Course guide
230698 - OPNET - Optical Networks

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 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:	JAUME COMELLAS COLOME
Others:	Primer quadrimestre: JAUME COMELLAS COLOME - 10 ALBERT PAGÈS CRUZ - 10

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

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

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

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 :
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
CE4. Ability to design and dimension transport, broadcast and distribution networks for multimedia signals
CE6. Ability to model, design, implement, manage, operate, administrate and maintain networks, services and contents
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
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 :
CE3. Ability to implement wired/wireless systems, in both fix and mobile communication environments.
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
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 :
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
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.

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 technologiccal requirements

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
CE6. Ability to model, design, implement, manage, operate, administrate and maintain networks, services and contents

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
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.

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: 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 center

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:
- Ramaswami, R.; Sivarajan, K.N. Optical networks : a practical perspective [on line]. 3rd ed. San Francisco: Morgan Kaufman, 2010 [Consultation: 22/09/2020]. Available on: https://www.sciencedirect.com/science/book/9780123740922. ISBN 9780123740922.
- Liu, K.H.. IP over WDM. Chichester: John Wiley and Sons, 2002. ISBN 0470844175.