

UNIVERSIDAD
POLITÉCNICA
DE MADRID

LEARNING GUIDE

COMMUNICATIONS NETWORK ARCHITECTURES

MÁSTER EN INGENIERÍA DE TELECOMUNICACIÓN

ACADEMIC YEAR	CODE	COURSE	CREDITS	TYPE	SEMESTER
2026-27	93001373	1	5 ECTS	COMPULSORY	FIRST SEMESTER
LANGUAGE		ASSIGNED CENTER			
SPANISH, ENGLISH		E.T.S. DE INGENIEROS DE TELECOMUNICACION			
ASSIGNED DEPARTMENT					
INGENIERÍA DE SISTEMAS TELEMÁTICOS					

COORDINATOR

JOSE IGNACIO MORENO NOVELLA - joseignacio.moreno@upm.es

REQUIRED PREREQUISITES

REQUIRED COURSES

—

RECOMMENDED PRIOR KNOWLEDGE

RECOMMENDED COURSES

—

OTHER RECOMMENDATIONS

—

RESULTS

RD-822/2021

Knowledge

KG1 Poseer y comprender conocimientos que aporten una base u oportunidad de ser originales en el desarrollo y/o aplicación de ideas, a menudo en un contexto de investigación

Skills

HG2 Que los estudiantes sepan aplicar los conocimientos adquiridos y su capacidad de resolución de problemas en entornos nuevos o poco conocidos dentro de contextos más amplios (o multidisciplinares) relacionados con su área de estudio

HE8 Capacidad de comprender y saber aplicar el funcionamiento y organización de Internet, las tecnologías y protocolos de Internet de nueva generación, los modelos de componentes, software intermediario y servicios

Competences

CE7 Capacidad para realizar la planificación, toma de decisiones y empaquetamiento de redes, servicios y aplicaciones considerando la calidad de servicio, los costes directos y de operación, el plan de implantación, supervisión, los procedimientos de seguridad, el escalado y el mantenimiento, así como gestionar y asegurar la calidad en el proceso de desarrollo

CG3 Que los estudiantes sean capaces de integrar conocimientos y enfrentarse a la complejidad de formular juicios a partir de una información que, siendo incompleta o limitada, incluya reflexiones sobre las responsabilidades sociales y éticas vinculadas a la aplicación de sus conocimientos y juicios

CE9 Capacidad para resolver la convergencia, interoperabilidad y diseño de redes heterogéneas con redes locales, de acceso y troncales, así como la integración de servicios de telefonía, datos, televisión e interactivos

CG4 Que los estudiantes sepan comunicar sus conclusiones y los conocimientos y razones últimas que las sustentan a públicos especializados y no especializados de un modo claro y sin ambigüedades

CT5 Capacidad para gestionar la información, identificando las fuentes necesarias, los principales tipos de documentos técnicos y científicos, de una manera adecuada y eficiente

CG5 Que los estudiantes posean las habilidades de aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo

- | | |
|------------|---|
| CT6 | Capacidad para emitir juicios sobre implicaciones económicas, administrativas, sociales, éticas y medioambientales ligadas a la aplicación de sus conocimientos |
| CT4 | Capacidad para trabajar de forma efectiva como individuo, organizando y planificando su propio trabajo, de forma independiente o como miembro de un equipo |
| CE6 | Capacidad para modelar, diseñar, implantar, gestionar, operar, administrar y mantener redes, servicios y contenidos |
| CT3 | Capacidad para adoptar soluciones creativas que satisfagan adecuadamente las diferentes necesidades planteadas |
| CE4 | Capacidad para diseñar y dimensionar redes de transporte, difusión y distribución de señales multimedia |
| CT1 | Capacidad para comprender los contenidos de documentación en lengua inglesa |
| CT2 | Capacidad para dinamizar y liderar equipos de trabajo multidisciplinares |

DESCRIPTION

The aim is to train students to address the design of public and private communication networks, taking into account parameters such as the services to be offered, their quality, the characteristics of the available network technologies and regulatory aspects, as well as the technological developments expected in the medium term. Students must work in groups to design and defend a telecommunications network for a specific scenario, oriented towards the business of a telecommunications operator or a large company. The work is carried out in coordination with the subject Communication Systems.

TOPICS

- | | |
|-----------|--|
| 1. | Introduction |
| 2. | Fixed/Mobile, Public/Private, Physical/Virtual Network Architecture |
| 3. | Enabling Technologies. |
| 4. | Network Service Development. VPN, Service Platforms, QoS. |
| 5. | Introduction to optical systems and networks. WDM systems and networks, ITU standards, and amplified optical systems. |

6. Optical Transport Networks: Topologies, Switching and Routing. Future Trends.
7. Practical Cases. Group PLB Development in coordination with the SCOM subject.

ACTIVITIES



Assessment activity



Learning activity

 Introduction				WEEKS 123456789101112131415E																
FORMAT	TOTAL DURATION	LOCATION	GROUP																	
In-person	01h 10m	Classroom (scheduled)	Normal																	
TOPICS																				
T1																				
METHODOLOGY																				
Lecture																				

 Fixed/Mobile, Public/Private, Physical/Virtual Network Architecture.				WEEKS 123456789101112131415E																
FORMAT	TOTAL DURATION	LOCATION	GROUP																	
In-person	03h 30m	Classroom (scheduled)	Normal																	
TOPICS																				
T2																				
METHODOLOGY																				
Lecture																				

 IP Multimedia Subsystem				WEEKS 123456789101112131415E																
FORMAT	TOTAL DURATION	LOCATION	GROUP																	
In-person	02h 20m	Classroom (scheduled)	Normal																	
TOPICS																				
T3																				
METHODOLOGY																				
Lecture																				

 5G Core Network			WEEKS 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 E
FORMAT In-person	TOTAL DURATION 01h 10m	LOCATION Classroom (scheduled)	GROUP Normal
TOPICS T3			
METHODOLOGY Lecture			

 Network Management			WEEKS 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 E
FORMAT In-person	TOTAL DURATION 02h 20m	LOCATION Classroom (scheduled)	GROUP Normal
TOPICS T3			
METHODOLOGY Lecture			

 Multiprotocol Label Switching			WEEKS 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 E
FORMAT In-person	TOTAL DURATION 02h 10m	LOCATION Classroom (scheduled)	GROUP Normal
TOPICS T3			
METHODOLOGY Lecture			

 Carrier Ethernet			WEEKS 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 E
FORMAT In-person	TOTAL DURATION 01h 10m	LOCATION Classroom (scheduled)	GROUP Normal
TOPICS T3			
METHODOLOGY Lecture			

 Software Defined Networks and Virtualization			WEEKS 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 E																
FORMAT	TOTAL DURATION	LOCATION	GROUP																
In-person	01h 10m	Classroom (scheduled)	Normal																
TOPICS																			
T5																			
METHODOLOGY																			
Lecture																			

 Introduction to optical systems and networks. WDM systems and networks, ITU standards, and amplified optical systems.			WEEKS 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 E																
FORMAT	TOTAL DURATION	LOCATION	GROUP																
In-person	04h 40m	Classroom (scheduled)	Normal																
TOPICS																			
T6																			
METHODOLOGY																			
Lecture																			

 Optical Transport Networks: Topologies, Switching and Routing. Future Trends.			WEEKS 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 E																
FORMAT	TOTAL DURATION	LOCATION	GROUP																
In-person	07h 00m	Classroom (scheduled)	Normal																
TOPICS																			
T6																			
METHODOLOGY																			
Lecture																			

First Team Project Presentation.			WEEKS																
			1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 E																
FORMAT In-person	TOTAL DURATION 02h 10m	LOCATION Classroom (scheduled)	ASSESSMENT Progressive, Global, Retake (Extraordinary)										WEIGHT 2%		MINIMUM GRADE 0 Non-rec.				
RECOVERABLE No		JUSTIFICATION This activity requires the development of a group project and its presentation, extension, and improvement in several gradual stages. For this reason, this activity must be carried out throughout the semester and is therefore non-recoverable.																	
TOPICS T1 T2 T3 T4 T5 T7																			
METHODOLOGY Group presentation																			
ASSESSED OUTCOMES KG1 HG2 CE4 CE6 CE7 HE8 CE9 CG3 CG4 CG5 CT2 CT3 CT4 CT5 CT6 CT1																			

Second Team Project Presentation			WEEKS																
			1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 E																
FORMAT In-person	TOTAL DURATION 02h 10m	LOCATION Classroom (scheduled)	ASSESSMENT Progressive, Global, Retake (Extraordinary)										WEIGHT 2%		MINIMUM GRADE 0 Non-rec.				
RECOVERABLE No		JUSTIFICATION This activity requires the development of a group project and its presentation, extension, and improvement in several gradual stages. For this reason, this activity must be carried out throughout the semester and is therefore non-recoverable.																	
TOPICS T1 T2 T3 T4 T5 T7 T6																			
METHODOLOGY Group presentation																			
ASSESSED OUTCOMES KG1 HG2 CE4 CE6 CE7 HE8 CE9 CG3 CG4 CG5 CT2 CT3 CT4 CT5 CT6 CT1																			

Final Team Project Presentation.			WEEKS															
			1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 E															
FORMAT	TOTAL DURATION	LOCATION	ASSESSMENT		WEIGHT		MINIMUM GRADE											
In-person	03h 10m	Exam Classroom	Progressive, Global, Retake (Extraordinary)		12%		4 Non-rec.											
RECOVERABLE		JUSTIFICATION																
No		This activity requires the development of a group project and its presentation, extension, and improvement in several gradual stages. For this reason, this activity must be carried out throughout the semester and is therefore non-recoverable.																
TOPICS																		
T1 T2 T3 T4 T5 T6 T7																		
METHODOLOGY																		
Group presentation																		
ASSESSED OUTCOMES																		
KG1 HG2 CE4 CE6 CE7 HE8 CE9 CG3 CG4 CG5 CT2 CT3 CT4 CT5 CT1 CT6																		

Group Work Assessment.			WEEKS															
			1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 E															
FORMAT	TOTAL DURATION	LOCATION	ASSESSMENT		WEIGHT		MINIMUM GRADE											
Not in person, with teacher	02h 10m		Progressive, Global, Retake (Extraordinary)		34%		4 Non-rec.											
RECOVERABLE		JUSTIFICATION																
No		This activity requires the development of a group project and its presentation, extension, and improvement in several gradual stages. For this reason, this activity must be carried out throughout the semester and is therefore non-recoverable.																
TOPICS																		
T1 T2 T3 T4 T5 T6 T7																		
METHODOLOGY																		
Team project																		
ASSESSED OUTCOMES																		
KG1 HG2 CE4 CE6 CE7 HE8 CE9 CG3 CG4 CG5 CT2 CT3 CT4 CT5 CT6 CT1																		

Individual Exam.			WEEKS															
			1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 E															
FORMAT	TOTAL DURATION	LOCATION	ASSESSMENT		WEIGHT		MINIMUM GRADE											
In-person	02h 10m	Exam Classroom	Progressive, Global, Retake (Extraordinary)		50%		4											
TOPICS																		
T1 T2 T3 T4 T5 T6																		
METHODOLOGY																		
Written exam																		
ASSESSED OUTCOMES																		
KG1 HG2 CE4 CE6 CE7 HE8 CE9 CG3 CG4 CG5 CT2 CT3 CT4 CT5 CT6 CT1																		



Group Work Tutorials.

WEEKS

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

E

FORMAT

In-person

TOTAL DURATION

07h 00m

LOCATION

Laboratory

GROUP

Reduced

TOPICS

T1

T2

T3

T4

T5

T6

T7

METHODOLOGY

Cooperative activities

Problem-solving class

Project-based learning

Design thinking

Laboratory assignments



Monographic sessions with student presentations and problem-solving activities

WEEKS

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

E

FORMAT

In-person

TOTAL DURATION

04h 40m

LOCATION

Classroom (scheduled)

GROUP

Reduced

TOPICS

T2

T3

T4

T5

T6

T7

METHODOLOGY

Problem-solving class

Challenge-based learning

Cooperative activities

WEEKLY SCHEDULE

 Assessment activity
  Learning activity
  Week with activity
  Exam period

Activity	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	E
 Introduction	.															
 Fixed/Mobile, Public/Private, Physical/Virtual Network Architecture.	.	.														
 IP Multimedia Subsystem		.														
 5G Core Network			.													
 Network Management			.													
 Multiprotocol Label Switching				.												
 Carrier Ethernet				.												

Activity	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	E
 Software Defined Networks and Virtualization					•											
 Introduction to optical systems and networks. WDM systems and networks, ITU standards, and amplified optical systems.						•	•									
 Optical Transport Networks: Topologies, Switching and Routing. Future Trends.							•	•	•	•						
 First Team Project Presentation.					•											
 Second Team Project Presentation												•				
 Final Team Project Presentation.														•		
 Group Work Assessment.																•
 Individual Exam.											•					•
 Group Work Tutorials.											•	•	•			
 Monographic sessions with student presentations and problem-solving activities							•			•						

ASSESSMENT CRITERIA

General criteria

The assessment of the subject is carried out through a non-recoverable activity that must be completed throughout the semester and accounts for 50% of the final mark, together with an individual exam that accounts for the remaining 50% of the final mark. In both cases, a minimum mark of 4/10 is required to pass the subject.

Assessment criteria for the regular exam period. Progressive assessment

Assessment criteria

The progressive assessment of the subject throughout the semester consists of two main components:

1. Development of a group project based on PBL techniques, in which students will work in groups on the design, dimensioning, and evaluation of a network for a telecommunications operator or large company, based on a set of initial basic requirements. The project will be developed in coordination with the subject Communication Systems.. The project is carried out in groups and requires its development and monitoring throughout the semester, with different synchronization points, including presentations and submission of draft versions of the report. Therefore, it is a compulsory activity that students must complete during the teaching period and is consequently a compulsory non-recoverable activity. Its assessment has two components: group presentations throughout the semester and the development of a report assessed incrementally throughout the semester. The total weight of this assessment is 50%. A minimum mark of 4/10 is required.
2. Development of an individual assessment. The total weight of this assessment is 50%. A minimum mark of 4/10 is required in each of the tests included in this individual assessment.

Throughout the course, student-led monographic sessions will be established, which may receive an additional score of 0.5 points.

The marks obtained through progressive assessment in the different evaluation — individual exam, project presentation, and project report — will remain valid throughout the same academic year, provided that the minimum mark required in the individual assessment is achieved.

- Other aspects:

In those assessments where individual tests are carried out using random questions based on a question bank, the solutions will not be published.

Any assessment or submitted assignment may require a complementary oral evaluation by the lecturer to verify that it has been completed by the student without the assistance of AI systems or in cases of low involvement in teamwork.

Activities

- First Team Project Presentation. (2%)
- Second Team Project Presentation (2%)
- Final Team Project Presentation. (12%)
- Group Work Assessment. (34%)
- Individual Exam. (50%)

Assessment criteria for the regular exam period. Global assessment

Assessment criteria

Students who do not pass the subject through progressive assessment will have the possibility of retaking the individual test, with the same structure and weighting as the one carried out in the progressive assessment.

- Other aspects:

In those assessments where individual tests are carried out using random questions based on a question bank, the solutions will not be published.

Any assessment or submitted assignment may require a complementary oral evaluation by the lecturer to verify that it has been completed by the student without the assistance of AI systems or in cases of low involvement in teamwork.

Accreditation of course participation in English will be obtained provided that the student follows the subject in English and completes all submissions — assignments and reports — presentations, and exams in English.

Activities

- First Team Project Presentation. (2%)
- Second Team Project Presentation (2%)
- Final Team Project Presentation. (12%)
- Group Work Assessment. (34%)
- Individual Exam. (50%)

Assessment criteria for the retake (extraordinary) exam period

Assessment criteria

Students who do not pass the subject through ordinary assessment will have the possibility of retaking the individual test, with the same structure and weighting as the one carried out in the ordinary assessment.

- Other aspects:

In those assessments where individual tests are carried out using random questions based on a question bank, the solutions will not be published.

Any assessment or submitted assignment may require a complementary oral evaluation by the lecturer to verify that it has been completed by the student without the assistance of AI systems or in cases of low involvement in teamwork.

Accreditation of course participation in English will be obtained provided that the student follows the subject in English and completes all submissions — assignments and reports — presentations, and exams in English.

Activities

- First Team Project Presentation. (2%)
- Second Team Project Presentation (2%)
- Final Team Project Presentation. (12%)
- Group Work Assessment. (34%)

- Individual Exam. (50%)

RESOURCES

Bibliography

The 3G IP Multimedia Subsystem (IMS): Merging the Internet and the Cellular Worlds, Wiley. ISBN-13: 978-0470516621

Devi Chadha, Optical WDM Networks: From Static to Elastic Networks. Wiley & Sons, IEEE PRESS, 2019.

Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud. W.Stallings. Addison-Wesley. ISBN: 0-13-417539-5

Web

Datos Estadísticos sector de las telecomunicaciones en España. <https://data.cnmc.es/telecomunicaciones-y-sector-audiovisual>

Punto Neutro Español de Internet. <https://www.espanix.net/es/index.html>

Erlang Calculations. <https://www.cas.mcmaster.ca/~qiao/publications/erlang/newerlang.html>

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IETF RFC 3261. SIP: Session Initiation Protocol

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IP Multimedia Subsystem (IMS) Call Flows. http://www.eventhelix.com/ims/#.VllylPmG_Tq

Open Gateway / CAMARA Project. <https://camaraproject.org/>

IMT towards 2030 and beyond (IMT-2030). <https://www.itu.int/en/ITU-R/study-groups/rsg5/rwp5d/imt-2030/Pages/default.aspx>

Bibliography

B. Mukherjee, I. Tomkos, M. Tornatore, P. Winzer, Y. Zhao (eds.) Springer Handbook of Optical Networks. 2020.

SUSTAINABLE DEVELOPMENT GOALS



Quality Education



Industry, Innovation and
Infrastructure

OTHER INFORMATION

The subject is related to SDG 9.