



## IDENTIFYING DATA

### (\*)Tecnoloxías de Rede

Subject	(*)Tecnoloxías de Rede			
Code	V05M145V01104			
Study programme	(*)Máster Universitario en Enxeñaría de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Mandatory	1st	1st
Teaching language	Spanish Galician			
Department				
Coordinator	López Ardao, José Carlos			
Lecturers	López Ardao, José Carlos			
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General description				

## Competencies

Code	
A5	CB5 Students must have learning skills to allow themselves to continue studying in largely self-directed or autonomous way
A6	CG1 The ability to project, calculate and design products, processes and facilities in telecommunication engineering areas.
A9	CG4 The capacity for mathematical modeling, calculation and simulation in technological centers and engineering companies, particularly in research, development and innovation tasks in all areas related to Telecommunication Engineering and associated multidisciplinary fields.
A12	CG7 The capacity for implementation and management of manufacturing processes of electronic and telecommunications equipment; guaranteeing safety for persons and property, the final quality of the products, and their homologation.
A13	CG8 The ability to apply acquired knowledge and to solve problems in new or unfamiliar environments within broader and multidiscipline contexts, being able to integrate knowledge.
A17	CG12 To have skills for lifelong, self-directed and autonomous learning.
A22	CE4 The ability to design and plan networks for transporting, broadcasting and distribution of multimedia signals.
A24	CE6 The ability to model, design, implement, manage, operate, and maintain networks, services and contents.
A25	CE7 The capacity for planning, decision making and packaging of networks, services and applications, taking into account the quality of service, direct and operating costs, plan implementation, monitoring, safety procedures, scaling and maintenance, as well as managing and ensuring quality in the development process.
A30	CE12 The ability to use programmable logic devices, as well as to design advanced electronic systems, both analog and digital. The ability to design communications components such as routers, switches, hubs, transmitters and receivers in different bands.

## Learning aims

Expected results from this subject	Typology	Training and Learning Results
Know how to model mathematically the essential elements of a network of telecommunications	know Know How	A6 A9 A13 A22 A24 A25

Understand the fundamental results on the capacity for different types of networks	know	A9 A22 A24 A25
Understand, formulate and solve simple models for analyzing the performance of a computer network	know Know How	A6 A9 A12 A22 A24 A25 A30
Know how to plan, design and deploy switched networks and IP networks in any application environment	know Know How	A5 A6 A9 A13 A17 A22 A24 A25
Know and understand the internal architecture of the switching equipment, methods of resource allocation and the basic techniques of providing Quality of Service	know	A5 A9 A17 A22 A24 A30

## Contents

Topic		
1. Network modeling (I)	a) Links: Statistical Multiplexing and queues b) Delay and packet loss analysis in queues	
2. Network modeling (II)	a) Queue networks b) Capacity of the network. Maximum flow minimum cut c) Utility function	
3. Switches	a) Switch architecture b) IWQ and OQ switches c) MaxWeight Scheduling d) Low-complexity scheduling algorithms	
4. Design and planning of Ethernet networks	a) VLAN Management and planning. VTP b) Advanced STP c) Link Aggregation d) Guidelines	
5. Routing in Internet	a) Intradomain routing algorithms b) Interdomain Routing: BGP	
6. Traffic Engineering and MPLS	a) Traffic Engineering b) MPLS basic concepts and description c) Label distribution d) MPLS and BGP	
7. Tunnels and Overlay Networks	a) The concept of overlay network and tunnel b) Tunnels SSL, IPSec, L2TP, MPLS c) VPNs	
8. Designing and planning of IP networks	a) ACLs and packet filtering b) Addressing: NAT and DHCP c) Guidelines d) The network of an ISP	
9. IPv6 Networks	a) The IPv6 protocol. Differences with IPv4 b) Transition: Dual stack IPv4 and IPv6 tunnels c) Routing in IPv6 d) DNS and IPv6 e) ICMPv6 and Neighbor Discovery	
10. Quality of Service	a) QoS basics b) Regulation and traffic monitoring c) Active queue management (AQM) d) Bandwidth scheduling e) Ethernet QoS: 802.1p f) IP QoS	

## 11. Multimedia

- a) Types of services and multimedia applications: VoIP, IPTV, VoD
- b) Impact of delay and losses in multimedia applications
- c) Objective and subjective quality
- d) Real-time Transport: RTCP, RTP, RTSP
- e) Signalling in IP networks: SIP
- f) Systems for Multimedia Streaming (UDP and HTTP Streaming)

### Planning

	Class hours	Hours outside the classroom	Total hours
Laboratory practises	6	6	12
Autonomous practices through ICT	0	10	10
Master Session	30	60	90
Long answer tests and development	2	0	2
Long answer tests and development	2	0	2
Troubleshooting and / or exercises	0	9	9

\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

### Methodologies

	Description
Laboratory practises	Practices of design, planning and architecture in different network scenarios and with different protocols, using GNS3 emulator. This methodology is related to the competencies CB5, CG1, CG8, CG12, CE4, CE6 and CE7
Autonomous practices through ICT	The practices of laboratory will entail the development of autonomous practices by the student. With this methodology will work the competitions CB5, CG1, CG8, CG12, CE4, CE6 and CE7
Master Session	Exposition of the ideas, concepts, technical and algorithms belonging to the lessons of the course. This also includes the resolution of problems and theoretical questions in the classroom, and two sessions of an hour for midterm exams, and a session of two hours for the final exam. With this methodology will work the competitions CG1, CG4, CG8, CE4, CE6, CE7 and CE12

### Personalized attention

### Assessment

	Description	Qualification
Long answer tests and development	Two exams will be done. The first one will cover lessons 1 to 3 and the second one lessons 4 to 7. Each partial exam has a 15% weight. Competencies CG1, CG4, CG8, CE4, CE6, CE7 and CE12 will be evaluated	30
Long answer tests and development	Final exam covering all the lessons. Competencies CG1, CG4, CG8, CE4, CE6, CE7 and CE12 will be evaluated	50
Troubleshooting and / or exercises	Participation in activities of in the virtual environment. This will essentially consists of the resolution of selected problems, ideas contests proposed by teachers, and participating in forums for questions and answers. This participation has a 20% weight in the final grade.	20
	This methodology is related essentially to the competencies CB5, CG8 and CG12, but also is important for competencies CG1, CG4, CE4, CE6, CE7 and CE12	

### Other comments on the Evaluation

The students can choose the evaluation method, continuous or single.

Continuous Evaluation (CE) will consist of three previous tests and a final exam:

- Two midterm exams (ME1 and ME2) in weeks 5 and 9, covering, respectively, the contents of the lessons 1 to 3, and 4 to 7. Each midterm exam has a 15% weight in the Final Qualification (FQ).
- Participation in the online activities (OA) in virtual environment, that represent 20% of the Final Qualification (FQ).
- A final exam (FE) covering all contents, with a weight of 50% of the Final Qualification (FQ).

$$FQ-CE = 0.15 \times (ME1 + ME2) + 0.2 \times OA + 0.5 \times FE$$

Single evaluation (SE) will only consist of the same FE at the end of the term.

It is considered that a student chooses CE when presenting to the first midterm exam (ME1), election to be held until end of course.

Students who do not present to this EP1 compulsorily opt for the Single Evaluation.

A new final exam (FE) will be done in the official dates in July, in order to improve the qualification with respect to May,  
The qualifications for all exams, partial or final, and activities will affect only the actual academic year.

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#### Sources of information

R. Srikant & Lei Ying, **Communication Networks**, Cambridge University Press,

Villy B. Iversen, **Teletraffic Engineering Handbook**, Web,

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J.F. Kurose, K.W. Ross, **Computer networking: a top-down approach featuring the Internet**, 6ª,

Kun I. Park, **QoS in packet networks**, 1ª,

Pazos Arias, J.J., Suárez González, A., Díaz Redondo, R.P., **Teoría de colas y simulación de eventos discretos**,

M.J. Newman, **Networks**, Oxford Univ. Press,

Diane Teare, **Implementing Cisco IP Routing (ROUTE) Foundation Learning Guide**, Cisco Press,

Richard Froom, Balaji Sivasubramanian, Erum Frahim, **Implementing Cisco IP Switched Networks (SWITCH) Foundation Learning Guide**, Cisco Press,

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#### Recommendations