Course guide
230566 - FIBERS - Fibers and Telecommunications

Last modified: 14/12/2023

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 739 - TSC - Department of Signal Theory and Communications.

Degree: MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Optional subject).
MASTER'S DEGREE IN PHOTONICS (Syllabus 2013). (Optional subject).
MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Optional subject).

Academic year: 2023 **ECTS Credits:** 3.0 **Languages:** English

LECTURER

Coordinating lecturer: Consultar aquí / See here:
https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/responsables-assignatura

Others: Consultar aquí / See here:
https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/professorat-assignat-idioma

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE4. Demonstrate knowledge of the fundamentals of image formation, propagation of light through different media and Fourier Optics.
CE9. Ability to synthesize and present photonics research results according to the procedures and conventions of scientific presentations in English.
CE2. Demonstrate the understanding of the peculiarities of the quantum model for light-matter interaction.

Generical:
CG1. Ability to project, design and implement products, processes, services and facilities in some areas of photonics, such as photonic engineering, nanophotonics, quantum optics, telecommunications and biophotonics.
CG2. Ability to modeling, calculate, simulate, develop and implement in research and technological centers and companies, particularly in research, development and innovation tasks in all areas related to Photonics.
CG4. Ability to understand the generalist and multidisciplinary nature of photonics, seeing its application, for example, to medicine, biology, energy, communications or industry

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.

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.

Basic:
CB6. Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context
CB7. Students should know how to apply the knowledge acquired and their problem-solving ability in new or little-known environments within broader (or multidisciplinary) contexts related to their area of ¿¿study.
CB8. Students should be able to integrate knowledge and face the complexity of formulating judgments based on information that, being incomplete or limited, includes reflections on the social and ethical responsibilities linked to the application of their knowledge and judgment.
CB10. Students should possess the learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous.

TEACHING METHODOLOGY

- Lectures
- Activity

LEARNING OBJECTIVES OF THE SUBJECT

The course on Fibers and Telecommunications provides an overview of both the fundamental physical phenomena and how different techniques have been develop 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 focus on the challenges of designing an Optical Communication System and how different phonics technologies are applied to overcome the imperfections of fibers, optical sources, amplifiers, receivers, etc.

STUDY LOAD

Type	Hours	Percentage
Hours large group	24,0	32.00
Self study	51,0	68.00

Total learning time: 75 h

CONTENTS

1. Introduction

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

Full-or-part-time: 2h 30m
Theory classes: 2h 30m

2. Light Propagation and Signal Transmission in Fibers

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

Full-or-part-time: 6h
Theory classes: 6h

3. Optical Transmitters and Receivers

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

Full-or-part-time: 6h
Theory classes: 6h

4. Optical Amplifiers

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

Full-or-part-time: 4h
Theory classes: 4h

5. Multichannel systems and networks

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

Full-or-part-time: 4h
Theory classes: 4h

ACTIVITIES

Visit

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

Full-or-part-time: 2h 18m
Theory classes: 2h 18m

GRADING SYSTEM

- Exam (50%)
- Team work, attending seminars, lab visits, possible oral presentation, class attendance, homework (50%)

BIBLIOGRAPHY

Basic:
- Saleh, B.E.A.; Teich, M.C. Fundamentals of photonics. 3rd ed. Hoboken: John Wiley & Sons, 2019. ISBN 9781119506874.
- Keiser, G. Optical fiber communications. 5th ed. New York: McGraw-Hill, 2013. ISBN 9781259006876.
- Agrawal, G.P. Fiber-optic communication [on line]. 4. Hoboken, New Jersey: Wiley, 2010 [Consultation: 20/06/2016]. Available on: http://onlinelibrary.wiley.com/book/10.1002/9780470918524. ISBN 9780470505113.