Last update: 06-05-2019

230631 - OFT - Optical Fiber Telecommunications

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering

Teaching unit: 739 - TSC - Department of Signal Theory and Communications

Academic year: 2019

Degree: MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Teaching unit Optional)
MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Teaching unit Optional)
MASTER'S DEGREE IN INFORMATION AND COMMUNICATION TECHNOLOGIES (Syllabus 2009). (Teaching unit Optional)
MASTER'S DEGREE IN NETWORK ENGINEERING (Syllabus 2009). (Teaching unit Optional)
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2009). (Teaching unit Optional)
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Teaching unit Optional)

ECTS credits: 5 Teaching languages: English

Teaching staff

Coordinator: GABRIEL JUNYENT GIRALT

Others: Junyent Giralt, Gabriel
Comellas Colomé, Jaume

Opening hours

Timetable: Any time is possible by appointment email

Degree competences to which the subject contributes

Specific:

3. Ability to implement wired/wireless systems, in both fix and mobile communication environments.

4. Ability to design and dimension transport, broadcast and distribution networks for multimedia signals

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.

Teaching methodology

Lectures (3h/week)
Group work or Individual work (distance):Technical Report
Oral presentations
Other activities
Extended answer test (Final Exam)

Learning objectives of the subject

The objective of this course is to train students in the methods of study, analysis, design and evaluation of optical fiber

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communication technologies.
First, we will analyze the great evolution in the main technologies related to fiber optics, and key devices to build transmission systems.
Next, we will analyze and evaluate the optical switching technologies of the transport plane of Automatically Switched Optical Networks (ASON), and the main optical fiber transmission technologies that currently allow the implementation of IP-DWDM transport networks, as well as its likely future evolution.
We also briefly discuss the important contribution that fiber optic transmission technology will have on the future evolution of radio access networks (Fronthaul) for the future 5G mobile technology.

Learning results of the subject:
- Ability to analyse, specify, design networks, services, processes and applications of telecommunications in local or long distance, with different bandwidths in IP over fiber optical networks.
- Ability to apply engineering tools as planning tools, dimensioning and optical network analysis.
- Ability to analyse, model and implement new architectures, network protocols and communication interfaces, and new services and applications in optical networks.

Study load

Total learning time: 125h	Hours large group:	39h	31.20%
	Hours medium group:	0h	0.00%
	Hours small group:	0h	0.00%
	Guided activities:	0h	0.00%
	Self study:	86h	68.80%

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Content

1. Evolution of Optical Fiber Telecommunication Technology.

Learning time: 10h
Theory classes: 4h
Self study : 6h

Description:
Evolution of optical fibers.
Evolution of transmission systems with optical channel multiplexing.
Evolution of optical spectral efficiency of transmission systems.
Evolution of optical switching and signal processing.
Evolution to new markets:
• "The new cloud era with Data Centers".
• Fiber Optic Infraestructure for 5G Mobile.
• FIber Optic Technology for Smat Cities.

2. Key devices for optical fiber transmission systems.

Learning time: 16h 30m
Theory classes: 9h
Self study : 7h 30m

Description:
Optical fibers: types, characteristics and performances.
Fiber optic propagation:
• Dispersions.
• Non lineal effects.
Optical multiplexers and demultiplexers.
Optical amplifiers:
• Erbium Doped Fiber optic Amplifier (EDFA).
• RAMAN: distributed optical amplifier.

3. Fiber Optic Transmission Systems.

Learning time: 23h 30m
Theory classes: 10h 30m
Self study : 13h

Description:
Modulation of Intensity and Direct Detection.
Coherent Systems with Heterodyne Detection.
Advanced Modulation Formats.
Dense Wavelength Division Multiplexing (DWDM).
Coarse Wavelength Division Division Multiplexing (CWDM).
Optical transceivers and transponders.

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4. Optical switching.

Learning time: 18h

Theory classes: 8h
Self study : 10h

Description:
Optical switches.
Optical Add Drop Multiplexer (OADM).
Reconfigurable OADM (ROADM).
Multi-degree ROADM.

5. IP Transport in Optical Networks.

Learning time: 19h

Theory classes: 8h
Self study : 11h

Description:
OTN technology.
Forward Error Control (FEC) technologies.
IP transmission based on technologies: Ethernet + OTN + FEC + DWDM with tunable laser + Optical amplifiers + M-ROADM + Control Plane.
Automatically Switched Optical Networks (ASON).
Metro and Core Networks.
Future evolution:
• Elastic Technologies with FlexGrid-WDM.
• Transponders for high speeds = 400Gbps.
• New modulation technologies: OFDM and Nyquist.
• Superchannels with optical multicarriers for transmissions at terabits.
• Spatial multiplexing (SDM) with multi-core fibers.
• Modal multiplexing with Few-Mode Fibers (FMF).
• Software Defined Networking and Network Functions Virtualization.

6. Fiber Optic Infraestructures to implement 5G Mobile

Learning time: 13h 40m

Theory classes: 5h 40m
Self study : 8h

Description:
Fiber optic technologies for Radio Access Networks (RAN): The path to 5G requires a strong optical network.
Transport CPRI over: Ethernet or OTN Mapping.
C-RAN: Fronthaul and Backhaul Networks.

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Planning of activities

TECHNICAL REPORT	Hours: 29h Self study: 29h

Description:
Technical Report: This activity involves the preparation of a Technical Work, in groups of 2 students, which must be delivered in PowerPoint format and presented to the class at the end of the course.
Oral Presentation: Oral presentation of Technical Report (30 minutes)
Final exam (90 minutes)

Support materials:
For this course ATENEA will be the virtual teaching support tool. From there the students will be able to download all the documents (slides, papers, pdfs, etc.) related to the course.

Descriptions of the assignments due and their relation to the assessment:
Technical Report:1 week before the end of course

Specific objectives:
Evaluate technical research done in group on a subject related to the course.

ORAL PRESENTATION	Hours: 0h 45m Laboratory classes: 0h 45m

Description:
Technical Report Presentation of a work group

Support materials:
Power point presentation

Specific objectives:
To evaluate the ability to present oral in group and individually results of the technical report

FINAL EXAM	Hours: 1h 30m Theory classes: 1h 30m

Description:
Final exam

Qualification system

Final examination: 40%
Individual assessment: 10%
Group assessments: 50% ("Technical Report", group technical work)

Regulations for carrying out activities

On the final exam students will be able to bring all kinds of technical information (slides, books, related papers of the course, etc.)

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Bibliography

Basic:

Kaminow, I.P.; Li, T.; Willner, A.E. Optics and photonics: optical fiber telecommunications VI A: components and subsystems [on line]. 6th ed. St. Louis, MO: Academic Press, 2013Available on: <http://site.ebrary.com/lib/upcatalunya/docDetail.action?docID=10698605>. ISBN 9780123972354 (VOL. A).

Kaminow, I.P.; Li, T.; Willner, A.E. Optics and photonics: optical fiber telecommunications, VI B: systems and networks [on line]. 6th ed. St. Louis, MO: Academic Press, 2013Available on: <http://site.ebrary.com/lib/upcatalunya/docDetail.action?docID=10713017>. ISBN 9780123972378 (VOL. B).

Alexandros Stavdas. Core and Metro Networks [on line]. Wiley, 2010 [Consultation: 17/07/2017]. Available on: <http://onlinelibrary.wiley.com/book/10.1002/9780470683576>. ISBN 9780470512746.

Binh, L.N. Advanced digital optical communications [on line]. 2nd. ed. Boca Raton, FL: CRC Press, 2015 [Consultation: 19/06/2017]. Available on: <http://site.ebrary.com.recursos.biblioteca.upc.edu/lib/upcatalunya/detail.action?docID=11022992>. ISBN 9781482226539.

Complementary:

Mukherjee, B. Optical WDM networks. New York: Springer, 2006. ISBN 0387290559.

Keiser, G. Optical fiber communications. 4th ed. New York: McGraw-Hill, 2011. ISBN 9780073380711.

Hui, R.; O'Sullivan, M. Fiber optic measurement techniques. Burlington, MA: Academic Press/Elsevier, 2009. ISBN 9780123738653.

Chan, C.C.K. Optical performance monitoring: advanced techniques for next-generation photonic networks. Amsterdam ; Boston: Academic Press, 2010. ISBN 9780123749505.

Chesnoy, J. Undersea fiber communication systems [on line]. 2nd. ed. Amsterdam: Academic Press, 2015 [Consultation: 19/06/2017]. Available on: <http://www.sciencedirect.com/science/book/9780128042694>. ISBN 9780128043950.

Chomycz, B. Planning Fiber Optic Networks. McGraw-Hill, 2009. ISBN 0071499199.

Others resources:

Hyperlink

Nom recurs

For this course ATENEA will be the virtual teaching support tool. From there the students will be able to download all the documents (slides, related papers, etc.) of the course.