Degree competences to which the subject contributes

Specific:
1. CETI5. 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. CEI2. Knowledge and use of the basics of programming networks, sistemas, telecommunication services.
7. CEI7. Knowledge and use of the concepts of network architecture, protocols and communication interfaces.
8. CEI8. 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 multimedia services.
9. CEI9. Knowledge of interconnection and routing methods, as well as basics of planning, network dimensioning based on traffic parameters.
10. CEI2. 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.
This course will provide a broad introduction to the topics related with data networking by focusing on the TCP-IP reference model, particularly the network architecture and protocols related. Topics being addressed analyze how networks work on the inside by applying a top-down approach; but because students' background already includes the upper layers, of the model, e.g. application and transport layer which were developed in the past courses; our effort should be placed on the:

- IP layer, both the legacy version 4 and the upgraded version 6.
- The control, address resolution and routing protocols.
- Some collaborative activities will also be programmed to foster the team work among students, active techniques such as problem based learning and/or collaborative learning will be used for a suitable topic that requires such techniques rather than oral expositions.
- The lab classes are usually held at the computer classroom, students working in pairs will solve problems proposed by the professor, i.e. we might use a network simulator like OPNET and create and analyze a network in detail. The students should fulfill a workbook where all exercises must be properly answered. Initially they will have to fulfill as well a preliminary work to be sure that they understand the theoretical aspects of the problem and the program they will use. After two or three sessions or for sure at the end of the lab work there will be an exam to evaluate the level of understanding of the student, this exam will be held individually within class time.

### Teaching methodology

Main topics will be introduced by the professor as a lecture in the classroom, not only exposing the daily topic orally, but using all type of docent material as well, i.e. Slides, multimedia material, web searches, and so on. Students will also participate in the development of the class by solving precisely determined exercises, short talks concerning the topics being explained and discussions of up-to-date information from technical medias and/or daily press or magazines. Some collaborative activities will also be programmed to foster the team work among students, active techniques such as problem based learning and/or collaborative learning will be used for a suitable topic that requires such techniques rather than oral expositions.

### Learning objectives of the subject

This course will provide a broad introduction to the topics related with data networking by focusing on the TCP-IP reference model, particularly the network architecture and protocols related. Topics being addressed analyze how networks work on the inside by applying a top-down approach; but because students' background already includes the upper layers, of the model, e.g. application and transport layer which were developed in the past courses; our effort should be placed on the:

- IP layer, both the legacy version 4 and the upgraded version 6.
- The control, address resolution and routing protocols.
- And, finally huge effort should be devoted to analyze networks, either fix or mobile, which interconnect communication equipments and end user devices.
- It is also remarkable to say that the subject is basic to follow future subject of the same track of this curricula, such as Multimedia networks, security and network secuirty and management, and finally Future Internet.
- Students' should also be trained in transversal competences such as:
  - Team work, to learn or improve the way they cooperate whit colleagues to plan activities and/or solve problems, applying the best solution by using the methodologies learned along the course.
  - Search any documentation autonomously he/she needs to carry out satisfactory the work charged, i.e. books, articles, tutorials or any kind of document presented in any format, eg. electronic or written.
  - To present his/ her works with a high level of quality by using any kind of office tools he/she needs; and also complete any document with relevant information such as references, cross-reference-tables, index, conclusions, and so on; so to produce an professional document.
  - Understand, write documents and even talk more fluently in English as a work language. It is well-known that English is almost imperative in today's technical and business world. This course is intended to foster the use of English as if the
students were working in a real company, integrating the learning of the language and the contents.

<table>
<thead>
<tr>
<th>Study load</th>
<th>Total learning time: 150h</th>
<th>Hours large group: 45h</th>
<th>30.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>Hours medium group:</td>
<td>00.00%</td>
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<tr>
<td></td>
<td></td>
<td>Hours small group:</td>
<td>10.00%</td>
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<tr>
<td></td>
<td></td>
<td>Guided activities:</td>
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<tr>
<td></td>
<td></td>
<td>Self study:</td>
<td>60.00%</td>
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</tbody>
</table>
# Content

## Topic 1: Introduction to Internet

<table>
<thead>
<tr>
<th>Description:</th>
</tr>
</thead>
</table>
| Introduction to Internet  
Network architecture  
Organisms  
RFC  
Transport protocol review |

<table>
<thead>
<tr>
<th>Related activities:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity: Class presentation: TCP version</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Learning time:</th>
</tr>
</thead>
</table>
| 5h  
Theory classes: 2h  
Guided activities: 2h  
Self study : 1h |

## Topic 2: IP protocol v.4

<table>
<thead>
<tr>
<th>Description:</th>
</tr>
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</table>
| IP protocol IP v4  
Main concepts: datagram  
Address formats: classless i classfull. NAT.  
IP frame format  
Subnetting and mask |

<table>
<thead>
<tr>
<th>Related activities:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity 2: Case study - subnetting and addressing</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Learning time:</th>
</tr>
</thead>
</table>
| 4h  
Theory classes: 2h  
Guided activities: 1h  
Self study : 1h |
<table>
<thead>
<tr>
<th>Topic 3: IPV v6 protocol</th>
<th>Learning time: 3h</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td></td>
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<tr>
<td>Protocol IPv6</td>
<td></td>
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<tr>
<td>Upgraded functions.</td>
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<tr>
<td>IPv6 frame format, header and address formats.</td>
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<tr>
<td>IPv6 vs IPv4: pros and cons</td>
<td></td>
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<tr>
<td>Transition from IPv4 to IPv6</td>
<td></td>
</tr>
<tr>
<td>IPv6 upgraded protocols: DHCPv6, ICMPv6, . .</td>
<td></td>
</tr>
<tr>
<td><strong>Related activities:</strong></td>
<td></td>
</tr>
<tr>
<td>Activity: IPv6 vs IPV4 and exercises</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Topic 4: Routing</th>
<th>Learning time: 4h 30m</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td></td>
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<tr>
<td>Internet routing: concept, types domain.</td>
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<tr>
<td>routing internally and externally</td>
<td></td>
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<tr>
<td>Routing tables</td>
<td></td>
</tr>
<tr>
<td>routing Protocols: OSPF i RIP and interdomain protocols</td>
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</tr>
<tr>
<td>Routings algorithms</td>
<td></td>
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<tr>
<td>Multicast routing protocol</td>
<td></td>
</tr>
<tr>
<td><strong>Related activities:</strong></td>
<td></td>
</tr>
<tr>
<td>Activity: Classroom exercisce - routing algorithm</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Topic 5: Network control Protocols and address resolution</th>
<th>Learning time: 2h</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td></td>
</tr>
<tr>
<td>Network control:  Internet Control message Protocol (ICMP)</td>
<td></td>
</tr>
<tr>
<td>Address resolution: ARP, RARP i DHCP</td>
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</tbody>
</table>
### Topic 6: Network interconnection

**Learning time:** 5h  
- Theory classes: 2h  
- Guided activities: 1h 30m  
- Self study: 1h 30m

**Description:**  
- Interconnections problems based on the TCP/IP architecture  
- Routers  
- Bridges and switches  
- VLAN

**Related activities:**  
- Activity: Work in classroom - Spanning Tree protocol

### Topic 7: Network management

**Learning time:** 5h  
- Theory classes: 1h 30m  
- Guided activities: 2h  
- Self study: 1h 30m

**Description:**  
- Concept  
- SNMP protocol  
- MIB and components

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

### Topic 8: Link and transport networks

**Learning time:** 6h  
- Theory classes: 3h  
- Guided activities: 1h 30m  
- Self study: 1h 30m

**Description:**  
- Wired Local Area Networks: Ethernet (IEEE 802.3)  
- Wireless LANS, WIFI (IEEE 802.11)  
- WAN networks  
- Switched WAN  
- Mobile WAN  
- Access networks

**Related activities:**  
- Activity: access networks today
The final rating will be the result of the average of the activities undertaken by the student throughout the course:

- **Theory (T):** The theoretical concepts related with the subject acquired by the student by individual study and by any other learning activity performed mainly in the classroom. They will be assessed by appropriate written exams or tests. Precisely there will be two main written exams as detailed below:
  * A partial exam, named CONTROL, at the middle of the course
  * and the final exam at the end of the semester, named Aval Final. Pay attention to the fact that this final exam covers the entire topics covered throughout the course.

Therefore the theory qualification comes up easily from the equation below:

\[
T = 40 \cdot \text{CONTROL} + 60 \cdot \text{Aval Final} \quad (\text{if Control rate is } > \text{AF rate})
\]

\[
\text{otherwise } T = \text{AF rate}
\]

- **Practice (P):** The practice tasks performed at the laboratory will be assessed according to some parameters: personal attitude, task developed, attendance and the qualification of the final test after the task is finally delivered. (25 %)

- **Class activities:** Students will work in the classroom by doing individual and group collaborative tasks and exercises throughout the course. Such tasks will also be assessed:
  * Work, activities and exercises done in class: 15%

Given the previous division, the final rating is obtained as follows:

\[
\text{Final Rating} = 60 \cdot T + 25 \cdot P + 15 \cdot C \quad (\%)
\]

### Qualification system

The attendance to the **Theory exams:** Control and final evaluation & **Practice (labs) classes** is mandatory.

### Practice 1: Network performance evaluation

**Learning time:** 10h

- Laboratory classes: 8h
- Self study: 2h

**Description:**
By using a network simulator (OPNET) we will understand and evaluate the performance of a domestic setting.

Total 4 sessions

### Practice 2: Network management and configuration

**Learning time:** 5h 30m

- Laboratory classes: 4h
- Self study: 1h 30m

**Description:**
Managing network exercises.
Total 3 sessions.
Bibliography

Basic:


Others resources:

Hyperlink

http://www.torrens-ibern.cat

http://wps.aw.com/aw_kurose_network_5/