IDENTIFYING DATA

Network and Switching Theory

Subject	Network and Switching Theory
Code	V05G306V01307
Study programme	Bachelor Degree in Telecommunication Technologies Engineering (BTTE)

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
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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.

Training and Learning Results

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.

Expected results from this subject

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
Lecturing	21	42	63
Practices through ICT	4	6	10
Problem solving	8	12	20
Project based learning	7	35	42
Essay questions exam	2	6	8
Problem and/or exercise solving	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
Lecturing	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.
Practices through ICT	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.
Problem solving	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. Students should assimilate knowledge to enable them in the CE28/TEL2 competency.
Project based learning	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 assistance

Methodologies	Description
Lecturing	The student may consult individually in the tutoring aid (https://moovi.uvigo.gal/user/profile.php?id=11340 and https://moovi.uvigo.gal/user/profile.php?id=11339) all doubts that arise in the study of the theoretical content.
Practices through ICT	The student may consult individually both in the practice time and in the tutoring aid (https://moovi.uvigo.gal/user/profile.php?id=11340 and https://moovi.uvigo.gal/user/profile.php?id=11339) all doubts that arise in the use of the software tools of the practices.
Project based learning	The student may consult individually in the tutoring aid (https://moovi.uvigo.gal/user/profile.php?id=11340) 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
Project based learning	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
Essay questions exam	Test over part of the subject themes. Questions and problems either of conceptual, logical, analytical or applied character. It will be a half and an hour long written test.	40	B5 C28 C31
Problem and/or exercise solving	Test over part of the subject themes. Questions and problems either of conceptual, logical, analytical or applied character. It will be a half and an hour long written test.	40	B5 C28 C31

Other comments on the Evaluation

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

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 one project and the individual resolution of two partial tests (40% of the overall grade each). The individual qualification in the project will depend as much on the joint qualification of the report of the project as on personal interviews (arranged from the delivery on) to the members of the group. The qualification of the project and of the exercises is effective only in the course they are done, including the extraordinary call 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: either $score\_1 = 0.2 \times project + 0.4 \times partial\_1 + 0.4 \times partial\_2$) if both partial scores are higher than 2.5 or failed score with $score\_2 = minimum(4.9, score\_1)$ if not.

The exam-only assessment (only choice on end-of-program call) 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 (exam-only 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 either attended both partial tests or a final exam will be subjected to a final qualification in that call. Exam-only assessment is selected for whenever either the project is not submitted or the final exam is attended. Those who fail the course at the ordinary call opportunity at the quarter end have an extraordinary one 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/V05G301V01107
Data Communication/V05G301V01204
Computer Networks/V05G301V01210