hand, revises the evolution of one of the most relevant technological achievements of photonics, as distinguished by the Noble Prize in Physics 2009 recently awarded to Charles K. Kao for his groundbreaking paper published in 1966. On the other hand, it focuses on the challenges of designing an Optical Communication System and how different photonics technologies are applied to overcome the imperfections of fibers, optical sources, amplifiers, receivers, etc. The course is given after the previous course on "Introduction to Photonics, Optics and Lasers"

### BIBLIOGRAPHY:

The course will include only parts of these references, at an appropriate level

- Fundamentals of Photonics, B. E.A. Saleh and M.C. Teich (Wiley, 2nd ed., 2007).
- Optical fiber communications. Keiser, G, 4th ed. McGraw-Hill, 2010
- Fiber-Optic Communication Systems, G. P Agrawal, 4th ed Wiley, 2010

### Study load

Total learning time: 75h	Hours large group:	22h 30m	30.00%
	Hours medium group:	0h	0.00%
	Hours small group:	0h	0.00%
	Guided activities:	2h 15m	3.00%
	Self study:	50h 15m	67.00%

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### Content

#### 1. Introduction

Degree competences to which the content contributes:

Description:

- 1.1. Evolution of Fiber Telecommunications
- 1.2. Main photonic technologies pushing the advance of transmission capacity
- 1.3. Introduction of basic elements of Fiber Telecommunication Systems

#### 2. Light Propagation and Signal Transmission in Fibers

Degree competences to which the content contributes:

Description:

- 2.1. Review of basic concepts
- 2.2. Transmission limitations in first multimode fibers
- 2.3. Optimized Single-mode fibers
- 2.4. Chromatic dispersion limitation: Techniques for measuring and for overcoming chromatic dispersion in real systems
- 2.5. Polarization of Light in fibers: difficulties and advantages
- 2.6. Transmission limitations due to High Power: Non-Linear Effects

#### 3. Optical Transmitters and Receivers

Degree competences to which the content contributes:

Description:

- 3.1. Semiconductor Lasers in Fiber Telecommunications
- 3.2. Broadband Optoelectronic Modulators
- 3.3. Coding Information on Light's properties: Modulation Formats
- 3.4. Photo-receivers: how the diverse photo-detector physical characteristics affect to the proper reception of the coded information

#### 4. Optical Amplifiers

Degree competences to which the content contributes:

Description:

- 4.1. How a Quantum Transition multiplied by 10.000 the transmission capacity of fibers: EDFA
- 4.2. Tailored optical amplification: Semiconductor Optical Amplifiers
- 4.3. From a limiting non-linear effect to a flexible optical amplification technique: Raman Amplifier

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### 5. Multichannel systems and networks

Degree competences to which the content contributes:

Description:

- 5.1. Your own first design of an Optical Communication System
  - 5.1.1. Wavelength Division Multiplexing (WDM) systems OR
  - 5.1.2. Time Division Multiplexing (TDM) systems: Passive Optical Networks (PON)
- 5.2. Checking your design's advantages and possible limitations

### Qualification system

- Homework + exam (60%).
- Team work, attending seminars, lab visits, possible oral presentation of your project, class attendance (40%)

### Bibliography