230015 - IXT - Introduction to Networks

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering  
Teaching unit: 744 - ENTEL - Department of Network Engineering  
Academic year: 2017  
Degree:  
- BACHELOR'S DEGREE IN AUDIOVISUAL SYSTEMS ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)  
- BACHELOR'S DEGREE IN ELECTRONIC SYSTEMS ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)  
- BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Teaching unit Compulsory)  
- BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)  
- BACHELOR'S DEGREE IN NETWORK ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)  
- BACHELOR'S DEGREE IN TELECOMMUNICATIONS SCIENCE AND TECHNOLOGY (Syllabus 2010). (Teaching unit Compulsory)  
ECTS credits: 6  
Teaching languages: Catalan, Spanish  

Teaching staff  
Coordinator:  
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- ALFONSO ROJAS ESPINOSA  
- JOAN SERRAT FERNÁNDEZ  

Degree competences to which the subject contributes  

Generical:  
6. ABILITY TO IDENTIFY, FORMULATE AND SOLVE ENGINEERING PROBLEMS Level 3. To identify and model complex systems. To identify methods and tools appropriate to pose the equations and descriptions associated with the models and to solve them. To carry out qualitative analysis and approaches. To determine the uncertainty of the results. To formulate hypotheses and experimental methods to validate them. To set up and manage undertakings. To identify major components and establish priorities. To develop critical thinking.  
7. They will have acquired knowledge related to experiments and laboratory instruments and will be competent in a laboratory environment in the ICC field. They will know how to use the instruments and tools of telecommunications and electronic engineering and how to interpret manuals and specifications. They will be able to evaluate the errors and limitations associated with simulation measures and results.  
12 CPE N1. They will be able to identify, formulate and solve engineering problems in the ICC field and will know how to develop a method for analysing and solving problems that is systematic, critical and creative.  

Transversal:
The objective of this course is to introduce students to the basic concepts of data communications networks. Basic knowledge about the structure of circuit-switched and packet-switched networks. It introduces the most relevant communication protocols operating in communications networks, the main characteristics of access networks, transport and wireless networks. Students will know the main techniques for error recovery and for shared medium access, as well as the mechanisms to interconnect heterogeneous networks and the basic routing algorithms.

Learning objectives of the subject

The objective of this course is to introduce students to the basic concepts of data communications networks. Basic knowledge about the structure of circuit-switched and packet-switched networks. It introduces the most relevant communication protocols operating in communications networks, the main characteristics of access networks, transport and wireless networks. Students will know the main techniques for error recovery and for shared medium access, as well as the mechanisms to interconnect heterogeneous networks and the basic routing algorithms.

Learning outcome:

Knowledge and use of the concepts of network architecture, communication protocols and interfaces. Understanding of the differences between access and transport networks, circuit-switched networks, packet-switched networks and mobile networks. Students will know and will analyse networking methods and routing operation.

Students will plan and carry out oral presentations, respond to the questions asked and write properly basic-level texts.

Identify the group's objectives and capability to design a working plan to achieve them. Identify the responsibilities of each member of the group and fulfillment of the objectives of the assignment.

Perform the tasks on schedule, according to the guidelines set by the teacher or tutor. Identify the degree of progress and achievement of the objectives of learning.

Use of resources and available services to run simple searches. Classify and summarize the information collected and properly cite sources.

Raise the problem correctly from the proposed statement and identify options for resolution. Apply the appropriate resolution method and identify the correction of the solution.

Knowledge and use of correct tools, software tools and applications available in the laboratories and carry out correctly the analysis of the collected data.
### Study load

<table>
<thead>
<tr>
<th></th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total learning time</strong></td>
<td>150h</td>
<td></td>
</tr>
<tr>
<td>Hours large group:</td>
<td>39h</td>
<td>26.00%</td>
</tr>
<tr>
<td>Hours small group:</td>
<td>26h</td>
<td>17.33%</td>
</tr>
<tr>
<td>Self study:</td>
<td>85h</td>
<td>56.67%</td>
</tr>
</tbody>
</table>
# Content

## 1. Introduction to telematic networks.

**Learning time:** 43h  
Theory classes: 11h  
Practical classes: 0h  
Laboratory classes: 6h  
Self study : 26h

**Description:**  
The main networks and telematic services are introduced.  
Network classification: acces network and transport network.  
Channel sharing between multiple users (multiplexing). Deterministic and statistical time division multiplexing.  
Network classification on basis of the switching technique. Circuit switching and packet switching (datagram and virtual circuit).  
Basic metrics for the channel utilization and the protocol efficiency.  
Main network architectures: TCP/IP and the OSI reference model.

Laboratory session: Configuration and analysis of asynchronous serial communications.

## 2. Data link.

**Learning time:** 20h 30m  
Theory classes: 5h 30m  
Practical classes: 0h  
Laboratory classes: 2h  
Self study : 13h

**Description:**  
Data link reliability. Flow and error control. Error detection and correction mechanisms, by means of automatic retransmission request (ARQ) or forward error correction (FEC). Analysis of different ARQ modes (Stop&Wait, Go-Back N, Selective repeat).

The more common techniques used for the access to shared mediums are also introduced. Contentionless (TDMA, polling, token ring) and contention techniques (Aloha, slotted-Aloha, CSMA, CSMA/CD, CSMA/CA).

Two laboratory sessions: Serial communications using a simple data communication protocol and HDLC (High-level Data Link Control) protocol.
### 3. Local Area Networks.

**Learning time:** 32h 30m
- Theory classes: 8h 30m
- Practical classes: 0h
- Laboratory classes: 4h
- Self study: 20h

**Description:**
The most common local area network technologies are studied: Ethernet and IEEE 802.11 networks (WiFi).

Characteristics and interconnection of Ethernet networks by means of repeaters, hubs and switches. Basic characteristics of wireless networks, frame types and procedures.

Laboratory session: Ethernet local area networks.

### 4. Network interconnection.

**Learning time:** 38h
- Theory classes: 8h
- Practical classes: 0h
- Laboratory classes: 10h
- Self study: 20h

**Description:**
Internet protocol (IP), addressing, datagrams fragmentation and reassembly.
Subnetting and supernetting.
Address Resolution Protocol (ARP).
Internet Control Messages Protocol (ICMP).
Introduction to multicast transmissions.
Metric concept and routing tables. Main dynamic and static routing mechanisms.
Introduction to transport layer protocols (UDP and TCP).
Dynamic Host Configuration Protocol (DHCP).
Domain Name System (DNS).

Laboratory sessions: Different sessions about IP networks working on LINUX stations. Several protocols are studied in detail (IP, ARP, ICMP). Routing tables and an introduction to dynamic routing protocols are also covered.
### Planning of activities

<table>
<thead>
<tr>
<th>Laboratory Session</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Introduction to Linux.</strong></td>
<td>First laboratory session about Linux. Students will learn the essentials of this operating system in order to be able to do the rest of the laboratory sessions.</td>
</tr>
<tr>
<td><strong>2. Serial Communications.</strong></td>
<td>Configuration and analysis of asynchronous serial communications. The study of a simple data link protocol is included.</td>
</tr>
<tr>
<td><strong>3. HDLC Protocol.</strong></td>
<td>High-level Data Link Control protocol configuration and analysis. The study is focused on the flow and error control mechanisms.</td>
</tr>
<tr>
<td><strong>4. Ethernet Local Area Networks.</strong></td>
<td>Physical and data link layers study of a switched Ethernet network. The session includes the study of the selfconfiguration mechanism and the line code, by means of scope captures.</td>
</tr>
<tr>
<td><strong>First Midterm Control.</strong></td>
<td>Midterm control to be done individually by the students in the laboratory.</td>
</tr>
<tr>
<td>Event Type</td>
<td>Hours</td>
</tr>
<tr>
<td>--------------------------------</td>
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<tr>
<td>First control of theory</td>
<td>1 h</td>
</tr>
<tr>
<td>Second laboratory midterm control</td>
<td>1 h</td>
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<tr>
<td>Laboratory session 5. IP networks</td>
<td></td>
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<tr>
<td>Extraordinary exam</td>
<td>2 h</td>
</tr>
<tr>
<td>Theory classes:</td>
<td>1 h</td>
</tr>
<tr>
<td>Theory classes:</td>
<td>1 h</td>
</tr>
<tr>
<td>Theory classes:</td>
<td>2 h</td>
</tr>
</tbody>
</table>
1 - This course has evaluation of theory and of laboratory.
   - The theory part is approved by continuous assessment. The theory mark consists of two controls with a weight of 50% each.
   - The laboratory mark consists of two controls with a weight of 50% each.
2 - The grade for the course is 70% of theory mark and 30% of laboratory mark.
   - If the course is approved, the evaluation process is completed.
   - If the course is failed and you fulfill the ETSETB conditions about extra exams, you can go to an EXTRA exam of the theory part held during the planned term (July). In this case, the grade for the course is 70% of the EXTRA mark and 30% of laboratory mark (the mark obtained in the normal evaluation period).
   - The extraordinary exam of the theory part will be done individually by the students in case of not passing the course (the student failed in the continuous evaluation). This exam will be held during the weeks planned by the ETSETB for extraordinary exams (in July).
3 - Laboratory attendance is compulsory.

This course evaluates this generic skill:
- Ability to identify, formulate and solve engineering problems (Level). For the evaluation, the grades obtained in the different tests and exams done during the semester, in which engineering problems appear, are taken into account.

Bibliography

Basic:

Complementary: