Degree competences to which the subject contributes

Specific:
1. CEFB5. Knowledge of informatic systems, its structure, function and interconnection, as well as fundamentals of its programming.
2. CETI2. Ability to select, design, develop, integrate, value, construct, tmanage, exploit and maintain technologies of machines, programming and nets, keeping suitable costs and quality parameters.
3. CETI4. Ability to select, design, deploy, integrate and manage network and communications infrastructure in an organization.
4. CETI6. Ability to design systems, applications and services based on network technologies, including internet, website, e-commerce, multimedia, interactive services and mobile computing.
5. CETI7. Ability to understand, implement and manage security and safety of computing systems.

6. CE12. Knowledge and use of the basics of programming networks, sistems, telecommunication services.
7. CE17. Knowledge and use of the concepts of network architecture, protocols and communication interfaces.
8. CE18. Ability to distinguish net concepts of access and transport, circuits and package commutation nets, fixed and mobile nets, as well as of application systems of distributed nets, voic, data and audio services and interactive and mutimedia services.
9. CE19. Knowledge of interconnection and routing methods, as well as basics of planning, network dimensioning based on traffic parameters.
10. CE2. Basic knowledge of use and programming computer, operating systems, data base and informatic programs with engineering applications.

Transversal:
12. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.
18. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.
19. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits
The subject is designed so that the student acquires a broad knowledge base, both theoretical and practical, related to TCP/IP networks in general and to the Internet in particular.

After completing the course, the student will be able to:

- Explain the TCP/IP architecture
- Explain the format of the packages, the addresses, the error control mechanisms and the assignment of IPv4 and IPv6 addresses.
- Explain and apply the concepts of CDIR and NAT
- Plan and configure the addressing of an IP network.
- Explain the operation of a router and configure it.
- Distinguish between exterior and interior routing and distance vector and link state paradigms.
- Configure different dynamic routing protocols and explain their operation
- Explain the DNS system
- Explain the concepts of port, socket and connection
- Explain TCP and UDP transport protocols, their associated headers and functionalities
- Choose the most appropriate transport protocol based on the characteristics of the service to be developed
- Explain the client-server and P2P service models
- Explain and analyze the operation of the classic Internet services: remote terminal, file transfer, mail and Web.
- Know the different options to protect a TCP/IP network or service
- Explain what a firewall is and configure it
- Explain the concept of encryption, authentication, VPN and AAA
- Explain how to manage a TCP/IP network and configure an item to be manageable
- Program a TCP/IP protocol or functionality associated with TCP/IP networks.

Teaching methodology

Two types of classes will be differentiated, those of theory and those of laboratory. In theory, the teacher will present in an expository manner the knowledge to be developed in the subject using slides, which will be available in advance at the atenea and, occasionally, other resources, such as technical documentation or examples solved on the board. In the laboratory, they will work in pairs to solve practical guided exercises aimed at consolidating the knowledge acquired in the theory part. Some examples of these exercises are the assembly and configuration of a network or the analysis of a protocol. It will also seek the acquisition of practical skills related to the use of tools or equipment of the networks and specifically the Internet, which will be used on a recurring basis. For example, the Wireshark protocol analyzer or routers.

These sessions will be accompanied by a non-contact work directed on three fronts. The first, the study and understanding of knowledge acquired in theory classes. The second, the individual response of the questionnaires associated with each practice, which will be taken into account in the note destined to assess participation (see, “follow-up tasks”). The third, to develop a minimum of two programming works aimed at solving a challenge related to the Internet and TCP/IP protocols.

Learning objectives of the subject

The subject is designed so that the student acquires a broad knowledge base, both theoretical and practical, related to TCP/IP networks in general and to the Internet in particular.
### Study load

<table>
<thead>
<tr>
<th>Study load</th>
<th>Hours large group</th>
<th>Hours medium group</th>
<th>Hours small group</th>
<th>Guided activities</th>
<th>Self study</th>
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<tbody>
<tr>
<td><strong>Total learning time</strong>: 150h</td>
<td>30h</td>
<td>0h</td>
<td>30h</td>
<td>0h</td>
<td>90h</td>
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</tbody>
</table>
# Content

## Topic 1: Introduction

**Learning time:** 7h
- Theory classes: 2h
- Laboratory classes: 2h
- Self study: 3h

**Description:**

**Related activities:**
[P1]

## Topic 2: Addressing

**Learning time:** 30h
- Theory classes: 6h
- Laboratory classes: 6h
- Self study: 18h

**Description:**

**Related activities:**
[P1], [R]

## Topic 3: Packet delivery

**Learning time:** 15h
- Theory classes: 4h
- Laboratory classes: 2h
- Self study: 9h

**Description:**

**Related activities:**
[P1][R]
### Topic 4: Routing

**Learning time:** 17h  
Theory classes: 4h  
Laboratory classes: 4h  
Self study: 9h

**Description:**  
Concepts of metric, cost and algorithm. Vector distance vs. link status (Bellman-Ford and Dijkstra algorithms). Protocols IGP vs. EGP. RIP and OSPF protocols.

**Related activities:**  
[P1] [R]

### Topic 5: Information delivery

**Learning time:** 10h 30m  
Theory classes: 2h  
Laboratory classes: 4h  
Self study: 4h 30m

**Description:**  
Transport layer TCP and UDP protocols (features and headers).

**Related activities:**  
[P2] [R]

### Topic 6: Services

**Learning time:** 25h  
Theory classes: 4h  
Guided activities: 6h  
Self study: 15h

**Description:**  
Classic internet services: remote terminal (Telnet), file transfer (FTP), email (SMTP, POP3 and IMAP4), Web (HTTP).

**Related activities:**  
[P2] [R]
### Topic 7: Security

**Learning time:** 20h  
Theory classes: 4h  
Laboratory classes: 4h  
Self study: 12h

**Description:**  
Protection elements (Firewalls). Encryption and authentication (IPsec, TLS, SSH, HTTPS), Remote Access (VPNs, AAA).

**Related activities:**  
[P3]

### Topic 7: Network management

**Learning time:** 10h  
Theory classes: 2h  
Practical classes: 2h  
Self study: 6h

**Description:**  
SNMP (protocol, SMI language and MIBs).

**Related activities:**  
Activity: session devoted to the EPSEVG network: architecture and management. Visit on the ground installations.
### Planning of activities

| [P1] Design, configuration and test of a TCP/IP network | Hours: 16h  
Self study: 2h  
Laboratory classes: 14h |
|---|---|
| **Description:**  
Organized in sessions. At the end of each one of them, the answers will be given to a small individual questionnaire. It will work:  
- Equipment: Hosts and routers  
- Basic configuration tools, connectivity, ARP tables, DNS queries  
- Address allocation (DHCP)  
- Addressing plan. CDIR  
- Static routing  
- Dynamic routing |

| [P2] Analysis of TCP/IP services | Hours: 12h  
Self study: 2h  
Laboratory classes: 10h |
|---|---|
| **Description:**  
Organized in sessions. At the end of each of them, the answers of a small individual questionnaire will be delivered. It will work:  
- Analysis of ports, connections and their states. Scanning of ports.  
- Analysis protocols Telnet, FTP, Web (HTTP) |

| [P3] Security in TCP/IP networks | Hours: 5h  
Self study: 1h  
Laboratory classes: 4h |
|---|---|
| **Description:**  
Organized in sessions. At the end of each one of them, the answers will be given to a small individual questionnaire. It will work:  
- Configuration of a firewall. Packet filtering  
- Authentication and encryption mechanisms |

| [P4] Management of TCP/IP networks | Hours: 2h 30m  
Self study: 0h 30m  
Laboratory classes: 2h |
|---|---|
| **Description:**  
At the end of the session the answers of a small individual questionnaire will be delivered. It will work:  
- Configuration of an SNMP agent and protocol analysis of the same name. |

| [R] Resolution of TCP/IP challenges | Hours: 45h  
Self study: 45h |
### Description:
Non-contact activity. Resolution of a minimum of two challenges proposed by the teacher. The resolution of these challenges implies the programming of a protocol or part of a protocol or a functionality associated to the TCP/IP networks. The code and a document with instructions on how to execute it and a small description of how it works will be delivered. If required, a demonstration will be made.

### Qualification system
The final qualification is obtained from 4 grades

- Non-eliminatory partial exam in which the theory and laboratory sessions will be evaluated. Weight: 25%
- Final exam in which all the sessions of the subject, both theory and laboratory, are evaluated. Weight: 35%
- A minimum of 2 works focused on solving a challenge from the programming. Weight 30%
- Participation. Designed to round out the note based on objective parameters such as attendance, classroom interaction or queries and completion of follow-up tasks. Weight: 10%.

Important: if the note is of the final exam is $> = 5$, the mark of the partial exam will be $= maximum$ (final exam, partial exam).

The re-evaluation of the subject consists in the completion of the Final exam.

### Bibliography

#### Basic:

#### Others resources:
- Hyperlink
  - [http://www.torrensibern.cat](http://www.torrensibern.cat)
  - [http://wps.aw.com/aw_kurose_network_5/](http://wps.aw.com/aw_kurose_network_5/)