

Course guide

300016 - FT - Fundamentals of Telematics

Last modified: 01/06/2023

Unit in charge:	Castelldefels School of Telecommunications and Aerospace Engineering
Teaching unit:	744 - ENTEL - Department of Network Engineering.
Degree:	BACHELOR'S DEGREE IN NETWORK ENGINEERING (Syllabus 2009). (Compulsory subject). BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING (Syllabus 2009). (Compulsory subject). BACHELOR'S DEGREE IN AEROSPACE SYSTEMS ENGINEERING (Syllabus 2015). (Optional subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: Definit a la infoweb de l'assignatura.

Others: Definit a la infoweb de l'assignatura.

PRIOR SKILLS

- Be familiar with the basic parameters of a system: transmitter-transmission system-receiver.
It is recommended to have completed ELECTRONICS FOR TELECOMMUNICATIONS

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

1. CE 12 TELECOM. Conocimiento y utilización de los fundamentos de la programación en redes, sistemas y servicios de telecomunicación. (CIN/352/2009, BOE 20.2.2009.)
2. CE 18 TELECOM. Capacidad de diferenciar los conceptos de redes de acceso y transporte, redes de conmutación de circuitos y de paquetes, redes fijas y móviles, así como los sistemas y aplicaciones de red distribuidos, servicios de voz, datos, audio y servicios interactivos y multimedia.(CIN/352/2009, BOE 20.2.2009.)

Transversal:

3. 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.
4. EFFECTIVE USE OF INFORMATION 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.

TEACHING METHODOLOGY

Although group activities may sometimes be organised, it is fundamentally a subject based on the individual study, effort, work and assessment of each student.

Theory-based lectures are basically given by the lecturer using a blackboard and slides. Students are encouraged to participate in class with questions and comments. The slides can be printed from Atenea so that students can study them and take notes during lectures.

Problem-based lectures are based on a wide array of representative problems that are available on Atenea, some of which will be solved by the lecturer in class; students will be told which problems will be solved in advance so that they can get more out of problem-solving lectures.

A practicals manual is available on Atenea for students to study and prepare before the laboratory session; the practical session is attended by the lecturer and practicals are assessed in specific examinations.

LEARNING OBJECTIVES OF THE SUBJECT

On completion of Fundamentals of Telematics, students will be able to:

- Describe the general functioning of a complex network: The Internet and PSTNs
 - Determine the causes and approximate values of network parameters such as bandwidth, information loss and delay, and their effects on various types of telematics services.
 - Explain the significance of fundamental concepts such as protocols, interfaces, architectures, services, applications, switching and multiplexing; explain and justify the need for network functions such as framing, addressing, error control, flow control and routing.
 - Define types of networks and their applications: transport networks, access networks, mobile networks, WANs, MANs, LANs, circuit and packet networks, datagram networks and virtual circuit networks.
- Identify types of networks and their suitability for various types of service, as well as the mechanisms and algorithms that allow the fundamental functions of communication networks to be deployed and the elements of which these networks are composed.
- Use tools and measuring equipment for telematics networks.

STUDY LOAD

Type	Hours	Percentage
Hours large group	26,0	17.33
Hours small group	19,5	13.00
Self study	84,0	56.00
Guided activities	7,5	5.00
Hours medium group	13,0	8.67

Total learning time: 150 h

CONTENTS

INTRODUCTION

Description:

Fundamental concepts: telematics services and applications, evolution of telecommunications services, digital information, transmitters and receivers, network, infrastructures, baseband transmission, coding, modulating and multiplexing. Introduction to other concepts: type of services, service level agreement (SLA), quality of service (QoS), interconnection, error, flow and congestion control, addressing, routing, management and administration, operations, maintenance and modelling. Network types, topology, broadcasting, switching, fix, mobile, access, transport, WAN/MAN/LAN/PAN/BAN. The aim of this topic is to engage students in problems related to the provision of telematics services. Solving these problems should prepare students for subsequent courses.

Related activities:

Guided visit to networks and services on the Baix Llobregat Campus, data transmission and telematics laboratory, laboratory verification examinations, problem solving, tests.

Full-or-part-time: 41h 15m

Theory classes: 5h

Practical classes: 1h

Laboratory classes: 8h

Guided activities: 2h 30m

Self study : 24h 45m

INTERNET

Description:

Information packets, fixed and variable size, nodes and links, sources, transmission, traffic, node queues, delays, datagram, routing, multicast, introduction to the Internet, TCP/IP. Network architecture, protocols, interfaces, interconnection and interconnection equipment. Features of a LAN, rules, MAC addresses, framing. Ethernet, LAN interconnection, structured cabling. MAC addresses, ARP protocol, IP addressing, name resolution. Routing, protocol types, metrics, Internet routing.

Related activities:

Guided visit to networks and services on the Baix Llobregat Campus, data transmission and telematics laboratory, laboratory verification examinations, problem solving, tests.

Full-or-part-time: 54h 35m

Theory classes: 10h

Practical classes: 4h

Laboratory classes: 4h

Guided activities: 3h 50m

Self study : 32h 45m

PUBLIC SWITCHED TELEPHONE NETWORK

Description:

Types of networks and services, terminals, nodes, links, transmission, signalling. Circuit switching.

Related activities:

Guided visit to networks and services on the Baix Llobregat Campus, problem solving, tests.

Full-or-part-time: 7h 55m

Theory classes: 3h

Guided activities: 0h 10m

Self study : 4h 45m

CONTROL MECHANISMS

Description:

Flow control, justification, Stop and Wait protocol, sequence number, sliding window. Round Trip Time (RTT), efficiency. Bit error rate. Bit error control. Packet error control, acknowledgments, timers and retransmissions, basic protocols. Congestion control, protocol types, Internet case.

Related activities:

Telematics laboratory, laboratory verification examinations, problem solving, tests.

Full-or-part-time: 46h 15m

Theory classes: 6h

Practical classes: 5h

Laboratory classes: 6h

Guided activities: 1h 30m

Self study : 27h 45m

ACTIVITIES

GUIDED VISIT TO NETWORKS AND SERVICES ON THE BAIX LLOBREGAT CAMPUS

Description:

In this directed activity, the lecturer will take groups of ten students on a tour of the following campus facilities: the telephone network, the data network, cabling and other infrastructures and the technical services. Students will have been given an indication of what they will see beforehand.

Specific objectives:

For students to obtain an overview of the networks and services of a building complex such as a university campus.

For students to become familiar with the workings of a telecommunications infrastructure in a real large-scale environment. For students to be able to identify the various parts that make up a telecommunications infrastructure.

For students to become familiar with telephone networks and for them to be able identify their components in a real, operational environment.

For students to become familiar with telephone networks and for them to be able identify their components in a real-life environment.

For students to become familiar with the types of service that the networks and infrastructures they have visited can provide.

For students to become familiar with the maintenance operations and tasks that are habitually carried out.

Material:

Explanatory slides on what students will see on the tour.

Delivery:

Students will draw up a brief report on what they have done and seen on the tour.

Full-or-part-time: 1h

Guided activities: 1h

DATA TRANSMISSION LABORATORY

Description:

Two 2-hour sessions in the Data Transmission Laboratory (331). Students will be able to operate over the laboratory voice and data infrastructure and will have acquired practical knowledge of the physical layer of a network. In particular, they will have learnt techniques for the implementation of a local voice and data network and for data codification. In these sessions, students will use specific tools for handling and checking twisted pair cables (climbers, impact wrenches and continuity testers) and a digital oscilloscope. Some consumable materials must be paid for by the student (see practicals).

Specific objectives:

On completion of all the laboratory sessions, students will be able to:

- Identify the elements of a voice and data network infrastructure in a building.
- Understand how the elements relate to each other.
- Use simple tools for building, testing and interconnecting these elements.
- Obtain and interpret digital signals carried over a twisted pair cable using a digital oscilloscope.

Material:

Outline of the practical sessions and a preliminary questionnaire (available on the digital campus).

Full-or-part-time: 4h

Laboratory classes: 4h

TELEMATICS LABORATORY

Description:

This activity is splitted in different practical sessions. Initially an introduction to the basic configuration of a Linux network is carried out. Students will become familiar with common Linux network commands and tools such as traffic and protocol analysers. They will also become aware of the elements that comprise the laboratory network and will be able to systematically diagnose connection problems.

Next, the student will configure Linux and Windows on computers connected to network devices that work on layers of the OSI model and use various network technologies (LAN, WLAN). The student will analyze the IP protocol, configure and test the addressing and routing scheme that will ensure connectivity among nodes and to the Internet. Students will then go on to study the network's performance and the impact of its features on applications for various services.

Specific objectives:

On completion of all the laboratory sessions, students will be able to:

- Configure basic network parameters on Linux and Windows operating systems
- Write simple scripts for the automatic configuration of these parameters in Linux
- Use basic network analysis tools (such as ping, traceroute, Wireshark, etc.)
- Identify the functions of devices in a LAN (hub, switch, router, wireless access point)
- Understand the fundamentals of addressing and routing
- Understand the concept of network address translation
- Understand the functioning of the ARP protocol
- Will be able to a process for and resolving problems in a network
- Understand the relationship between network performance and the needs of a particular service
- Understand the causes and impact of congestion and the advantages of QoS

Material:

Outline of the practical sessions and a preliminary questionnaire (available on the digital campus).

Full-or-part-time: 14h

Laboratory classes: 14h

LABORATORY VERIFICATION EXAMINATIONS

Description:

Two laboratory examinations during the course.

Specific objectives:

The assessment is designed to grade the practical laboratory skills acquired by students up to that point.

Material:

Practicals manual. The results obtained in the examination.

Delivery:

The written exercise carried out by the student during the test.

Full-or-part-time: 2h

Guided activities: 2h

PROBLEM SOLVING

Description:

In preparation for mid-semester examinations, a preliminary session will be held to decide on an approach to a specific problem, where students will work on the solution.

Specific objectives:

This activity takes place after the corresponding problem-solving classes. The objectives of this activity are as follows:

- For the student to become aware of his or her level before the examination takes place.
- For the student to be able to correct his or her errors and fully comprehend the fundamental topics in relation to the problems studied.

Material:

Enunciation problems

Delivery:

The students' solution to the problem.

Full-or-part-time: 1h

Guided activities: 1h

TESTS

Description:

There will be a theory and problem test approximately every quarter-semester.

Specific objectives:

The exercise submitted should show that the student:

- Has acquired the necessary skills in the theory and problem classes.
- Understands and knows how to apply and explain the fundamental concepts worked on in the theory and problem groups.
- Is familiar with the topics taught in class and those suggested for individual study by the lecturer.
- Is able to relate and integrate the concepts, techniques and technologies discussed in the theory and problem classes.
- Has a clear idea of the orders of magnitude of the parameters of telematics networks and services looked at in class.
- Is able to calculate exactly or approximately, as the case may be, the value of the variables and parameters discussed in the theory and problem classes.

Material:

Students can use the slides from the lectures, sets of problems and their lecture or class notes to prepare for this activity.

Delivery:

The written exercise carried out by the student during the test.

Full-or-part-time: 2h

Guided activities: 2h

GRADING SYSTEM

Evaluation criteria to be applied are published in the infoweb of the course

EXAMINATION RULES.

All the activities are compulsory.



BIBLIOGRAPHY

Basic:

- Keshav, Srinivasan. An engineering approach to computer networking : ATM networks, the internet, and the telephone network. Reading, Mass.: Addison-Wesley, cop. 1997. ISBN 0201634422.
- Casademont Serra, Jordi; Beltrán Martínez, Victoria. Redes de comunicaciones : de la telefonía móvil a Internet [on line]. Barcelona: Edicions UPC, 2010 [Consultation: 15/04/2020]. Available on: <http://hdl.handle.net/2099.3/36575>. ISBN 9788498804416.
- Stallings, William. Comunicaciones y redes de computadores [on line]. 7ª ed. Madrid [etc.]: Pearson Educación, 2004 [Consultation: 26/07/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=1245. ISBN 8420541109.

RESOURCES

Hyperlink:

- Internet. Páginas web específicas, por ejemplo de organismos de normalización