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300016 - FT - Fundamentals of Telematics

Coordinating unit: 300 - EETAC - Castelldefels School of Telecommunications and Aerospace Engineering

Teaching unit: 744 - ENTEL - Department of Network Engineering

Academic year: 2018

Degree: BACHELOR'S DEGREE IN AEROSPACE SYSTEMS ENGINEERING/BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING (Syllabus 2015). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN NETWORK ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN AEROSPACE SYSTEMS ENGINEERINGS/BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING - NETWORK ENGINEERING (AGRUPACIÓ DE SIMULTANEÏTAT) (Syllabus 2015). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN AEROSPACE SYSTEMS ENGINEERING/BACHELOR'S DEGREE IN NETWORK ENGINEERING (Syllabus 2015). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN AEROSPACE SYSTEMS ENGINEERING (Syllabus 2015). (Teaching unit Optional)
BACHELOR'S DEGREE IN AIR NAVIGATION ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN AIRPORT ENGINEERING (Syllabus 2010). (Teaching unit Optional)

ECTS credits: 6 Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: 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.

Requirements

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.

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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

Total learning time: 150h	Hours large group:	26h	17.33%
	Hours medium group:	13h	8.67%
	Hours small group:	19h 30m	13.00%
	Guided activities:	7h 30m	5.00%
	Self study:	84h	56.00%

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Content

INTRODUCTION TO TELEMATICS

Learning time: 29h

Theory classes: 4h
Practical classes: 1h
Laboratory classes: 8h
Guided activities: 2h
Self study : 14h

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. 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 in groups, tests.

Communication Networks

Learning time: 28h 30m

Theory classes: 4h
Practical classes: 6h
Laboratory classes: 3h
Guided activities: 1h 30m
Self study : 14h

Description:
Network types, topology, switching, circuit switching, packet switching, fix, mobile, access, transport, WAN/MAN/LAN/PAN/BAN. Network architecture, protocols, interfaces, interconnection and interconnection equipment.

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

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PACKET SWITCHING NETWORKS

Learning time: 20h 40m

Theory classes: 4h
Practical classes: 0h
Laboratory classes: 2h
Guided activities: 0h 40m
Self study : 14h

Description:
Information packets, fixed and variable size, nodes and links, sources, transmission, traffic, node queues, delays, datagram, virtual circuits, routing, multicast, introduction to the Internet, TCP/IP.

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

CIRCUIT SWITCHING NETWORKS

Learning time: 8h 10m

Theory classes: 2h
Guided activities: 0h 10m
Self study : 6h

Description:
Types of networks and services, terminals, nodes, links, transmission, signalling.

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

MEDIUM ACCESS: LANs

Learning time: 11h 40m

Theory classes: 3h
Laboratory classes: 2h
Guided activities: 0h 40m
Self study : 6h

Description:
Features of a LAN, protocols, rules, MAC addresses, framing. Ethernet, LAN interconnection, structured cabling.

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

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FLOW, ERROR AND CONGESTION CONTROL	Learning time: 34h Theory classes: 6h Practical classes: 6h Guided activities: 2h Self study : 20h

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

Related activities:
Telematics laboratory, laboratory verification examinations, problem solving in groups, tests.

ADDRESSING AND ROUTING	Learning time: 18h Theory classes: 3h Laboratory classes: 4h 30m Guided activities: 0h 30m Self study : 10h

Description:
PSTN addressing, MAC addresses, ARP protocol, IP addressing, name resolution. Routing, protocol types, metrics, Internet routing.

Related activities:
Telematics laboratory, laboratory verification examinations, problem solving in groups, tests.

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Planning of activities

GUIDED VISIT TO NETWORKS AND SERVICES ON THE BAIX LLOBREGAT CAMPUS

Hours: 1h
Guided activities: 1h

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.

Support materials:
Explanatory slides on what students will see on the tour.

Descriptions of the assignments due and their relation to the assessment:
Students will draw up a brief report on what they have done and seen on the tour.

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.

DATA TRANSMISSION LABORATORY

Hours: 6h
Laboratory classes: 6h

Description:
Two 3-hour sessions in the Data Transmission Laboratory (331). The sessions follow on from Activity 1. 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).

Support materials:
Outline of the practical and a questionnaire (available on the digital campus).
Digital oscilloscope manual (printed copy)

Descriptions of the assignments due and their relation to the assessment:
Filled-out questionnaire to be submitted at the end of the second practical. Compulsory assignment.

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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.

TELEMATICS LABORATORY	Hours: 13h 30m Laboratory classes: 13h 30m

Description:
This activity is in two parts. The first, lasting three hours, is an introduction to the basic configuration of a Linux network. 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.
The second part involves work on a project lasting ten and a half hours divided into three 3-h sessions and a single session lasting an hour and a half. The aim is for students to set up a small network connection to the Internet designed for them to study the relationship between the services and capabilities of a network. Students 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). In the first session, students apply the knowledge acquired in the first session (Linux and network tools) to the study of the IP protocol, before setting up the network. The network will be set up in the subsequent two classes. The first step will be for students to define, 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. The fourth lesson, lasting an hour and a half, will be devoted to finishing outstanding work from previous lessons or to other, optional activities.

Support materials:
Outline of the practical and a questionnaire (available on the digital campus)

Descriptions of the assignments due and their relation to the assessment:
Filled-out questionnaire to be submitted at the end of the second practical. Compulsory assignment.

Specific objectives:
On completion of all the laboratory sessions, students will be able to:
- Configure basic network parameters in 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 and Wireshark (Ethereal)
- Identify the functions of devices in a LAN (hub, switch, router, wireless point of access)
- 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

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LABORATORY VERIFICATION EXAMINATIONS	Hours: 2h Guided activities: 2h

Description:
Two laboratory examinations during the course.

Support materials:
Practicals manual. The results obtained in the examination.

Descriptions of the assignments due and their relation to the assessment:
The written exercise carried out by the student during the test.

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

GROUP PROBLEM SOLVING	Hours: 2h 30m Guided activities: 2h 30m

Description:
In preparation for mid-semester and end-of-semester examinations, a preliminary session will be held to decide on an approach to a specific problem. Students will then form subgroups of five students to solve the problem and will discuss it among themselves. The lecturer will then provide the solution.

Support materials:
Enunciation problems

Descriptions of the assignments due and their relation to the assessment:
The students' solution to the problem (one per subgroup).

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 improve his or her communication, debating and persuasion skills with fellow students.
- For the student to be able to correct his or her errors and fully comprehend the fundamental topics in relation to the problems studied.

TESTS	Hours: 2h Guided activities: 2h

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

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

Descriptions of the assignments due and their relation to the assessment:
The written exercise carried out by the student during the test.

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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.

Qualification system

Assessment for the course involves:
- Two assessment examinations on theoretical and applied topics (45%: 20% for the first and 25% for the second)
- Two tests on theoretical and applied topics (20%: 10% each)
- Two laboratory examinations (25%: 10% for the first and 15% for the second)
- Directed activities (5%)
- Subjective assessment (5%)
- The final mark will be the average of all marks.

- For students to be graded for laboratory sessions:
- They must attend all practicals.
- Any absences must be justified.

Regulations for carrying out activities

All the activities are compulsory.

Bibliography

Basic:

Keshav, H. An engineering approach to telecommunications networking. 1a ed.. New York: Addison-Wesley, 2010.

Casademont Serra, Jordi; Beltrán Martínez, Victoria. Redes de comunicaciones : de la telefonía móvil a Internet [on line]. Barcelona: Edicions UPC, 2010Available on: <http://hdl.handle.net/2099.3/36575>. ISBN 9788498804416.

Stallings, William. Comunicaciones y redes de computadores. 7ª ed. Madrid [etc.]: Pearson Educación, 2004. ISBN 8420541109.

Others resources:

Hyperlink

Internet

Páginas web específicas, por ejemplo de organismos de normalización