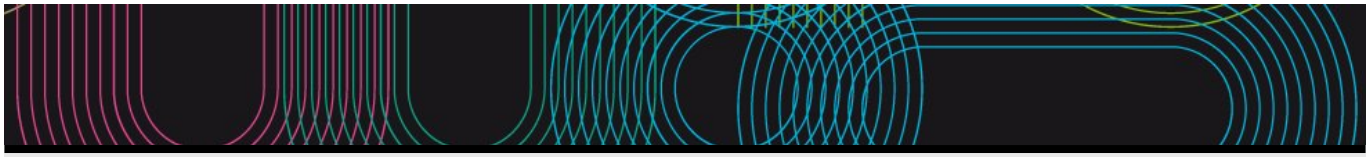

IDENTIFYING DATA				
Internet Engineering				
Subject	Internet Engineering			
Code	V05M145V01210			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	1st	2nd
Teaching language	Spanish			
Department				
Coordinator	Fernández Veiga, Manuel			
Lecturers	Fernández Veiga, Manuel			
E-mail	mveiga@det.uvigo.es			
Web	http://faitic.uvigo.es			
General description	Internet Engineering presents and analises the state of the art on the deployment, operations and configuration of large distributed systems in the Internet. The subject covers the study of advanced channel coding techniques, software defined networking, multipath transmission, and also the architecture and main technical challenges of large data centers. A review of network and service virtualization techniques is also included. Students will achieve skills for innovation and research in the field of network engineering.			

Competencies	
Code	
A5	CB5 Students must have learning skills to allow themselves to continue studying in largely self-directed or autonomous way
B1	CG1 Ability to project, calculate and design products, processes and facilities in telecommunication engineering areas.
B4	CG4 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.
B8	CG8 Ability to apply acquired knowledge and to solve problems in new or unfamiliar environments within broader and multidiscipline contexts, being able to integrate knowledge.
B12	CG12 Skills for lifelong, self-directed and autonomous learning.
C4	CE4 Ability to design and plan networks for transporting, broadcasting and distribution of multimedia signals.
C6	CE6 Ability to model, design, implement, manage, operate, and maintain networks, services and contents.
C7	CE7 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.
C8	CE8 Ability to understand and know how to apply the operation and organization of the Internet, new generation Internet technologies and protocols, component models, middleware and services.

Learning outcomes	
Expected results from this subject	Training and Learning Results
Knowledge and know-how about advanced channel coding techniques	B4 C4 C6
To understand the operations and properties of large distributed systems in the Internet. Deep knowledge and insights about advanced communication system	B1 B4 C4 C6 C7 C8

To learn how to analyze and put into use multi path transmission techniques and congestion control algorithms on different types of networks	A5 B4 B8 C4 C6 C7 C8
To understand the design principles, the operation and performance of large data centers in the Internet	A5 B1 B4 B12 C6 C7 C8
To command the principles of network & services virtualization. To learn how to perform resource allocation, to compare alternative architectures and comprehend the underlying Internet economic forces.	A5 B1 B4 B8 B12 C4 C6 C7 C8

Contents	
Topic	
1. The Internet ecosystem	1.1 Technology. Normalisation. Prospective 1.2 Service provisioning 1.3 Economy of Internet
2. Advanced channel coding	2.1 Capacity-approaching codes 2.2 Capacity-achieving-codes 2.3 Network coding 2.4 Erasure coding
3. Datacenter architectures	3.1 Datacenter structure and architecture 3.2 Advanced & efficient switching systems
4. Datacenter networking	4.1 Ethernet bridging & virtual bridging 4.2 VLAN partitioning and extension 4.3 Other tunneling technologies
5.Software defined networking	5.1 Software defined networking: concepts, elements and products 5.2 Network function virtualization
6. Resource allocation	6.1 Resource allocation in cloud systems 6.2 Load balancing techniques 6.3 Randomized policies. Optimal allocations 6.4 Auctioning

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	13	26	39
Laboratory practises	14	56	70
Long answer tests and development	2	0	2
Practical tests, real task execution and / or simulated.	1	0	1
Troubleshooting and / or exercises	0	13	13
*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	Descriptive exposure of concepts, technical problems and solutions of the state of the art in the discipline. Emphasis on the critical thinking ability to assess the models, the decisions and the operations of the systems under study. Through this methodology, the competencies CB5, CG1, CG4, CG8, CG12, CE4, CE5, CE7 and CE8 are acquired.

Laboratory practises	Development of an engineering project: design, planning, costs, dimensioning, configuration and testing, deployment and maintenance of a cloud-computing infrastructure. Through this methodology, the competencies CB5, CG1, CG4, CG8, CG12, CE4, CE5, CE7 and CE8 are acquired.

Personalized attention

Methodologies	Description
Master Session	Problem solving, advising about the material, recommended bibliography, further explanations of concepts and techniques. Individual mentoring about any of the latter matters.
Laboratory practises	Help with the design, installation, configuration and use of any software piece needed for developing the practical project. Individual office hours.

Assessment

	Description	Qualification		Training and Learning Results	
Long answer tests and development	Written examination, closed books, two hours length. The students will answer questions of conceptual and logical character on any one of the systems, components, algorithms or technologies that have been covered in the lectures.	50		B1 B4 B8 B12	C4 C6 C7 C8
Practical tests, real task execution and / or simulated.	Functional and performance tests of the assigned engineering project. Critical assessment of the technical solutions, the design decisions and the implementation.	30	A5	B1 B4 B8 B12	C4 C6 C7 C8
Troubleshooting and / or exercises	Written homework, selected problems and exercises.	20	A5	B4 B8	C8

Other comments on the Evaluation

The student must choose between two alternative, mutually exclusive assessment method: continuous assessment or final assessment.

The continuous evaluation options consists in a final written exam (50% of the qualification), the completion of an engineering project (30% of the qualification) and homework (20%). This project will be due the last working day preceding the start of the examination period. The final assessment option consists in a final written exam (60% of the qualification) and in the completion of an engineering project (40% of the qualification). This project will be due the last working day preceding the start of the examination period. The examinations of the continuous and the final assessment options may not be equal.

The students must declare their preferred assessment type right after the programming assignment is announced. A student will be considered as defective (not active) upon not manifesting any preference at this point.

The students who fail the course will be given a second opportunity at the end of the academic year to do so. Their academic achievements will be re-evaluated, both with a written exam (theoretical knowledge) and a review of their engineering project looking for improvement or changes. The weights are the same they were committed to, according to their choice.

Any assigned grade will only be valid during the academic year where it is awarded.

Should any form of plagiarism be detected in any project or test submitted, the final grade in the subject will be FAIL (0) and the event will be reported to the academic officers so that the appropriate sanctions can be taken.

Sources of information

Basic Bibliography

P. van Mieghem, **Performance analysis of communications networks and systems**, CambridgeUniversity Press, 2014

P. Goransson, C. Black, **Software defined networking: a comprehensive approach**, Morgan Kauffman, 2014

Complementary Bibliography

R. Srikant, L. Ying, **Communication networks. An optimization, control and stochastic networks perspective**, Cambridge University Press, 2013

M. Medard, A. Sprintson, **Network coding. Fundamentals and applications**, Academic Press, 2011

X. Guang, Z. Zhang, **Linear network error correcting coding**, Springer, 2014

W. Stallings, **Foundations of modern networking**, Addison-Wesley, 2015

Recommendations

Subjects that it is recommended to have taken before

Network Technologies/V05M145V01104