Course guide
230631 - OFT - Optical Fibre Telecommunications

Last modified: 11/04/2025

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 TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Optional subject).
MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Optional subject).

Academic year: 2025 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: JOAN MANUEL GENE BERNAUS

Others: Primer quadrimestre:
JOAN MANUEL GENE BERNAUS - 10

PRIOR SKILLS

Basic knowledge on fiber-optic communications

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)
Individual weekly assignments
Group work: Technical Report
Oral presentations of Technical Reports
Exams

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 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

Type	Hours	Percentage
Self study	86,0	68.80
Hours large group	39,0	31.20

Total learning time: 125 h

CONTENTS

1. Evolution of Optical Fiber Telecommunication Technology

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.

Full-or-part-time: 6h
Theory classes: 3h
Self study : 3h

2. Key devices for Fiber-Optic Transmission Systems

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.

Full-or-part-time: 18h
Theory classes: 9h
Self study : 9h

3. Fiber-Optic Transmission Systems

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.

Full-or-part-time: 24h
Theory classes: 12h
Self study : 12h

4. Optical Switching

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

Full-or-part-time: 12h
Theory classes: 6h
Self study : 6h

5. Fiber-Optic Technologies for 5G Systems

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.

Full-or-part-time: 6h
Theory classes: 3h
Self study : 3h

6. Fiber-Optic Technologies for Data Centers

Description:
Fiber-optic technologies for data centers:
- Data center architectures
- Singlemode fiber vs multimode fiber
- Optical transceivers

Full-or-part-time: 6h
Theory classes: 3h
Self study : 3h

ACTIVITIES

ASSIGNMENTS

Description:
Weekly assignments

Full-or-part-time: 35h
Self study: 35h

TECHNICAL REPORT

Description:
This activity involves the preparation of a Technical Work in group of 2-3 students, which must be presented to the class at the end of the course.
Oral Presentation: slide show (20 minutes)
Report: scientific paper-like format (10 pages)

Material:

Full-or-part-time: 15h
Self study: 15h

ORAL PRESENTATION

Description:
Technical Report Presentation of a work group

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

Full-or-part-time: 1h
Theory classes: 1h

PARTIAL EXAM

Full-or-part-time: 1h
Theory classes: 1h

FINAL EXAM

Description:
Final exam

Full-or-part-time: 1h
Theory classes: 1h

GRADING SYSTEM

Final exam: 25%
Partial exam: 25%
Individual assignments: 25%
Technical report: 25%

BIBLIOGRAPHY

Basic:
- Kaminow, I.P.; Li, T.; Willner, A.E. Optical fiber telecommunications VI A: components and subsystems [on line]. 6th ed. San Diego [etc]: Academic Press, 2013 [Consultation: 20/04/2020]. Available on: https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=1187142. ISBN 9780123972354 (VOL. A).
- Kaminow, I.P.; Li, T.; Willner, A.E. Optical fiber telecommunications, VI B: systems and networks [on line]. 6th ed. San Diego [etc]: Academic Press, 2013 [Consultation: 20/04/2020]. Available on: https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=1190987. 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: 01/04/2020]. Available on: https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=1752752. ISBN 9781482226539.

Complementary:
- Mukherjee, B. Optical WDM networks. New York: Springer, 2006. ISBN 0387290559.
- Keiser, G. Optical fiber communications. 5th ed. New York: McGraw-Hill, 2013. ISBN 9781259006876.
- Hui, R.; O'Sullivan, M. Fiber optic measurement techniques. 2nd ed. London: Academic Press, 2023. ISBN 9780323909570.
- 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, 2016 [Consultation: 08/06/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=4179433. ISBN 9780128043950.
- Chomycz, B. Planning Fiber Optic Networks. McGraw-Hill, 2009. ISBN 0071499199.

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.