Course guides
230698 - OPNET - Optical Networks

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

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

Academic year: 2021  ECTS Credits: 5.0  Languages: English

LECTURER
Coordinating lecturer: Comellas Colome, Jaume
Others: Prat Gomà, Josep
Spadaro, Salvatore

PRIOR SKILLS
Fiber optic communications fundamentals.
Computer networks fundamentals.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE4. Ability to design and dimension transport, broadcast and distribution networks for multimedia signals
CE3. Ability to implement wired/wireless systems, in both fix and mobile communication environments.
CE6. Ability to model, design, implement, manage, operate, administrate and maintain networks, services and contents
CE8. Ability to understand and to know how to apply the functioning and organization of the Internet, new generation Internet technologies and protocols, component models, middleware and services
CE7. Ability to plan networks and decision-making about services and applications taking into account: quality of service, operational and direct costs, implementation plan, supervision, security processes, scalability and maintenance. Ability to manage and assure the quality during the development process

Transversal:
CT5. 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.

CT4. 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.

CT3. 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, application classes, workgroup assignments, individual assignments
LEARNING OBJECTIVES OF THE SUBJECT

The aim of this course is to give insight of modern techniques used in broadband optical communications networks. Main concepts about key devices involved, traffic engineering, control and management of optical networks, as well as resiliency, will be given considering both, backbone and access networks.

STUDY LOAD

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

Total learning time: 125 h

CONTENTS

**Introduction: Optical networks evolution**

**Description:**
Fiber optic communications as well as Optical networks evolution

**Related activities:**
Personal assignment

**Related competencies:**
CE8. Ability to understand and to know how to apply the functioning and organization of the Internet, new generation Internet technologies and protocols, component models, middleware and services
CT4. 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.

**Full-or-part-time:** 11h
Theory classes: 3h
Self study: 8h

**Optical Network Enabling technologies**

**Description:**
Basic WDM devices review (splitters, filters, switches, WSS)
ROADM and OXC

**Specific objectives:**
Comprehension of the physical technologies involved in optical networks

**Related competencies:**
CE4. Ability to design and dimension transport, broadcast and distribution networks for multimedia signals
CE3. Ability to implement wired/wireless systems, in both fix and mobile communication environments.

**Full-or-part-time:** 11h
Theory classes: 3h
Self study: 8h
Traffic Engineering Basics

**Description:**
Routing and wavelength assignment
Network performance metrics
Resiliency in optical networks

**Related activities:**
Individual assignment

**Related competencies:**
CE7. Ability to plan networks and decision-making about services and applications taking into account: quality of service, operational and direct costs, implementation plan, supervision, security processes, scalability and maintenance. Ability to manage and assure the quality during the development process
CE6. Ability to model, design, implement, manage, operate, administrate and maintain networks, services and contents
CE4. Ability to design and dimension transport, broadcast and distribution networks for multimedia signals
CE8. Ability to understand and to know how to apply the functioning and organization of the Internet, new generation Internet technologies and protocols, component models, middleware and services
CT4. 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.

**Full-or-part-time:** 15h
Theory classes: 5h
Self study: 10h

Control and Management of Optical Networks

**Description:**
ASON fundamentals. GMPLS controlled networks.

**Specific objectives:**
Main characteristics of optical networks management.

**Related competencies:**
CE7. Ability to plan networks and decision-making about services and applications taking into account: quality of service, operational and direct costs, implementation plan, supervision, security processes, scalability and maintenance. Ability to manage and assure the quality during the development process
CE8. Ability to understand and to know how to apply the functioning and organization of the Internet, new generation Internet technologies and protocols, component models, middleware and services
CE3. Ability to implement wired/wireless systems, in both fix and mobile communication environments.
CT3. 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.

**Full-or-part-time:** 13h
Theory classes: 5h
Self study: 8h
### Metro and Access Optical Networks

**Description:**
- Passive optical networks
- Access networks evolution

**Specific objectives:**
- Access networks characteristics.

**Related competencies:**
- CE6. Ability to model, design, implement, manage, operate, administrate and maintain networks, services and contents
- CE3. Ability to implement wired/wireless systems, in both fix and mobile communication environments.
- CT5. 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.

**Full-or-part-time:** 15h  
Theory classes: 5h  
Self study: 10h

### Packet Switched Optical Networks

**Description:**
- Optical Packet and Burst Switching Technologies

**Specific objectives:**
- Understanding OPS characteristics and technological requirements

**Related competencies:**
- CE6. Ability to model, design, implement, manage, operate, administrate and maintain networks, services and contents
- CE8. Ability to understand and to know how to apply the functioning and organization of the Internet, new generation Internet technologies and protocols, component models, middleware and services

**Full-or-part-time:** 11h  
Theory classes: 3h  
Self study: 8h

### Energy efficiency in Optical networks

**Description:**
- Networks energy consumption. Green optical networks

**Related competencies:**
- CE8. Ability to understand and to know how to apply the functioning and organization of the Internet, new generation Internet technologies and protocols, component models, middleware and services
- CT4. 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.

**Full-or-part-time:** 11h  
Theory classes: 3h  
Self study: 8h
Elastic/flexgrid optical networks

Description:
Elastic network characteristics and Performance evaluation

Related competencies:
CE4. Ability to design and dimension transport, broadcast and distribution networks for multimedia signals
CT5. 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.

CT3. 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.

Full-or-part-time: 13h
Theory classes: 5h
Self study: 8h

Software Defined Networks (SDN)

Description:
Software defined networks principles. Optical Network Virtualization

Full-or-part-time: 11h
Theory classes: 3h
Self study: 8h

Optical Networks and data centres

Description:
Cloud computing and traffic evolution. Optics in the data centre

Related competencies:
CE8. Ability to understand and to know how to apply the functioning and organization of the Internet, new generation Internet technologies and protocols, component models, middleware and services
CT4. 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.

Full-or-part-time: 12h
Theory classes: 4h
Self study: 8h

Artificial Intelligence empowered Optical Networks

Description:
AI applications for optical networks

Full-or-part-time: 3h
Theory classes: 2h
Guided activities: 1h
GRADING SYSTEM

Lectures attendance (10%), Workgroup assignments (20%), Individual work (30%), Exam (40%)

BIBLIOGRAPHY

Complementary: