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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: 2016

Degree: 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 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 2013). (Teaching unit Optional)

ECTS credits: 3 Teaching languages: English

Teaching staff

Coordinator: José A. Lázaro, UPC.

Others: Joan Gene, UPC

Degree competences to which the subject contributes

Basic:

CB6. (ENG) Poseer y comprender conocimientos que aporten una base u oportunidad de ser originales en el desarrollo y/o aplicación de ideas, a menudo en un contexto de investigación

CB7. (ENG) Que los estudiantes sepan aplicar los conocimientos adquiridos y su capacidad de resolución de problemas en entornos nuevos o poco conocidos dentro de contextos más amplios (o multidisciplinares) relacionados con su área de estudio.

CB8. (ENG) Que los estudiantes sean capaces de integrar conocimientos y enfrentarse a la complejidad de formular juicios a partir de una información que, siendo incompleta o limitada, incluya reflexiones sobre las responsabilidades sociales y éticas vinculadas a la aplicación de sus conocimientos y juicio.

CB10. (ENG) Que los estudiantes posean las habilidades de aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo.

Specific:

CE4. (ENG) Màster en Fotònica:
Demostrar que conoce los fundamentos de la formación de imagen, de la propagación de la luz a través de los diferentes medios y de la Óptica de Fourier.

CE9. (ENG) Màster en Fotònica:
Capacidad para sintetizar y exponer los resultados de investigación en fótonica según los procedimientos y convenciones de las presentaciones científicas en inglés.

CE2. (ENG) Màster en Fotònica:
Demostrar que comprende las peculiaridades que comporta el modelo cuántico para la interacción luz-materia.

Generical:

CG1. (ENG) Màster en Fotònica:
Capacidad para proyectar, diseñar e implantar productos, procesos, servicios e instalaciones en algunos ámbitos de la fotónica como los relacionados con la ingeniería fotónica, la nanofotónica, la óptica cuántica, las telecomunicaciones y la biofotónica

CG2. (ENG) Màster en Fotònica:
Capacidad para la modelización, cálculo, simulación, desarrollo e implantación en centros de investigación, centros tecnológicos y empresas, particularmente en tareas de investigación, desarrollo e innovación en todos los ámbitos relacionados con la Fotónica.

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CG4. (ENG) Màster en Fotònica:
Capacidad para entender el carácter generalista y multidisciplinario de la fótonica viendo su aplicación por ejemplo a la medicina, biología, energía, comunicaciones o la industria

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.

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

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

Learning time: 2h 30m
Theory classes: 2h 30m

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

Learning time: 6h
Theory classes: 6h

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

Learning time: 6h
Theory classes: 6h

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

4. Optical Amplifiers

Learning time: 4h
Theory classes: 4h

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	Learning time: 4h Theory classes: 4h

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

Planning of activities

Visit	Hours: 2h 18m Theory classes: 2h 18m

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

Qualification 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. 2. New York: John Wiley & Sons, 2007. ISBN 9780471358329.

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.