Course guide
230631 - OFT - Optical Fiber Telecommunications

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: 2022  ECTS Credits: 5.0  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

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

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>39,0</td>
<td>31.20</td>
</tr>
<tr>
<td>Self study</td>
<td>86,0</td>
<td>68.80</td>
</tr>
</tbody>
</table>

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 Infrastructure for 5G Mobile.
- Fiber Optic Technology for Smart 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 linear 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 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

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### 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:

Complementary:

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.