



IDENTIFYING DATA

(*)Enxeñaría de Internet

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|---------------------|---|-----------|------|------------|
| Subject | (*)Enxeñaría de Internet | | | |
| Code | V05M145V01231 | | | |
| Study programme | (*)Máster Universitario en Enxeñaría de Telecomunicación | | | |
| Descriptors | ECTS Credits | Choose | Year | Quadmester |
| | 5 | Mandatory | 1st | 2nd |
| Teaching language | Spanish Galician English | | | |
| Department | | | | |
| Coordinator | Fernández Veiga, Manuel | | | |
| Lecturers | Fernández Veiga, Manuel | | | |
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| General description | Internet Engineering presents and analyses the state-of-the-art about the fabrics, operations and configuration of large distributed systems on Internet. The topics covered include software defined networking, advanced coding techniques, multi path traffic engineering and contemporary techniques for virtualizing networks and computing resources. This subject prepares students for innovation and research in the field of computer networking. | | | |

Competencies

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|------|--|
| 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. |
| 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. |
| A26 | CE8 The 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 aims

| | | |
|---|----------|-------------------------------|
| Expected results from this subject | Typology | Training and Learning Results |
| Knowledge and know-how about advanced channel coding techniques | Know How | A6 A9 A22 A26 |
| To understand the operations and properties of large distributed systems in the Internet. Deep knowledge and insights about advanced communication system | Know How | A6 A9 A25 A26 |

| | | |
|---|------------------|--|
| To learn how to analyze and put into use multi path transmission techniques and congestion control algorithms on different types of networks. | know Know How | A6 A9 A25 A26 |
| To understand the design principles, the operation and performance of large data centers in the Internet | know | A6 A9 A13 A17 A22 A24 A25 A26 |
| 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. | know Know How | A5 A6 A9 A13 A17 A22 A24 A25 A26 |

Contents

| Topic | |
|--|---|
| 1. The Internet ecosystem, revisited | 1.1 Technology. Normalisation. Prospective 1.2 Service provisioning 1.3 Economy of Internet |
| 2. Transmission systems | 2.1 Advanced channel coding 2.2 Network coding 2.3 Energy efficiency 2.4 Cases of study |
| 3. Switching | 3.1 Software defined networking 3.2 Cases of study: mobility, indirections, multicast/anycast |
| 4. Multipath | 4.1 Wireline networks 4.2 Wireless networks 4.3 Congestion control |
| 5. Data center networking | 5.1 Architectures 5.2 Optimisation of components 5.3 Performance |
| 6. Virtualization and cloud networking | 6.1 Infrastructure. Technologies 6.2 Ecosystems and interfaces: IaaS, NaaS 6.3 Content distribution networks. Data-centric networking |

Planning

| | Class hours | Hours outside the classroom | Total hours |
|--|-------------|-----------------------------|-------------|
| Master Session | 11 | 22 | 33 |
| Seminars | 14 | 70 | 84 |
| Long answer tests and development | 2 | 0 | 2 |
| Practical tests, real task execution and / or simulated. | 1 | 5 | 6 |

*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. The lectures teach the competences A6, A9, A22, A25 and A26. |
| Seminars | Completion of a medium-size engineering project: design, planning, costs, dimensioning, configuration and testing, deployment and maintenance of an infrastructure of cloud computing. All the competences will be evaluated. |

Personalized attention

Methodologies Description

| | |
|----------------|--|
| Master Session | The students can attend to the personalized attention hours in order to clarify, argue or solve any technical difficulty uncovered during the development of the project. Personalised attention is also provided for in-depth discussion of concepts and solutions covered in the lectures. |
| Seminars | The students can attend to the personalized attention hours in order to clarify, argue or solve any technical difficulty uncovered during the development of the project. Personalised attention is also provided for in-depth discussion of concepts and solutions covered in the lectures. |

Assessment

| | Description | Qualification |
|--|---|---------------|
| Long answer tests and development | Written examination written, 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 covered in the lectures. Competencies A6, A9, A22, A25 and A26 will be assessed. | 50 |
| 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 of design and the implementation. All the competences will be evaluated. | 50 |

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) and the completion of an engineering project (50% of the qualification). 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 July 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.

Sources of information

P. van Mieghem, **Performance analysis of communications networks and systems**, 1^a,
R. Srikant, L. Ying, **Communication networks. An optimization, control and stochastic networks perspective**, 1^a,
M. Medard, A. Sprintson, **Network coding. Fundamentals and applications**, 1^a,
X. Guang, Z. Zhang, **Linear network error correcting coding**, 1^a,
K. Hwang, G. C. Fox, J. J. Dongarra, **Distributed and cloud computing: from parallel processing to the Internet of things**, 1^a,
M. J. Kavis, **Architecting the cloud: design decisions for cloud computing service models**, 1^a,

A curated list of research papers will be announced at the beginning of the academic term to serve as optional and supplementary readings for the students.

Recommendations

Subjects that it is recommended to have taken before

(*)Tecnologías de Aplicación/V05M145V01105

(*)Tecnologías de Rede/V05M145V01104