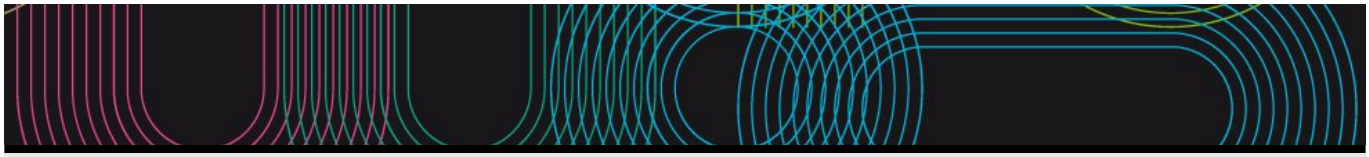

IDENTIFYING DATA				
Network and Switching Theory				
Subject	Network and Switching Theory			
Code	V05G300V01642			
Study programme	Degree in Telecommunications Technologies Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	3rd	2nd
Teaching language	Spanish			
Department				
Coordinator	Suárez González, Andrés			
Lecturers	López García, Cándido Antonio Suárez González, Andrés			
E-mail	asuarez@det.uvigo.es			
Web	http://faitic.uvigo.es			
General description	The objective pursued with this course is that students acquire mastery of the basic methods of analysis for predicting the performance of networks, services and telecommunication systems, in terms of the amount of traffic they carry, the physical structure of the system and the way it is interconnected, the capacity of its constituent network elements and the algorithms used in them.			

Competencies	
Code	
B5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
C28	CE28/TEL2 The ability to apply the techniques that are basis of computer networks, services and applications, such as management, signaling and switching, routing and securing systems (cryptographic protocols, tunneling, firewalls, charging mechanisms, authentication and content protection) traffic engineering (graph theory, queuing theory and teletraffic) rating, reliability and quality of service in both fixed, mobile, personal, local or long distance environments with different bandwidths, including telephony and data.
C31	CE31/TEL5 The ability to follow the technological progress of transmission, switching and processing to improve computer networks and services.

Learning outcomes		
Expected results from this subject	Training and Learning	Results
Ability to apply mathematical methods of queueing theory to the analysis and design of telecommunication networks and systems.	B5	C28 C31
Ability to understand the basic compromises in designing telecommunication networks and systems in function of the parameters of traffic.	B5	C28 C31
Ability to use methods of discrete mathematics to resolve problems of routing and interconnection of networks, reliability, quality of service and distribution of contents in wired and wireless networks, fixed and mobile networks, access and transport networks.	B5	C28 C31
Mastery of the necessary basic concepts to resolve problems of resource optimization in networks.	B5	C28 C31

Contents
Topic

Queuing Theory	One-server systems. Finite queue systems. Systems with congestion: models of Erlang and Engset. Reversibility. Networks of queues with product solution. Applications: design of link capacity; design of buffer size; congestion in cellular networks; analysis of systems with priorities; provision of ARQ; provision of multiaccess networks.
Graph theory	Graph traversal and connectivity. Minimum cut, maximum flow. Tree coverage and expansion. Minimum cost trees. Graph coloring. Results and uses. Regular and irregular random graphs: small world networks, scale-free networks. Applications: Network topology design, the web graph, message broadcasting in wired networks and ad hoc networks.
Network Optimization	Utility Maximization. NUM decomposition problems. Applications.

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	21	42	63
Practice in computer rooms	4	6	10
Troubleshooting and / or exercises	8	12	20
Projects	7	35	42
Long answer tests and development	2	6	8
Troubleshooting and / or exercises	0	7	7

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

Methodologies

	Description
Master Session	It will present a systematic theoretical approach to the subject, highlighting the objectives, key concepts and relationships between different topics. Students should assimilate knowledge to enable them in the CG5, CE28/TEL2 and CE31/TEL5 competencies.
Practice in computer rooms	Guided practice where it is intended to study problems by both by applying analytical techniques and by using software tools, providing a training in the use of the latter. So students should acquire practical training in the CE28/TEL2 competency.
Troubleshooting and / or exercises	Resolution in detail of a series of selected problems and/or exercises, focused on both the theoretical concepts involved and the methodology to be employed.
Projects	Group work focused on studying and solving a real problem using the techniques studied in theory and the software tool seen in practice. So students should gain practical experience that will enable them on the CE31/TEL5 competency.

Personalized attention

Methodologies	Description
Master Session	The student may consult individually in the tutoring hours all doubts that arise in the study of the theoretical content.
Practice in computer rooms	The student may consult individually both in the practice time and in the tutoring hours all doubts that arise in the use of the software tools of the practices.
Projects	The student may consult individually in the tutoring hours all doubts that arise both in applying the theoretical concepts and in the use of the software tools used in the projects.

Assessment

	Description	Qualification	Training and Learning Results	
Projects	Group work, presentation and defense of the resolution of a typical real-world problem by applying both theoretical knowledge as using, where appropriate, the software tools used in practical classes.	20		C28 C31
Long answer tests and development	Partial test developed over the first two themes, around the eighth week of class.	60	B5	C28 C31

Troubleshooting and / or exercises	The student will have to resolve individually two bulletins of problems, corresponding to the first two lessons.	20	C28

Other comments on the Evaluation

It is left to the discretion of the students two alternative evaluation methods in the subject: continuous assessment and one-time evaluation.

Selection of continuous assessment involves conduct of a no-scoring short test (15 minutes) of basic knowledge. It will take place during the first two weeks of class. In addition to this short test, the continuous assessment will consist of the group development of two projects, the individual resolution of two groups of problems on the two first lessons, and the completion of a written exam about the full subject at the end of the quarter. Projects will be presented during the last class C. During these expositions there will be also personal interviews with each one of the group members. The personal qualification of the project will depend on both this interview and the project exposition and report. The rating of the projects and of the exercises is effective only in the course they are proposed, including the second opportunity at the end of the academic year. In any case, the score on the continuous assessment evaluation (once the requirement at the beginning of this paragraph is met) is given by: score = 0.2 x projects + 0.8 x maximum (exam, 0.2 x exercises + 0.6 x exam).

The one-time assessment will consist of a written examination on the contents of the subject. The final grade will be the score obtained in this exam. This exam will include (one-time assessment) one or several questions about the computer tools presented in the laboratory, evaluating a minimum on the CE28/TEL2 competency.

All students who have attended the final exam will be subjected to a final qualification. Continuous evaluation is selected for when delivering the two projects. Those who fail the course at the first opportunity at the quarter end have a second at the end of the academic year, similar to the first call.

Sources of information

Basic Bibliography

Pazos Arias, J.J., Suárez González, A., Díaz Redondo, R.P., **Teoría de colas y simulación de eventos discretos**, 2003,
M.J. Newman, **Networks**, 2012,

Complementary Bibliography

Villy B. Iversen, **TELETRAFFIC ENGINEERING and NETWORK PLANNING**, 2011,
Boyd, S., Vandenberghe, L., **Convex Optimization**, 2009,

Recommendations

Subjects that it is recommended to have taken before

Mathematics: Probability and Statistics/V05G300V01204
Data Communication/V05G300V01301
Computer Networks/V05G300V01403