



IDENTIFYING DATA

Computer Networks

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|---------------------|---|-----------|------|------------|
| Subject | Computer Networks | | | |
| Code | V05G300V01403 | | | |
| Study programme | (*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación | | | |
| Descriptors | ECTS Credits | Choose | Year | Quadmester |
| | 6 | Mandatory | 2nd | 2nd |
| Teaching language | Spanish Galician | | | |
| Department | | | | |
| Coordinator | López Ardao, José Carlos | | | |
| Lecturers | López Ardao, José Carlos López Bravo, Cristina Manso Vázquez, Mario Rodríguez Pérez, Miguel Sousa Vieira, Estrella Suárez González, Andrés | | | |
| E-mail | jardao@det.uvigo.es | | | |
| Web | http://www.socialwire.es | | | |
| General description | Operating principles, architecture, technology and norms of computer networks, especially of Internet. Design-oriented course, complemented by practical skills | | | |

Competencies

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|------|--|
| Code | |
| A1 | CG1: The ability to write, develop and sign projects in the field of Telecommunication Engineering, according to the knowledge acquired as considered in section 5 of this Law, the conception and development or operation of networks, services and applications of Telecommunication and Electronics. |
| A3 | CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations |
| A4 | CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity. |
| A6 | CG6: The aptitude to manage mandatory specifications, procedures and laws. |
| A9 | CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics. |
| A20 | CE11/T6: The ability to conceive, deploy, organize and manage networks, systems, services and Telecommunication infrastructures in residential (home, city, digital communities), business and institutional environments, being responsible for launching of projects and continuous improvement like knowing their social and economical impact. |
| A26 | CE17/T12: The knowledge and usage of concepts of communication network architecture, protocols and interfaces. |
| A27 | CE18/T13: The ability to differentiate the concepts of access and transport networks, packet and circuit switched networks, mobile and fixed networks, as well as distributed network application and systems, voice, data, video, audio, interactive and multimedia services. |
| A28 | CE19/T14: The knowledge of methods of networking and routing, as well as the fundamentals of planning and network evaluation based on traffic parameters. |

Learning aims

| Expected results from this subject | Training and Learning Results |
|---|-------------------------------|
| CG1 The ability to write, develop and sign projects in the field of Telecommunication Engineering, according to the knowledge acquired as considered in section 5 of this Law, the conception and development or operation of networks, services and applications of Telecommunication and Electronics. | A1 |

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|---|-----|
| CG3 The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations | A3 |
| CG4 The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity. | A4 |
| CG6: The aptitude to manage mandatory specifications, procedures and laws. | A6 |
| CG9 The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics | A9 |
| CE11/T6 The ability to conceive, deploy, organize and manage networks, systems, services and Telecommunication infrastructures in residential (home, city, digital communities), business and institutional environments, being responsible for launching of projects and continuous improvement like knowing their social and economical impact. | A20 |
| CE17/T12 The knowledge and usage of concepts of communication network architecture, protocols and interfaces | A26 |
| CE18/T13 The ability to differentiate the concepts of access and transport networks, packet and circuit switched networks, mobile and fixed networks, as well as distributed network application and systems, voice, data, video, audio, interactive and multimedia services | A27 |
| CE19/T14 The knowledge of methods of networking and routing, as well as the fundamentals of planning and network evaluation based on traffic parameters | A28 |

Contents

| Topic | |
|--|--|
| 1. Introduction | a) Network Infrastructure: Nodes, links and networks b) Circuit and Packet Switching c) Communications Architecture: Layers, encapsulating, models |
| 2. Packet Networks. Internet | a) Performance: Throughput, delays, losses b) The Internet ecosystem |
| 3. Links and subnetworks | a) Concept of link and subnetwork b) Interconnection of networks at level 2: Bridges |
| 4. Ethernet and WiFi | a) Ethernet Switching. b) VLANs and trunking c) Spanning Tree d) WiFi networks |
| 5. Internet and IP | a) Interconnection of subnetworks. Routers b) IP Addressing c) IP datagram format d) Fragmentation e) The ICMP protocol |
| 6. IP Forwarding | a) IP Forwarding mechanism b) Connected and Next-Hop Routes c) The DHCP protocol |
| 7. Name and address translation | a) ARP b) DNS c) NAT |
| 8. Routing | a) Graph theory. Shortest distance paths b) Link state: Dijkstra's algorithm c) Distance vector: Bellman-Ford d) Broadcast routing |
| 9. Internet routing | a) Routing hierarchy b) Intradomain routing: RIP, OSPF c) Interdomain routing: BGP |
| 10. Midterm Exam | Lectures 1 to 7 |
| 11. Transport protocols | a) Service model b) TCP & UDP c) Transport connections: establishment, retransmissions, flow control |
| 12. Congestion control | a) Network model b) Dynamics, fairness and stability c) TCP Reno, Vegas, FAST |
| 13. Web. Content distribution networks | a) HTTP protocol b) Proxy web. Caching. Persistence c) Content distribution networks: architecture and operations |

14. Network security

- a) Vulnerabilities. Protection
- c) Secure network and transport layers
- c) Denial of service. Spoofing
- d) Fundamentals of cryptography
- e) Digital signatures

Planning

| | Class hours | Hours outside the classroom | Total hours |
|------------------------------------|-------------|-----------------------------|-------------|
| Master Session | 26 | 39 | 65 |
| Troubleshooting and / or exercises | 10 | 15 | 25 |
| Autonomous practices through ICT | 6 | 15 | 21 |
| Integrated methodologies | 0 | 10 | 10 |
| Practice in computer rooms | 10 | 15 | 25 |
| Long answer tests and development | 2 | 0 | 2 |
| Long answer tests and development | 2 | 0 | 2 |

*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 | Exposition of ideas, concepts, techniques and algorithms that shape every lecture. |
| Troubleshooting and / or exercises | Resolution by part of the students of problems and exercises of some of the lessons, and resolution by the teacher in the classroom |
| Autonomous practices through ICT | The students must develop a network program. There will be several sessions for tutoring with the professor and development, test and debugging of the programs in the laboratories where these will be tested and evaluated |
| Integrated methodologies | Participation in on-line activities to be proposed along the course, and in activities of making questions and answer of these |
| Practice in computer rooms | Practices in the computers of the computer classroom, guided by the professor |

Personalized attention**Methodologies Description**

| | |
|----------------|---|
| Master Session | Individual tuition will be dispensed to the students in the office hours announced at the beginning of the term. It is not mandatory to book the appointment. |
|----------------|---|

Assessment

| | Description | Qualification |
|-----------------------------------|--|---------------|
| Autonomous practices through ICT | The students must develop a network program. There will be several sessions for tutoring with the professor and development, test and debugging of the programs in the laboratories where these will be tested and evaluated | 20 |
| Integrated methodologies | Participation in on-line activities to be proposed along the course, and in activities of making questions and answer of these | 10 |
| Long answer tests and development | Final exam | 50 |
| Long answer tests and development | Midterm exam | 20 |

Other comments on the Evaluation

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

The Continuous Evaluation (CE) consist of three previous tests plus a final exam:

- A midterm exam (ME) in the 10th week, which will cover the contents of lectures 1 to 7, and represents 20% of the final grade (FG)
- The development of a network program (NP). The deadline will be the day of the final exam. The compliance of prescriptions and the quality of the software will determine the qualification of this test. Depending on the number of students, teachers may allow this program to be done by couples of students but in that case both members of the couple must belong to the same group of laboratory and both of them must follow continuous assessment. The NP represents 20% of the final (NF)
- Participation in online activities (AO) that will be proposed along the course and in the activities of raising questions and answer them. The OA represents 10% of the final grade (NG)
- A final exam (FE) covering all the contents, which has a weight of 50% of the final grade (FG)

$$\mathbf{FG-CE = 0.2xME + 0.1xOA + 0.2xNP + 0.5xFE}$$

The Single Evaluation (SE) will consist of the same Final Exam at the end of the semester and the same Network Program (NP) proposed for CE. In this case, the program must be made mandatory and delivered individually.

The grade of NP in this case is simply APT (with a numeric value 1), if it meets the minimum requirements or NOT APT (with a numeric value 0) in the other case or if the NP is not delivered, in which case the grade will be 40% of the FE. That is,

$$\mathbf{FG-SE = (0.4 + 0.6xNP) \times FE}$$

It is considered that a student choose CE when presenting to the midterm exam. The students not doing this exam must opt for SE.

In July there will be a new FE and also it will be allowed the delivery of a new NP consisting of a modified version of the May program, and whose specifications will be published with at least 4 weeks with respect to the deadline of the Final Exam. Any student, regardless opting for CE or SE, will be able to do this FE and present a new NP

For students who chose CE, these FE and NP represent an opportunity to improve the grade in these with respect to May, and so the calculation of the final grade considers the best grade obtained between May and July.

For students who chose to SE, the FE and the NP are considered joint and inseparable, that is,

$$\mathbf{FG-SE = \text{Max}[(0.4 + 0.6xNP-May) \times FE-May, (0.4 + 0.6xNP-July) \times FE-July]}$$

The grades of all written tests, partial or final, programs and activities will only take effect in the academic year in which they are proposed.

Sources of information

J.F. Kurose, K.W. Ross, **Computer networking: a top-down approach featuring the Internet**, 6,
 L. Peterson, B. Davie, **Computer networks: a systems approach**, 5,
 C. López, M. Rodríguez, S. Herrería, M. Fernández, **Cuestiones de redes de datos: principios y protocolos**, 1,

Recommendations

Subjects that continue the syllabus

Data Networks: Technology and Architecture/V05G300V01542
 Network and Switching Theory/V05G300V01642

Subjects that are recommended to be taken simultaneously

Data Communication/V05G300V01301

Other comments

Though advisable, it is not necessary prior exposure to computer programming.