Course guide
300262 - OPTICAL - Next- Generation Optical Network Infrastructures for Future Cloud-Based Services

Last modified: 11/05/2026

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

Degree: MASTER'S DEGREE IN APPLIED TELECOMMUNICATIONS AND ENGINEERING MANAGEMENT (MASTEAM) (Syllabus 2015). (Optional subject).
MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Optional subject).
ERASMUS MUNDUS MASTER IN COMMUNICATIONS ENGINEERING AND DATA SCIENCE (CODAS 1) (Syllabus 2024). (Optional subject).
ERASMUS MUNDUS MASTER IN COMMUNICATIONS ENGINEERING AND DATA SCIENCE (CODAS 2) (Syllabus 2024). (Compulsory subject).
MASTER'S DEGREE IN ARTIFICIAL INTELLIGENCE FOR CONNECTED INDUSTRIES (AI4CI) (Syllabus 2025). (Compulsory subject).

Academic year: 2026 **ECTS Credits:** 3.0 **Languages:** English

LECTURER

Coordinating lecturer: Spadaro, Salvatore

Others: Spadaro, Salvatore

PRIOR SKILLS

Fundamentals of optical communications systems and architectures

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Transversal:
02 SCS N1. SUSTAINABILITY AND SOCIAL COMMITMENT - Level 1. Analyzing the world¿s situation critically and systemically, while taking an interdisciplinary approach to sustainability and adhering to the principles of sustainable human development. Recognizing the social and environmental implications of a particular professional activity.
05 TEQ. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.
06 URI. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.
03 TLG. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

Basic:
CB6. Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context.
CB8. Students will be able to integrate knowledge and face the complexity of formulating judgments based on information that, while being incomplete or limited, includes reflections on social and ethical responsibilities linked to the application of their knowledge and opinions.
CB10. Students will acquire learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous.

TEACHING METHODOLOGY

The subject will be based on:
• Lectures about: 1) Current transport technologies to support cloud-based services; 2) adoption of innovative optical technologies and systems for intra/inter data centres interconnections and, 3) Control and Management architecture and technologies for the overall optical data centres resources.
• Technical use cases discussion with active participation of students; tutorial papers available in literature will be used as a starting point to identify the main requirements of future data centres to support and provide cloud-based services.
• Technical presentations given by groups of students.

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the subject, the student will be able:
• To critically evaluate current bottlenecks of transport technologies to support requirements of future cloud-based services and applications.
• To identify main performance parameters to be met once intra/inter data centre interconnections are designed.
• To benchmark different technological solutions for the transport networks against the requirements raised by the supported applications and services.

STUDY LOAD

Type	Hours	Percentage
Hours large group	27,0	36.00
Self study	48,0	64.00

Total learning time: 75 h

CONTENTS

Current transport network technologies for cloud-based services and applications

Description:
The aim of this part of the subject is to identify the main bottlenecks of current transport networks for intra/inter data centres interconnections (e.g. scalability, energy consumption, etc.) to support future services and applications.

Related activities:
Starting from scientific articles available in the literature, the students (organised in groups) are requested to prepare a set of slides to identify some of the use cases and related requirements of future applications and service (e.g., virtual data centres service, latency, energy consumption, etc.)

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

Optical systems and technologies for cloud computing and data centres interconnects

Description:
In this part of the subject, different optical technologies will be discussed highlighting the potential of each one as candidates to be used for intra/inter data centre interconnections (fast switching technologies based on SOA, flex-grid and flex-rate, etc.).

Related activities:
Besides the lectures, the students are requested to review technical tutorial-like papers on available data centre networks design and topologies using optical technologies and systems. The main aim is to critically benchmark the different available proposals.

Full-or-part-time: 22h
Theory classes: 10h
Self study : 12h

Enabling optical systems for energy-efficient optical networks

Description:
One of the requirements in next generation data centres is power efficiency. Optical technologies able to reduce the power consumption will be presented and discussed; special emphasis will be devoted to the sleep-mode approach to keep limited the power consumption experimented.

Related activities:
The students will be requested to review technical papers available in the literature about the "sleep-mode operation" of optical systems (optical transceivers, optical amplifiers, etc.), enabling energy efficient interconnection systems.

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

Control/Management plane for data centre networks based on optical switching

Description:
The aim of this part of the subject is to introduce control and management architectures and technologies solutions for the overall orchestration of data centres resources, including both network and IT resources. Prior to this, requirements from the management point of view of future data centres will be identified. SDN-based centralised architecture for optical transport network will be discussed.

Related activities:
The students (organised in groups) will be requested to review and prepare some slides from technical articles available in the literature related with architectures for the efficient management and control of data centres resources. Technical discussion will follow-up).

Full-or-part-time: 29h
Theory classes: 9h
Self study : 20h

GRADING SYSTEM

Any academic fraud, plagiarism or use or possession of unauthorised means in an assessment activity leads to a mark of zero (0) for the affected test or assignment. Furthermore, in accordance with the University's regulations, if disciplinary proceedings are initiated the subject is recorded as "Pending Assessment" until a decision is reached. These incidents are managed in accordance with the **Action Framework for Academic Integrity in Assessment at the UPC**.

The overall evaluation will be performed through a final exam and the evaluation of the individual presentations/reports on the different topics.

BIBLIOGRAPHY

Basic:
- Ramaswami, Rajiv; Sivarajan, Kumar N; Sasaki, Galen H. Optical networks : a practical perspective [on line]. 3rd ed. San Francisco [etc.]: Morgan kaufmann, cop. 2010 [Consultation: 26/07/2022]. Available on: https://www-sciencedirect-com.recursos.biblioteca.upc.edu/book/9780123740922/optical-networks. ISBN 9780123740922.