



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 - 2016
Degree:	Master's Degree in Photonics Erasmus Mundus Master's Degree in Photonics Engineering, Nanophotonics and Biophotonics
ECTS credits: 3	Teaching languages: English

Academic staff

Coordinator:	José A. Lázaro (UPC)	jose.lazaro@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. 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.
3. 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.
4. 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

Lectures

Activities:

- Research center or laboratory visits or Seminar on: Telecommunication Systems and/or Biomedical Applications

Objectives and short 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 modern 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"

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Study load

Total learning time: 75h	Hours large group:	22.5h	30%
	Hours medium group:	0h	0%
	Hours small group:	0h	0%
	Guided activity:	2.25h	3%
	Self study:	50.25h	67%

Course index

1. Introduction

- 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

- 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

- 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

- 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.

5. Multichannel systems and networks

- 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



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Qualification system

Exam (40%)

Team work, attending seminars, lab visits, possible oral presentation, class attendance, homework (60%)

Bibliography

- 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