Universidad Politécnica de Cartagena

Centro Universitario de la Defensa

Communication Networks & Services

Syllabus

Industrial Organization Engineering Degree

Academic year 2013-2014

1. COURSE DETAILS

Name	Communication Networks & Services				
Course field	Communication Networks & Services				
Code	511103013				
Degree Course	Grado en Ingeniería de Organización Industrial				
Programme	2009 (Decreto 269/2009 de 31 de julio)				
Faculty	Centro Universitario de la Defensa en la Academia General del Aire				
Type	Optional				
Duration	Four-month course	**Year**	3rd		
Language	Spanish/English				
ECTS	6	**Hours / ECTS**	25	**Total workload (hours)**	150
Lectures Timetable	To be defined			**Room**	To be defined
Classes/Labs/Seminars timetable	To be defined			**Building**	Lab 3, Pavilion 4

2. TEACHING STAFF CONTACT DETAILS

Head of the course	Pedro J. García-Laencina		
Department	Department of Integrated Areas		
Area of expertise	Computer Science, Signals & Communications		
Office location	Office 15, CUD Building		
Phone	+34 968189979	**Fax**	+34 968188780
E-mail	pedroj.garcia@cud.upct.es		
URL / WEB	http://moodle.upct.es/course/view.php?id=511103013		
Office hours (for supervisions)	Tuesday & Thursday 12:40-14:40; As a general rule, students who want to make a supervision should make an appointment by e-mail (with a day in advance) to properly organize the attention of all students.		
Office hours location (for supervisions)	Office 15, CUD Building		
Job Title	Doctor of Telecommunication Engineering. Full-time Lecturer (Assistant Professor, PhD Tenure Track), Field: Computer Science & Artificial Intelligence.		
Teaching Experience	Five years as lecturer at CUD (3 years) and ETSIT-UPCT (2 years). Courses taught: Digital Signal Processing, Communication Theory, Communications Laboratory, Complements of Signals & Communications, Technical Drawing, Computer Science, Communication Networks & Services		
Research interests	Computational Intelligence Machine Learning Statistical Pattern Recognition Signal & image processing Biomedical engineering: Bio-signals Brain Computer Interfaces		
Professional experience	2 years Navantia-FABA: Software Engineer for HMI (Human Machine Interfaces) of Integrated Platform Management Systems of Military Ships		
Other topics of interest	Dual Use Technologies: Civil & Military Applications		

3. COURSE OUTLINE

3.1. Presentation

The subject "*Communications Networks & Services (CNS)*" is presented as an elective in the formation of a future Air Force officer with the Engineering Degree in Industrial Management. Specifically, the main objective is that students learn the basic theoretical and practical concepts for networks and telecommunication systems, and thus, develop the skills needed to apply them in their future professional practice. It should be remarked that this subject provides the minimum knowledge needed to facilitate the development of later advanced subjects on telecommunication systems.

As it has been already mentioned, this course covers the fundamentals of network and telecommunication services. Since its beginnings in the XIX century, communication systems have been developed as a solution to the needs of industry and society. Currently, networks, systems and telecommunication services are present in numerous civilian and military contexts as the fundamental basis for the development of the Information Society in the XXI century. Like other organizations, the Security Forces and Defense need tools and solutions based on the Information Technology and Communications (ICT) to efficiently manage their processes and operations.

Therefore, the content of the course will extend over seven teaching units, covering both basic and specific aspects of types and network architectures, transmission and data encoding, transmission media, multiplexing, data link control, packet and circuit switching, structured cabling systems, LAN topologies, TCP/IP technology and the most widespread services and applications today.

The subject CNS is carried out under an eminently practical approach by making a special effort on the laboratory works. It is also an aim to develop generic skills such as teamwork, independent learning, and organizational capacity planning and concern for quality and a job well done.

3.2. Year and duration within the degree programme

The subject CNS is studied in the third year (second quarter). It is an elective course that provides basic knowledge to facilitate the learning of later advanced subjects on telecommunication systems.

3.3. Description of the course

Today, the learning of the basics of ICT, and particularly, the main networks, systems and telecommunications services is an integral part of the training of every professional, as the ICT technologies are part of the working environments in which they develop their careers.

With the subject "Communications Networks & Services", students will be able to understand how the telecommunications systems work and, also, to manage the main equipment and technical documentation necessary for the design and configuration of networks and systems. Thus, it provides the basic knowledge of the different parts that make up a telecommunication system, ranging from the physical layer and the transmission of signals/data to the layer of ICT applications. At the end of this course, students will be able to make the appropriate use of the resources of the telecommunication systems and services in their specialty field.

The training provided to each student enables him to extrapolate the knowledge gained to other infrastructure, so that the skills acquired will be useful in their professional development in the medium and long term.

3.4. Related courses. Prerequisites and recommendations

This subject is optional and requires no other previous courses in the curriculum. Thus, there is no any prerequisite or recommendation associated with this subject.

Due to the fact that this course belongs to Information & Communication Technologies (ITC), it extends the basic notions analyzed in the course “Security and Defense Technology” (3rd year) and complements the course "Electromagnetic Exploration Systems" (4th year). Furthermore, although indirectly and to a lesser extent, this subject is also related with other courses as "Computer Science" (1st year), "Electrical Technology" or "Electronic Automation and Instrumentation" (2nd year).

3.5. Special measures

Special measures will be done for allowing simultaneous studies related to military & aeronautical training activities. Specifically, we will form working groups/cooperative learning of students with limited availability, fostering learning track by scheduling tutoring activities and developing theoretical/practical exercises by using the website of this subject.

4. COMPETENCES

4.1. Specific competences of the course

The specific skills of the subjects develop competence E2.8:
"Ability to organize, control, protection and use of units responsible for force protection, control systems, control and operational support to air operations"
Details are specified in paragraphs 4.4 (learning objectives) and 5.1 (curriculum content).

4.2. Generic and transversal competences

INSTRUMENTAL COMPETENCES

- ☒ T1.1 Analytical and summary skills
- ☐ T1.2 Organizational and planning skills
- ☒ T1.3 Oral and written communication skills in their mother tongue
- ☐ T1.4 Oral and written comprehension skills in a foreing language
- ☐ T1.5 Basic computer skills
- ☐ T1.6 Information management ability
- ☒ T1.7 Problem solving skills
- ☐ T1.8 Decision making ability

PERSONAL COMPETENCES

- ☐ T2.1 Critical and self-critical ability
- ☒ T2.2 Teamwork
- ☐ T2.3 Interpersonal skills
- ☐ T2.4 Ability to work in an interdisciplinary team
- ☐ T2.5 Ability to communicate with experts in other fields
- ☐ T2.6 Ability to deal with diversity and multiculturalism
- ☐ T2.8 Ethical commitment

SYSTEMIC COMPETENCES

- ☒ T3.1 Ability to apply theory to practice
- ☒ T3.2 Learning ability
- ☐ T3.3 Ability to adapt to new situations
- ☐ T3.4 Creativity
- ☐ T3.5 Leadership
- ☐ T3.6 Knowledge about other cultures and customs
- ☒ T3.7 Ability to work autonomously
- ☐ T3.8 Initiative and entrepreneurship
- ☐ T3.9 Quality concern
- ☐ T3.10 Motivation for success

4.3. General aims/ Degree specific competences

PROFESSIONAL COMPETENCES

E 2.8."Ability to organize, control, protection and use of units responsible for force protection, control systems, control and operational support to air operations"

4.4. Learning objectives

At the end of the course the student should be able to:

1. Knowing the historical evolution of networks and communication systems, allowing you to contextualize the current state of technology.

2. Learn the basic principles of communication systems, the main types of existing networks and the two models most widespread network architecture: OSI and TCP / IP.

3. Understanding the basics of signals and data in the time domain and frequency, along with the different types of analog and digital transmission.

4. Knowing the different transmission media-guided and unguided, which are present in most networks and communications systems.

5. Learning the basic principles of design and installation of a structured cabling system.

6. Knowing the services offered by the link-level protocols and their relationship with local area networks, both wired and wireless.

7. Understanding the basic mechanisms of the protocol for interconnecting IP networks, IPv4 and IPv6 extension, supported protocols and the main IP routing algorithms and routing Internet.

8. Understanding the basics of different types of communication equipment, such as hubs (hubs), bridges (switches) and routers (routers).

9. Learning the operation of the transport protocols UDP and TCP.

10. Learning more application protocols currently used, such as remote login, file transfer, e-mail, the Web, instant messaging and multimedia applications (Radio/Voice/Video over IP).

11. Learning the basics of network security, and knowing the new concepts of ciberdefence and cibersecurity.

In short, at the end of this course, students will have learned new knowledge autonomously and, also, proper techniques for the design, development and operation of telecommunications systems and services.

The activities of teaching / learning have been designed to allow students to develop their ability to: teamwork, analysis and synthesis of information, writing and oral communication through the development of the labs and, then, performing oral exposition and comprehension of a communications network/system at the end of the course.

5. CONTENTS

5.1. Contents according to the Degree programme

Access network. Switching and transport network. Main current networks. Telephone networks. Mobile terrestrial networks. Data networks and Internet. Broadcast networks.

5.2. Lectures programme

PART I: OVERVIEW OF COMMUNICATIONS

UNIT 1. INTRODUCTION

1.1 Brief historical review of communications
1.2 Concepts and basic definitions
1.3 Basic diagram of a communications system
1.4 Types of networks
- 1.4.1 For connection type link: Networks of Diffusion and Point to Point
- 1.4.2 On the physical topology: bus, ring, star and mesh
- 1.4.3 For geographic scale: LAN, MAN and WAN
- 1.4.4 For field data: Public and Private
- 1.4.5 By establishing communication: Circuit Switched / Packages

1.5 Network Architecture
- 1.5.1 Reference Model OSI (Open Systems Interconnection)
- 1.5.2 TCP / IP Reference Model

1.6 Normalization and standards

PART II. SIGNALS AND DATA COMMUNICATIONS

UNIT 2. SIGNALS AND DATA TRANSMISSION

2.1 Concepts and terminology used in signal and data transmission.
2.2 Time domain and frequency domain.
- 2.2.1 Concepts in the time domain
- 2.2.2 Concepts in the frequency domain
  - 2.2.2.1 Fundamentals of Fourier analysis
  - 2.2.2.2 Power spectral density and bandwidth
  - 2.2.2.3 Relationship between the transmission speed and the bandwidth

2.3 Interference in transmission
- 2.3.1 Energy Decibels and Signal
- 2.3.2 Attenuation
- 2.3.3 Delay Distortion
- 2.3.4 Noise
- 2.3.5 Channel Capacity
- 2.3.6 maximum transmission speeds

2.4 Transmission types
- 2.4.1 Transmission asynchronous / synchronous
- 2.4.2 Transmission series / parallel
- 2.4.3 Transmission simplex / half duplex / full-duplex

UNIT 3. ANALOG AND DIGITAL TRANSMISSION

3.1 Introduction to signal and analog and digital data
3.2 Transmission of digital data via digital signals
- 3.2.1 Encoding NRZ (nonreturn to zero)
- 3.2.2 Binary-Multilevel Coding
- 3.2.3 Biphase Coding

3.3 Transmission of digital data using analog signals
- 3.3.1 ASK (Amplitude-Shift Keying)
- 3.3.2 FSK (Frequency-Shift Keying)
- 3.3.3 PSK (Phase-Shift Keying)

3.4 Transmission of digital signals by analog data
- 3.4.1 PCM (Pulse Code Modulation)
- 3.4.2 PAM (Pulse Amplitude Modulation)
- 3.4.3 DM (Delta Modulation)

3.5 Transmission of analog data with analog signals
- 3.5.1 AM (Amplitude Modulation)
- 3.5.2 FM (Frequency Modulation)
- 3.5.3 PM (Phase Modulation)

PART III. THE PHYSICAL LAYER

UNIT 4. TRANSMISSION MEDIA

4.1 Guided transmission media
- 4.1.1 Twisted Pair
- 4.1.2 Coaxial Cable
- 4.1.3 Fiber Optics

4.2 Unguided transmission media
- 4.2.1 Radiowaves
- 4.2.2 Microwave
- 4.2.3 Infrared

UNIT 5. Structured Cabling Systems

5.1 Introduction
5.2 Topologies
5.3 Subsystems of Structured Cabling
- 5.3.1 Distribution Subsystem campus
- 5.3.2 Vertical Distribution Subsystem
- 5.3.3 Horizontal Distribution Subsystem

5.4. Regulation
5.5. Network equipments
- 5.5.1 Hub
- 5.5.2 Switches
- 5.5.3 Routers

PART IV. THE LINK LAYER

UNIT 6. INTRODUCTION TO LEVEL LINK

6.1 Features: Terminology and definitions
6.2 Types of links: point-to-point and broadcast
6.3 Services provided by the link layer
- 6.3.1 Management frames
- 6.3.2 Link Management
- 6.3.3 Error Control
- 6.3.4 Flow Control
- 6.3.5 Media Access Control

6.4 Importance of the link layer in context

UNIT 7. LINK LEVEL IN THE LOCAL AREA NETWORKS

7.1 Multiple access protocols (MAC, Media Access Control)
- 7.1.1 TDM (Time Division Multiplexing)
- 7.1.2 FDM (Frequency Division Multiplexing)
- 7.1.3 CDMA (Code Division Multiple Access)
- 7.1.4 Dynamic Access Protocols
- 7.1.5 Random Access Protocols
- 7.1.6 MAC level addressing

7.2 Ethernet
- 7.2.1 Format of Ethernet frames
- 7.2.2 Operation of CSMA / CD
- 7.2.3 Collision domain and Broadcast domain
- 7.2.4 Switched Ethernet
- 7.2.5 STP / RSTP
- 7.2.6 Ethernet half duplex
- 7.2.7 Virtual LAN
- 7.2.8 Ethernet Technologies

7.3 Wireless Networks
- 7.3.1 Characteristics of wireless networks
- 7.3.2 Wi-Fi IEEE 802.11
- 7.3.3 Protocol CSMA / CA
- 7.3.4 IEEE 802.11 Frames
- 7.3.5 IEEE 802.16 WiMax

PART V. THE NETWORK LAYER

UNIT 8. NETWORK LEVEL: INTERCONNECTING NETWORKS

8.1 Basic functions: routing
8.2 Services Network
- 8.2.1 Model mode network of virtual circuits
- 8.2.2 Model datagram mode network
- 8.2.3 Network Service oriented and connection-oriented

8.3 Routing in the Internet. The IP protocol
- 8.3.1 IPv4

10.6 Service hypermedia: WWW (World Wide Web)
- 10.6.1 Hypermedia documents
- 10.6.2 Transfer hypermedia: the HTTP
- 10.6.3 Intermediaries: proxies and gateways

10.7 Instant messaging

10.8 Multimedia
- 10.8.1 Radio over IP
- 10.8.2 Voice over IP
- 10.8.3 Video over IP

PART VIII. NETWORK SECURITY

UNIT 11. SECURITY IN COMMUNICATION NETWORKS

11.1 Introduction to network security
- 11.1.1 Security in the Physic Layer
- 11.1.2 Security in the Link Layer
- 11.1.3 Security in the Network Layer
- 11.1.4. Security in the Transport Layer
- 11.1.5. Security in the Application Layer

11.2 Cyber security & defence

5.3. Practices/Laboratory sessions program

CNS laboratory sessions

Six lab sessions (2 hours each) will be realized in order to that students become familiar with the underlying technologies in most current networks and communications services and, also, they are able to use the most common equipment and tools (hardware and software) common in the design and operation of telecommunication networks and services.

These five lab sessions will have sufficient complexity to be followed without difficulty while reinforcing the knowledge acquired in the lectures / problems. The sessions will use a local network consisting of various types of computers: PCs with Windows and Linux operating systems, and different physical devices to interconnect LAN (hub, switch, router, etc.). Also, free software is used for analysis and monitoring of frames and packets, and other software applications for network design and configuration.

6. TEACHING METHODOLOGY

6.1. Learning activities

Activity	Lecturer role	Student Role	ECTS
Lectures	Oral lecture. Resolution of questions/doubts.	Attendance: Class attendance	**1,40**
		Non-attendance: Personal study	**1,20**
Classes	Oral lecture. Approach to problems of increasing difficulty. Group work. Finally, solving problems in public.	Attendance: Class attendance	**0,60**
		Non-attendance: Solving problems during personal study	**0,80**
Practices (Lab sessions)	Practical class. Resolution by students of different collections of problems guided step by step through the lecturer. Use of computers and network equipments.	Attendance: Individual work or Group/Couple work in the laboratory under lecturer supervision.	**0,40**
Virtual tests	Evaluation tests for each teaching unit to perform individually through the virtual classroom.	Non-attendance: Doing short evaluation tests using the virtual classroom.	**0,40**
Seminar/Visit	A seminar/visit where professionals in the Information Technology and Communications (ICT) can show the student different systems/communication networks applicable in industry and/or defense sector.	Attendance: Attendance to the seminar/visit	**0,10**
End of course assessment	Final exam following the current regulation.	Attendance: Written test	**0,10**
Research project	An end of course work on a case study of a telecommunications system/service/network in the field of security and defense. Depending on the scope of work, it may be performed individually, in pairs or groups of students.	Attendance: Oral exposition (in English)	**0,10**
		Non-attendance: Development of research project (written in English).	**0,90**
TOTAL			**6**

7. ASSESSMENT

7.1. Assessment system

Methods	Criteria	Weighting	Generic Competences	Evaluated learning objectives (4.4)
Individual written official exam (Up to 80 %)	It will consist of a battery of short questions and multiple choice. Its aim is to evaluate the knowledge acquired in the different teaching units. It should be note that the exam may include issues related to laboratory sessions.	Up to 8 points. *It is required a minimum rating of 4 out of 10 on this test to pass the course. If the virtual tests are considered, the final exam will count up to 5 points of the qualification; otherwise, it will involve up to 8 points.*	T1.1, T1.3, T1.7	All
Virtual tests (Up to 30 %)	In order to evaluate the learning process of each teaching unit, the student can take an optional test with different short and multiple choice questions of similar complexity than those exercises solved in class and in the literature. These optional tests will be conducted individually through the virtual classroom after each teaching unit. The teacher will determine the date and venue of each test. Each test will be associated with a teaching unit. However, in particular circumstances, and always following the criterion of the head of this course, a test may include one or more teaching units. The conduct of these tests is optional and, therefore, it is not a obligatory requirement to pass the course. Furthermore, these tests can never replace the final examination.	Up to 1/N × 3 points for each test. (*N* denotes the number of virtual tests) *The average of the obtained results in the N tests may be taken into account along with the final exam if the operation favors the final grade for the course. Otherwise, the final exam will be an 80% of the final grade for the course.*	T1.1, T1.3, T1.7	All

Research project (20 %)	A number of topics and cases of studies will be proposed in order to that students will analyze and orally present a telecommunication network/system/service in the context of industry and/or defense. Students can also make their own proposals. The oral exposition of the project will be held in English during the last weeks of the course, lasting between 20-30 minutes.	Up to 2 points.	T1.1, T1.3, T1.7, T2.2, T3.1, T3.2, T3.7	All

IMPORTANT: ***To pass the course you must achieve a final score equal to or greater than 5***, taking into account all the criteria and evaluation tests of the assessment system.

7.2. Learning process monitoring

The learning process monitoring will be made through the following activities:

- Results of the interim assessment tests.
- Monitoring of student work in lab sessions.
- Statistics from the use of documentary material placed in the Virtual Classroom.
- Individual and group tutorials

8. RESULTS, LEARNING ACTIVITIES AND ASSESSMENT

Learning Objectives (4.4)	Lectures	Classes	Laboratory Sessions	Continuous assessment	Seminary/Visit	Research Project	Individual work
1. Knowing the historical evolution of networks and communication systems, allowing you to contextualize the current state of technology	■			■		■	■
2. Learning the basic principles of communication systems, the main types of existing networks and the two models most widespread network architecture: OSI and TCP / IP.	■		■	■		■	■
3. Understanding the basics of signaling and data in the time domain and frequency, along with the different types of analog and digital transmission.	■	■	■	■	■	■	■
4. Knowing the different transmission media-guided and unguided, which are present in most networks and communications systems.	■	■	■	■	■	■	■
5. Learning the basic principles of design and installation of a structured cabling system.	■	■	■	■	■	■	■

Learning Objectives (4.4)	Lectures	Classes	Laboratory Sessions	Continuous assessment	Seminary/Visit	Research Project	Individual work
6. Knowing the services offered by the link-level protocols and their relationship with local area networks, both wired and wireless.	■	■	■	■	■	■	■
7. Understanding the basic mechanisms of the protocol for interconnecting IP networks, IPv4 and IPv6 extension, supported protocols and the main IP routing algorithms and routing Internet.	■	■	■	■	■	■	■
8. Understanding the basics of different types of communication equipment, such as hubs (hubs), bridges (switches) and routers (routers).	■	■	■	■	■	■	■
9. Learning the operation of the transport protocols UDP and TCP.	■	■	■	■	■	■	■
10. Learn more application protocols currently used, such as remote login, file transfer, e-mail, the Web, instant messaging and multimedia applications (Radio, Voice and Video over IP).	■	■	■	■	■	■	■
11. Learning the basics of network security, and knowing the new concepts of ciberdefence and cibersecurity.	■	■	■	■	■	■	■

9. SCHEDULE

AH: ATTENDANCE HOURS.
CAH: CONVENTIONAL ATTENDANCE HOURS.
NCAH: NON-CONVENTIONAL ATTENDANCE HOURS.
NAH: NON-ATTENDANCE HOURS.

		Attendance Activities									Non Attendance Activities				
		Conventional				No Conventional									
Week	Units or activities	*Lectures*	*Classes*	*Lab sessions*	*Total CAH*	*Seminar*	*Visit*	*Tutorials*	*Final Exam*	*Total NCAH*	*Personal study*	*Virtual exams*	*Research project*	*Total NAH*	TOTAL HOURS
1	Overview of the course + Unit 1	4	0	0	*4*	0	0	0	0	*0*	1	0	0	*1*	*5*
2	Unit 2	3	1	0	*4*	0	0	0	0	*0*	2	1	0	*3*	*7*
3	Unit 3	3	1	0	*4*	0	0	0	0	*0*	2	1	0	*3*	*7*
4	Unit 4 + Lab Session 1	2	0	2	*4*	0	0	0	0	*0*	2	1	0	*3*	*7*
5	Unit 5	3	1	0	*4*	0	0	0	0	*0*	2	1	0	*3*	*7*
6	Unit 6 (I) + Lab Session 2	2	0	2	*4*	0	0	0	0	*0*	2	0	0	*2*	*6*
7	Unit 6 (II) + Unit 7 (I)	3	1	0	*4*	0	0	0	0	*0*	3	1	0	*4*	*8*
8	Unit 7 (II) + Unit 8 (I)	3	1	0	*4*	0	0	0	0	*0*	3	1	0	*4*	*8*
9	Unit 8 (II)	3	1	0	*4*	0	0	0	0	*0*	3	0	2	*5*	*9*
10	Unit 8 (III) + Lab Session 3	1	1	2	*4*	0	0	0	0	*0*	4	1	4	*9*	*13*
11	Unit 9 + Lab Session 4	1	1	2	*4*	0	0	0	0	*0*	4	1	4	*9*	*13*
12	Unit 10 + Lab Session 5	2	0	2	*4*	0	0	1	0	*1*	4	1	4	*9*	*14*
13	Unit 11	3	1	0	*4*	0	0	0	0	*0*	2	1	0	*3*	*7*
14	Seminar + Visit + Research Project	2	2	0	*4*	1	1	1	0	*3*	4	0	4	*8*	*15*
15	Research Project (Oral Exposition -English-)	0	4	0	*4*	0	0	1	0	*1*	4	0	4	*8*	*13*
	Exams	0	0	0	*0*	0	0	1	2	*3*	8	0	0	*8*	*11*
	Others	0	0	0	*0*	0	0	0	0	*0*	0	0	0	*0*	*0*
	TOTAL HOURS	**35**	**15**	**10**	***60***	**1**	**1**	**4**	**2**	***8***	**50**	**10**	**22**	***82***	**150**

10. REFERENCES

11.1. Main References

- *Comunicaciones y Redes de Computadores (6ª edición)*. William Stallings. Prentice Hall, 2003.
- *Redes de Computadoras (4ª edición).* Andrew S. Tanenbaum. Prentice Hall, 2003.
- *Transmisión de datos y redes de comunicaciones (4º Edición)*. B. Forouzan. Mc-Graw Hill, 2007.
- *Redes de Computadores: Un Enfoque Descendente Basado en Internet (5ª edición)*. James F. Kurose, Keith W. Ross. Addison-Wesley, 2010.
- *Redes de Computadores*. José María Barceló Ordinas, Jordi Íñigo Griera, Ramón Martí Escalé, Enric Peig Olivé, Xavier Perramon Tornil. Universitat Oberta de Catalunya, 2004. (Libre acceso: http://cv.uoc.es/cdocent/W2YEM0UV3EIOG3E91A0X.pdf)

11.2. Additional References

Recommended books:

- *Academia de Networking de Cisco Systems: Guía del primer año CCNA 1 y 2*. 3º Edición. Cisco Press, Madrid, 2008.
- *Academia de Networking de Cisco Systems: Guía del segundo año CCNA 3 y 4.* 3º Edición. Cisco Press, Madrid, 2008.
- *Redes de Area Local (2ª edición).* Francisco J. Molina, Editorial Ra-Ma, 2005.
- *Redes y Servicios de Telecomunicaciones (4ª edición)*. José Manuel Huidobro. Thomson – Paraninfo, 2006.

More books:

- *Introducción a las redes locales*. José Félix Rábago, Editorial Anaya, 1995.
- *Modern Electronic Communication (6ª edición)*. Gary M. Miller. Prentice Hall, 1999.
- *Electronic Communication Systems: A complete course (3ª edición)*. William Schweber, Prentice Hall, 1999.

11.3. Network resources

All material used during the development of this course is available in Virtual Classroom:

http://moodle.upct.es/course/view.php?id=511103013