Course guide
230015 - IXT - Introduction to Networks

Last modified: 24/05/2024

Unit in charge:	Barcelona School of Telecommunications Engineering
Teaching unit:	744 - ENTEL - Department of Network Engineering.

Degree: BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Compulsory subject).

Academic year: 2024   **ECTS Credits:** 6.0   **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: ISRAEL MARTÍN ESCALONA - MONICA AGUILAR IGARTUA

Others: Primer quadrimestre:
MONICA AGUILAR IGARTUA - 11, 13
ALBERTO BAZÁN GUILLÉN - 41, 43
ISRAEL MARTÍN ESCALONA - 41, 43
JOSEP RAFEL PEGUEROLES VALLES - 11, 13, 14

Segon quadrimestre:
MONICA AGUILAR IGARTUA - 11, 13, 21, 22, 23
FRANCISCO BARCELO ARROYO - 11, 22, 23, 31, 42, 43
JORDI CASADEMONT SERRA - 31, 33
ISABEL VICTORIA MARTIN FAUS - 13
JOSEP RAFEL PEGUEROLES VALLES - 21
MARCOS POSTIGO BOIX - 33, 41, 42, 43

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Generical:

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.
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.
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:

1. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.
3. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.
4. EFFECTIVE USE OF INFORMATI0N RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.
5. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

TEACHING METHODOLOGY

Application classes
Lectures
Laboratory classes
Individual work (not presential)
Short-answer tests (Control)
Short-answer tests (Test)
Extended-response tests (Final Exam)
Laboratory

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 fullfilment 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 analyse of the collected data.

STUDY LOAD

Type	Hours	Percentage
Hours large group	39,0	26.00
Self study	85,0	56.67
Hours small group	26,0	17.33

Total learning time: 150 h

CONTENTS

Chapter 1. Introduction to telematic networks.

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.

Full-or-part-time: 37h
Theory classes: 11h
Self study : 26h

Chapter 2. Data link.

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.

Full-or-part-time: 20h 30m
Theory classes: 7h 30m
Self study : 13h

Chapter 3. Local Area Networks.

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 repeiters, hubs and switches. Basic characteristics of wireless networks, frame types and procedures.

Laboratory session: Ethernet local area networks.

Full-or-part-time: 28h 30m
Theory classes: 8h 30m
Self study : 20h

Chapter 4. Network interconnection.

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 (UPD 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.

Full-or-part-time: 28h
Theory classes: 8h
Self study : 20h

ACTIVITIES

LABORATORY SESSION 1. SERIAL COMMUNICATIONS.

Description:
Configuration and analysis of asynchronous serial communications. The study of a simple data link protocol is included.

Delivery:
Previous study. It must be made before the laboratory session. It is an essential requirement to perform the session and therefore to be evaluated.

Related competencies :
10 ECI N1. 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.
07 AAT N1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.
06 URI N1. EFFECTIVE USE OF INFORMATI0N RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.
04 COE N1. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.
05 TEQ N1. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.

Full-or-part-time: 6h
Laboratory classes: 6h

LABORATORY SESSION 2. HDLC PROTOCOL.

Description:
High-level Data Link Control protocol configuration and analysis. The study is focused on the flow and error control mechanisms.

Delivery:
Previous study. It must be made before the laboratory session. It is an essential requirement to perform the session and therefore to be evaluated.

Related competencies :
10 ECI N1. 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.
07 AAT N1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.
06 URI N1. EFFECTIVE USE OF INFORMATI0N RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.
04 COE N1. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.
05 TEQ N1. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.

Full-or-part-time: 3h
Laboratory classes: 3h

LABORATORY SESSION 3 ETHERNET LOCAL AREA NETWORKS.

Description:
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.

Delivery:
Previous study. It must be made before the laboratory session. It is an essential requirement to perform the session and therefore to be evaluated.

Related competencies :
10 ECI N1. 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.
07 AAT N1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.
06 URI N1. EFFECTIVE USE OF INFORMATI0N RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.
04 COE N1. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.
05 TEQ N1. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.

Full-or-part-time: 5h
Laboratory classes: 5h

LABORATORY SESSION 4. IP NETWORKS.

Description:
By means of virtualization over Linux workstations, all the functionalities of the IP layer are studied in detail. A first study of dynamic routing protocols is also included.

Delivery:
Previous study. It must be made before the laboratory session. It is an essential requirement to perform the session and therefore to be evaluated.

Related competencies :
10 ECI N1. 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.
07 AAT N1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.
06 URI N1. EFFECTIVE USE OF INFORMATI0N RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.
04 COE N1. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.
05 TEQ N1. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.

Full-or-part-time: 10h
Laboratory classes: 10h

FIRST LABORATORY MIDTERM CONTROL.

Description:
Midterm control to be done individually by the students.

Related competencies :
10 ECI N1. 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.
04 COE N1. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.
07 AAT N1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.
03 TLG. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
06 URI N1. EFFECTIVE USE OF INFORMATI0N RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.

Full-or-part-time: 1h
Laboratory classes: 1h

FIRST CONTROL OF THEORY

Description:
Control of the 1st part of the theory, to be done individually by the students.

Related competencies :
08 CRPE N3. 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.
04 COE N1. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.

Full-or-part-time: 2h
Theory classes: 2h

SECOND LABORATORY MIDTERM CONTROL.

Description:
Midterm control to be done individually by the students.

Related competencies :
10 ECI N1. 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.
03 TLG. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
07 AAT N1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.
06 URI N1. EFFECTIVE USE OF INFORMATI0N RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.
04 COE N1. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.

Full-or-part-time: 1h
Laboratory classes: 1h

SECOND CONTROL OF THEORY

Description:
Control of the 2nd part of the theory, to be done individually by the students.

Full-or-part-time: 2h
Theory classes: 2h

EXTRAORDINARY EXAM

Description:
Extraordinary exam of the theory part to be done individually by the students in case of not passing the course (the student failed in the continuous evaluation). This exam will be hold during the weeks planned by the ETSETB for extraordinary exams (in July).

Related competencies :
08 CRPE N3. 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.
04 COE N1. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.

Full-or-part-time: 2h
Theory classes: 2h

GRADING SYSTEM

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 fulfil the ETSETB conditions about extra exams, you can go to an EXTRA exam of the theory part hold 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 obtaines 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 hold 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:
- Forouzan, B. A. Data communications and networking with TPC/IP protocol suite. 6th ed. New York: McGraw-Hill, 2022. ISBN 9781260597820.

Complementary:
- Kleinrock, L. Queueing systems: vol 1: theory. New York: John Wiley & Sons, 1975. ISBN 0471491101 (V. 1).