Course name:	**Course code:**
Fundamentals of Telecommunications	CE 500

Location in curricular map:
Specialization Axis

Course description:
This course covers basic topics in electronic communications, which are the basis for network communications. The course begins with an analysis of various types of electrical signals and the ways to calculate their frequency content, which limits the communication channel capacity, and the bit rate that may be used for transmission. Analog modulation systems are analyzed to serve as the basis for the analysis of the digital transmission systems which are derived from them; also other forms of digital transmission are analyzed such as base band for local area networks, or disperse spectrum for wireless communications. Afterwards, the diverse alternatives for network communications and physical mediums that may be used, are analyzed.

Course learning outcomes:
At the end of the course the student will: Know the content of the different types of frequency, as well as the relationship that they have with the performance of the communications system. Know and comprehend the forms of analog modulation and their application to communication systems. Know and comprehend the forms of digital modulation and their application, as well as the ways to codify analog signals for digital transmission. Know the characteristics and applications of the diverse forms of modulation in disperse spectrum. Simulate communication systems to determine their performance characteristics. Know and comprehend the characteristics of communication networks and will be able to select communication networks for specific applications. Know the characteristics of transmission mediums and select the adequate combination to satisfy the needs of a communication network.

Course content:	
Topic	Hours
1. Introduction to communication systems. 1.1. Signals and spectrums 1.2. Transmission 1.3. Filtering 1.4. Channel capacity	4 6
2. Modulation systems. 2.1. Linear and exponential modulation 2.2. Amplitude modulation 2.3. Frequency modulation	 10
3. Digital communications. 3.1. Pulse sampling and modulation 3.2. Digital transmission and base band 3.3. Digital modulation 3.3.1. Amplitude modulation 3.3.2. Frequency modulation 3.3.3. Phase modulation 3.3.4. Quadrature modulation 3.4. Digital transmission in pass band 3.5. Disperse spectrum systems	 10
4. Communication networks. 4.1. Channel codification and encrypting 4.2. Commutation networks 4.3. Multichannel and multicarrier systems	
5. Transmission mediums. 5.1. Transmission lines 5.2. Wave propagation 5.3. Antennas 5.4. Fiber optics	6

Learning activities guided by professor:	Hours 36
1. Thematic exposition by professor	16
2. Simulation of communication systems guided by professor	6
3. Discussion presentation and/or plenary guided by professor	6
4. Solution of cases in small groups guided by professor	4
5. Individual activities guided by professor	4

Independent learning activities:	Hours 60
1. Reading of materials selected by professor. • The student must read various reading materials of selected topics to comprehend the various protocols that are used in network architectures. These materials are from chapters 1, 2, 3, 5, 6, 8 through 13 and 17 of the Gary M Miller text. • The student will read and solve in small groups, cases presented in the Gary M Miller text. The results will be presented to the group.	25
2. Writing of article or summary of reading materials. • The student must write a technical article where he or she presents an innovative technique or application regarding communication systems. This article must be presented to the group.	10
3. Solving of selected problems. • The student will solve problems from chapters 1, 2, 3, 5, 6, 8 through 13 and 17 of the Gary M Miller text. These problems must be delivered in the established date.	15
4. Simulation of communications systems. • The student will simulate using a computer, the analog and digital modulation techniques, as well as the characteristics of a communication channel.	10
5. Research and development of a topic assigned by professor. • Optional activity in which the student may exchange independent work hours for reading and article writing hours.	10
6. Integral course project. • Optional activity in which the student integrates the knowledge acquired throughout the course with his or her experience regarding communication networks, to analyze a situation or need. This will be presented in the last class session and may replace activities 2 or 5.	OP

Evaluation procedures and instruments:
The evaluation procedures and instruments are the following: 1. Oral or written exam. • The student must prove to the professor via an oral or written exam, the knowledge of the primary course topics. 2. Deliverables. • The student must deliver a technical article in which he or she presents a technology or innovative application regarding computer networks, indicating advantages and technical requirements. • The student will deliver a report for each of the selected problems, which must be solved individually. • The student will deliver a technical memoir of the integral course project, which must contain the background of the organization, current situation, requirement definition, selected communication network, necessary equipment and considerations, as well as conclusions.

3. Presentations.
    - All students must present the technical article as well as an application case solution, to the group, in the day and hour that is established by the group and professor.
4. Participation in discussion sessions.
    - This will not be subject to evaluation.
5. Participation in lab work sessions.
    - The results of the simulations will be evaluated.

Evaluation criteria:

1. The evaluation instruments and procedures will be centered on the guided and non guided learning activities.
2. The professor will evaluate and assign a grade to each of the evaluation instruments. The grade must be within 0 and 100.
    - Oral or written exam 30 points.
    - Technical article 20 points.
    - Problem solutions 15 points.
    - Presentations 15 points.
    - Lab work participation 20 points.
3. The professor will report to the Graduate College the grade average for all the evaluation instruments obtained by each student.
4. The minimum passing grade is 80 points.
5. A student may not obtain a failing grade due to accumulated non attendance.

Bibliography:

Type	Title	Author	Publisher	Year
Text	Modern Electronic Communication	Gary M Miller, Jeffrey S. Beasley	Prentice Hall	2002
Reference	Communications Systems	Carlson, A. Bruce, Crilly, Paul B.	McGraw Hill	2002
Reference	Digital Communications	Proakis, John	McGraw Hill	2001
Reference	Telecommunications Cabling Installation	BICSI	McGraw Hill	2002

Course name:	**Course code:**
Network Connectivity and Design	CE 501

Location in curricular map:
Specialization Axis

Course description:
This course is oriented towards the analysis and design of computer networks, as well as basic and application aspects. During class sessions the various levels of the OSI reference model will be analyzed, with a focus on the first three: physical, data and network. In this analysis, the various theoretical aspects as well as application aspects will be studied, such as structured cabling at the physical level, various implementation protocols for the data link level, and the routing addressing and algorithms for the network level, as well as the devices that work on each of these levels. The last part of the course will analyze the various criteria for the characterization of a computer network as well as design aspects. At the end of the course a computer network must be characterized and/or designed and improvement alternatives must be suggested.

Course learning outcomes:
At the end of the course the student will: Know and comprehend the functions of the various OSI model levels, as well as their relationship with real network operating systems. Know and comprehend the structured cabling specifications and know how to apply them to the installation and cabling of a network. Know and comprehend the basic link protocols and make decisions regarding performance parameters. Differentiate between local area network standards and select the adequate ones for a particular situation. Know the various routing protocols and select the most adequate one for a particular network topology. Analyze the communication requirements of an organization and design the most adequate topology, as well as the most convenient interconnection devices and addressing squeme. Know the primary tendencies in computer networks from the design perspective.

Course content:	
Topic	Hours
1. Introduction to computer networks. 1.1. Approximations to the design of a network 1.2. Key factors in the evolution of computer networks 1.3. The OSI reference model 1.4. Network architectures	4
2. Physical level. 2.1. Digital representation of information 2.2. Fundamental properties of digital communications 2.3. Properties of physical mediums and digital transmission systems 2.4. Structured cabling	8
3. Data link level. 3.1 ARQ Protocols 3.2 Adaptation functions 3.3 Control of the data link 3.4 Medium access sub level 3.4.1 Random access protocols 3.4.2 Medium access control planning 3.5 Local area network standards 3.6 LAN bridges	8
4 Network level. 4.1 Network services and internal network functions 4.2 Datagram and virtual circuits 4.3 Network package routing 4.4 Routing algorithms 4.5 Congestion control 4.6 Routers	6
5 Network analysis. 5.5. Characterization of a computer network 5.6. Analysis of network requirements 5.7. Network topology design 5.8. Addressing schemes	10

Learning activities guided by professor:	Hours 36
1. Thematic exposition by professor	14
2. Device configuration workshop guided by professor	6
3. Discussion presentation and/or plenary guided by professor	8
4. Solution of cases in small groups guided by professor	4
5. Individual activities guided by professor	4

Independent learning activities:	Hours 60
1. Reading of materials selected by professor. • The student must read various reading materials of selected topics to comprehend the various protocols that are used in network architectures. These materials are from chapters 1, 2, 3, 5, 6 and 7 of the León García text. • The student will read and solve in small groups, cases presented in chapters 6 through 14 of the Thomas M. Thomas text. The results will be presented to the group.	20
2. Writing of article or summary of reading materials. • The student must write a technical article where he or she presents an innovative technique or application regarding computer networks. This article must be presented to the group.	6
3. Solving of selected problems. • The student will solve problems from chapters 1, 2, 3, 5, 6 and 7 of the Leon García text. These problems must be delivered in the established date.	6
4. Lab work. • The student will configure various interconnection devices for networks in the laboratory. This activity might require previous research and reading of configuration manuals.	6
5. Research and development of a topic assigned by professor. • Activity in which the student may exchange independent work hours for reading and article writing hours.	8
6. Integral course project. • Activity in which the student integrates the knowledge acquired throughout the course with his or her experience regarding networks, in the analysis, design and suggestion of improvements to an existing network. This will be presented in the last class session.	14

Evaluation procedures and instruments:
The evaluation procedures and instruments are the following: 1. Oral or written exam. • The student must prove to the professor via an oral or written exam, the knowledge of the primary course topics. 2. Deliverables. • The student must deliver a technical article in which he or she presents a technology or innovative application regarding computer networks, indicating advantages and technical requirements. • The student will deliver a report for each of the selected problems, which must be solved individually. • The student will deliver a technical memoir of the integral course project, which must contain the background of the organization, current situation, requirement definition, selected communication network, necessary equipment and considerations, as well as conclusions.

3. Presentations.
    - All students must present the technical article as well as an application case solution, to the group, in the day and hour that is established by the group and professor.
4. Participation in discussion sessions.
    - This will not be subject to evaluation.
5. Participation in lab work sessions.
    - The results of the device configurations will be evaluated.

Evaluation criteria:

1. The evaluation instruments and procedures will be centered on the guided and non guided learning activities.
2. The professor will evaluate and assign a grade to each of the evaluation instruments. The grade must be within 0 and 100.
    - Oral or written exam 20 points.
    - Technical article 10 points.
    - Problem solutions 15 points.
    - Presentations 15 points.
    - Lab work participation 10 points.
    - Integral course project 30 points.
3. The professor will report to the Graduate College the grade average for all the evaluation instruments obtained by each student.
6. The minimum passing grade is 80 points.
4. A student may not obtain a failing grade due to accumulated non attendance.

Bibliography:

Type	Title	Author	Publisher	Year
Text	Communication networks	Alberto León García, Indra Widjaja	Mc Graw Hill	2003
Reference	DCN: Designing Cisco Networks	Thomas M. Thomas, Erik J. Freeland	Mc Graw Hill	2000
Reference	Computer Networks	Andrew S. Tanenbaum	Prentice Hall	2003
Reference	Communications and computer networks	William Stallings	Prentice Hall	2000

Course name:	**Course code:**
High Performance Networks	CE 502

Location in curricular map:
Specialization Axis

Course description:
This course has an orientation towards the analysis of topics related to high performance networks relating to either transmission speed or distance. The course focuses initially on fundamental and configuration aspects of TCP/IP, which is the primary architecture to date. Afterwards an analysis of high performance networks such as ATM, FDDI, SONET and others under development. For each of the architectures, factors such as performance, technology and applications will be analyzed. In the final part of the course, study on how computer networks offer a guaranteed quality of service for the applications that require it.

Course learning outcomes:
At the end of the course the student will: Know and comprehend the functions of a TCP/IP architecture for data communications. Know the various routing protocols and select the most adequate for a particular network topology. Specify the configuration of a DHCP server. Know and comprehend the characteristics and applications of an ATM architecture. Differentiate the various standards for high performance networks and select the most adequate architecture for the needs of an organization. Know and comprehend the characteristics and how to implement equipment that provides quality of service for a computer network

Course content:	
Topic	Hours
1. TCP/IP. 1.1. TCP/IP architecture 1.2. Internet protocol 1.3. IPV6 1.4. User datagram protocol 1.5. Transport control protocol 1.6. DHCP and mobile IP 1.7. Routing protocols 2. ATM Networks. 2.1. RDSIBA reference model 2.2. ATM level 2.3. ATM adaptation level 2.4. ATM signalization 3. Advanced network architectures. 3.1. Carrier systems - T1/E1 3.2. ISDN 3.3. FDDI 3.4. Frame relay 3.4.1. Typical topology 3.4.2. Levels of frame relay 3.4.3. Notable aspects of frame relay 3.5. Ethernet - 1Gb 4. Quality of service for the Internet 4.1. MPLS 4.2. Integrated services for the Internet 4.3. Reservation protocol 4.4. Differentiated service 4.5. Internet 2	10 8 12 6

Learning activities guided by professor:	Hours 36
1. Thematic exposition by professor	16
2. Discussion presentation and/or plenary guided by professor	8
3. Solution of cases in small groups guided by professor	8
4. Individual activities guided by professor	4

Independent learning activities:	Hours 60
1. Reading of materials selected by professor. • The student must read various reading materials of selected topics to comprehend the various protocols that are used in network architectures. These materials are from chapters 8, 9 and 10 of the León García text and chapters 2,3,4,5,7 and 8 of the Ulysses Black text.	20
2. Writing of article or summary of reading materials. • The student must write a technical article where he or she presents an innovative technique or application regarding high performance computer networks. This article must be presented to the group.	10
3. Solving of selected problems. • The student will solve problems from chapters 8, 9 and 10 of the Leon García text. These problems must be delivered in the established date.	10
4. Research and development of a topic assigned by professor. • Activity in which the student does research regarding a course topic and presents it to the group in the established class session.	10
5. Integral course project. • Activity in which the student integrates the knowledge acquired throughout the course with his or her experience regarding networks, in the analysis od the implementation of a high performance network or with quality of service. This will be presented in the last class session.	10

Evaluation procedures and instruments:
The evaluation procedures and instruments are the following: 1. Oral or written exam. • The student must prove to the professor via an oral or written exam, the knowledge of the primary course topics. 2. Deliverables. • The student must deliver a technical article in which he or she presents a technology or innovative application regarding high performance networks, indicating advantages and technical requirements. • The student will deliver a report for each of the selected problems, which must be solved individually. • The student will deliver a technical memoir of the integral course project, which must contain the background of the organization, current situation, requirement definition, selected communication network, necessary equipment and considerations, as well as conclusions. 3. Presentations. • All students must present the technical article as well as an application case solution, to the group, in the day and hour that is established by the group and

professor.

4. Participation in discussion sessions.
    - This will not be subject to evaluation.

Evaluation criteria:

1. The evaluation instruments and procedures will be centered on the guided and non guided learning activities.
2. The professor will evaluate and assign a grade to each of the evaluation instruments. The grade must be within 0 and 100.
    - Oral or written exam 30 points.
    - Technical article 15 points.
    - Problem solutions 20 points.
    - Presentations 15 points.
    - Integral course project 20 points.
3. The professor will report to the Graduate College the grade average for all the evaluation instruments obtained by each student.
7. The minimum passing grade is 80 points.
4. A student may not obtain a failing grade due to accumulated non attendance.

Bibliography:

Type	Title	Author	Publisher	Year
Text	Emerging technologies for computer networks	Uyless Black	Prentice Hall	1999
Text	Communication Networks	Alberto León García, Indra Widjaja	McGraw Hill	2003
Reference	High Speed Networks and internets: performance and service	William Stallings	Prentice Hall	2002
Reference	Communication Networks	Andrew S. Tanenbaum	Prentice Hall	2003

Course name:	**Course code:**
Wireless Networks	CE 503

Location in curricular map:
Specialization Axis

Course description:
This course is oriented towards the analysis and design of wireless communication networks, with an emphasis in data communication via IP protocol. The course begins with an overview of the evolution of wireless systems, analyzing cellular phone systems, and how data communications have been integrated to these networks. The functions of the TCP/IP architecture in wireless networks is analyzed, where there is transmission interference and information loss. Also, the architecture of wireless networks is analyzed, as well as antenna coverage areas, traffic modeling and aspects regarding change in coverage area. At the end of the course, the student will characterize and/or design a computer network and suggest improvement alternatives.

Course learning outcomes:
At the end of the course the student will: Know the evolution of cellular systems from analog to digital, as well as emerging technologies and applications. Design a wireless LAN taking into account the coverage, as well as selection and configuration of necessary equipment. Comprehend the implications of using IP in wireless networks and for future applications. Mathematically model the behavior of traffic in wireless networks for various environmental conditions and the effects on transmission errors. Know the various routing protocols and select the most adequate for a particular network topology. Know the techniques to improve performance of a network, like scheduling and traffic conformation, as well as modeling for the evaluation of configuration alternatives. Know the primary tendencies in wireless networks from a design perspective.

Course content:	
Topic	Hours 36
1. Introduction to wireless networks and cellular systems. 1.1. Evolution 1.2. Global mobile communications system (GSM) 1.3. Wireless LANs 2. Cellular systems. 2.1. Fundamental principles 2.2. Digital cellular systems 2.3. Innovative cellular systems 2.4. Cell coverage and antennas 3. Mobile wireless Internet. 3.1. IPv4 and IPv6 3.2. Transport control protocol 3.3. Quality of service 4. Tele-traffic theory. 4.1. Random processes 4.2. Discrete Markov chains 4.3. Systems with losses 4.4. Impact of error control on performance 5. IP characterization and classification 5.1. Characterization 5.2. Aggregation 5.3. Statistical characteristics 5.4. Statistical analysis 6. Architecture for mobile and wireless IP networks 6.1. Network architecture 6.2. Conceptual node model 6.3. Scheduling techniques 6.4. Traffic modeling 6.5. Performance parameters 7. Performance analysis of cellular IP networks 7.1. Service differentiation 7.2. Handover in cellular networks and packages 7.3. Analysis of loss for CBR and VBR flows	4 6 6 6 4 6 4

Learning activities guided by professor:	Hours 36
1. Thematic exposition by professor	16
2. Device configuration workshop guided by professor	6
3. Discussion presentation and/or plenary guided by professor	6
4. Solution of cases in small groups guided by professor	4
5. Individual activities guided by professor	4

Independent learning activities:	Hours 60
1. Reading of materials selected by professor. • The student must read various reading materials of selected topics to comprehend the various protocols that are used in network architectures. These materials are from chapters 1, 2, 3, 4, 5, 6 and 9 of the Janevski text.	20
2. Writing of article or summary of reading materials. • The student must write a technical article where he or she presents an innovative technique or application regarding wireless networks. This article must be presented to the group.	6
3. Solving of selected problems. • The student will solve problems from chapters 1, 2, 3, 4, 5, 6 and 9 of the Janevski text. These problems must be delivered in the established date.	6
4. Lab work. • The student will configure various devices for wireless networks in the laboratory. This activity might require previous research and reading of configuration manuals.	6
5. Research and development of a topic assigned by professor. • Optional activity in which the student may exchange independent work hours for reading and article writing hours.	8
6. Integral course project. • Activity in which the student integrates the knowledge acquired throughout the course with his or her experience regarding wireless networks, in the analysis, design and/or suggest of improvements to an existing wireless network. This will be presented in the last class session.	14

Evaluation procedures and instruments:
The evaluation procedures and instruments are the following: 1. Oral or written exam. • The student must prove to the professor via an oral or written exam, the knowledge of the primary course topics. 2. Deliverables. • The student must deliver a technical article in which he or she presents a technology or innovative application regarding wireless networks, indicating advantages and technical requirements. • The student will deliver a report for each of the selected problems, which must be solved individually. • The student will deliver a technical memoir of the integral course project, which must contain the background of the organization, current situation, requirement definition, selected communication network, necessary equipment and considerations, as well as conclusions. 3. Presentations.

- All students must present the technical article as well as an application case solution, to the group, in the day and hour that is established by the group and professor.

4. Participation in discussion sessions.
    - This will not be subject to evaluation.
5. Participation in lab work sessions.
    - The results of the device configurations will be evaluated.

Evaluation criteria:

1. The evaluation instruments and procedures will be centered on the guided and non guided learning activities.
2. The professor will evaluate and assign a grade to each of the evaluation instruments. The grade must be within 0 and 100.
    - Oral or written exam 20 points.
    - Technical article 10 points.
    - Problem solutions 15 points.
    - Presentations 15 points.
    - Lab work participation 20 points.
    - Integral course project 20 points.
3. The professor will report to the Graduate College the grade average for all the evaluation instruments obtained by each student.
8. The minimum passing grade is 80 points.
4. A student may not obtain a failing grade due to accumulated non attendance.

Bibliography:

Type	Title	Author	Publisher	Year
Text	Traffic analysis and design of wireless IP networks	Toni Janevski	Artech House	2003
Text	Wireless communications	Theodore S. Rapaport	Prentice Hall	2001
Reference	Wireless and cellular communications	William Lee	Mc Graw Hill	2004
Reference	Handbook of wireless networks and mobile communications	Ivan Stojmenovic	Wiley – Interscience	2002
Reference	Mobile & wireless communications	P. Nicopolitidis, M. S. Obaidat	Wiley	2002

Course name:	**Course code:**
Security in Network Environments	CE 504

Location in curricular map:
Specialization Axis

Course description:
This course covers aspects relating to security in computer networks; security has two parts: security of stored or traveling information and physical security of network equipment. To protect information and be able to access it, symmetrical and non-symmetrical encryption techniques are used, like public and private keys. User authentification is another aspect of security that is studied in the course. The definition of security zones helps organizations guarantee the integrity of private data, at the same time that services are offered to external users. To complete the security scheme, the analysis of equipment and devices for network security will be done. At the end of the course the student will characterize and/or design a computer network and suggest improvement alternatives.

Course learning outcomes:
At the end of the course the student will: Know and comprehend the primary techniques for data encryption, symmetrical and non-symmetrical. Know and apply security practices in computer networks, such as authentification, access control and information integrity. Divide a network in various zones according to the security needs of each. Configure firewalls to protect the network from external threats. Configure a virtual network using a commuter. Design a security and incident response plan for a computer network.

Course content:	
Topic	Hours
1. Conventional encryption. 1.1. Introduction and tendencies 1.2. General concepts 1.3. Classic encrypting techniques 1.4. Modern encrypting techniques 1.5. Introduction to finite fields 1.6. Symmetric ciphers	6
2. Public keys and hashing functions. 2.1. Introduction to number theory 2.2. Public key cryptography 2.3. Hash and Mac algorithms 2.4. Digital signatures	10
3. Network security practices. 3.1. Authentification practices 3.2. E-mail security 3.3. IP security 3.4. Web security	8
4. Security systems. 4.1. Intruders and viruses 4.2. Definition of security zones 4.3. Firewalls 4.3.1. Firewall PIX 4.3.2. Firewall IOS 4.4. Virtual private networks 4.5. Site security and access control 4.5.1. Impact of physical security 4.5.2. Infrastructure security 4.6. Service provider security	12

Learning activities guided by professor:	Hours
1. Thematic exposition by professor	14
2. Security configuration workshop guided by the professor	6
3. Discussion presentation and/or plenary guided by professor	8
4. Solution of cases in small groups guided by professor	4
5. Individual activities guided by professor	4

Independent learning activities:	Hours 60
1. Reading of materials selected by professor. • The student must read various reading materials of selected topics to comprehend the various protocols that are used in network architectures. These materials are from chapters 1 through 19 of the William Stallings text. • The student will read and solve in small groups, cases presented in the Saadat Malik text. The results will be presented to the group.	20
2. Writing of article or summary of reading materials. • The student must write a technical article where he or she presents an innovative technique or application regarding network security. This article must be presented to the group.	6
3. Solving of selected problems. • The student will solve problems from chapters 1 through 19 of the William Stalling. These problems must be delivered in the established date.	6
4. Lab work. • The student will configure various devices for network security in the laboratory. This activity might require previous research and reading of configuration manuals.	6
5. Research and development of a topic assigned by professor. • Optional activity in which the student may exchange independent work hours for reading and article writing hours.	8
6. Integral course project. • Activity in which the student integrates the knowledge acquired throughout the course with his or her experience regarding networks, in the analysis, design and suggestion of improvements in security aspects to an existing network. This will be presented in the last class session.	14

Evaluation procedures and instruments:
The evaluation procedures and instruments are the following: 1. Oral or written exam. • The student must prove to the professor via an oral or written exam, the knowledge of the primary course topics. 2. Deliverables. • The student must deliver a technical article in which he or she presents a technology or innovative application regarding network security, indicating advantages and technical requirements. • The student will deliver a report for each of the selected problems, which must be solved individually. • The student will deliver a technical memoir of the integral course project, which must contain the background of the organization, current situation, requirement definition, selected communication network, necessary equipment and considerations, as well as conclusions.

3. Presentations.
    - All students must present the technical article as well as an application case solution, to the group, in the day and hour that is established by the group and professor.
4. Participation in discussion sessions.
    - This will not be subject to evaluation.
5. Participation in lab work sessions.
    - The results of the device configurations will be evaluated.

Evaluation criteria:

1. The evaluation instruments and procedures will be centered on the guided and non guided learning activities.
2. The professor will evaluate and assign a grade to each of the evaluation instruments. The grade must be within 0 and 100.
    - Oral or written exam 20 points.
    - Technical article 10 points.
    - Problem solutions 15 points.
    - Presentations 15 points.
    - Lab work participation 10 points.
    - Integral course project 30 points.
3. The professor will report to the Graduate College the grade average for all the evaluation instruments obtained by each student.
9. The minimum passing grade is 80 points.
4. A student may not obtain a failing grade due to accumulated non attendance.

Bibliography:

Type	Title	Author	Publisher	Year
Text	Cryptography and network security	William Stallings	Prentice Hall	2003
Reference	Network security principles and practices	Saadat Malik	Ciscipress	2002
Reference	Designing security architecture solutions	Jay Ramachandran	Wiley	2002
Reference	Corporate computer and network security	Raymond Panko	Prentice Hall	2004
Reference	Principles of computer security	Art Conklin, Gregory White	McGraw Hill	2004

Course name:	**Course code:**
Information Theory and Encoding	CE 505

Location in curricular map:
Specialization Axis

Course description:
This course covers topics relating to information theory and encoding, as well as data compression. First, random discrete and non-discrete variables are considered to analyze information uncertainty. Next, communication channels and sources are analyzed, to establish their capacity and transference rate with regards to the noise and distortion that the message may suffer along its way. Information recovery and the amount that can be transmitted depends largely on the encoding that is used, which may be linear codes, cyclic or convolution types. Along with encoding, data compression may be introduced, which may be with or without losses depending on the desired compression rate, and the specific application. Various algorithms will be programmed to prove their capabilities.

Course learning outcomes:
At the end of the course the student will: Know and comprehend how noise and interference in a digital and analog signal affects information recovery. Know how the communication channel affects in costs and ho the source influences transfer rate and random noise. Differentiate various forms of data encoding and will be able to select the most appropriate for specific detection and recovery conditions, as well as the amount of information the code can manage with regards to the capacity of the channel. Comprehend and apply data compression techniques, without loss, like arithmetic and dictionary types, and will know when to use them. Comprehend and apply data compression techniques with loss, like the transformation method, and will know when to use them. Program compression algorithms with and without loss for different types of data.

Course content:	
Topic	Hours 36
1. Entropy and mutual information. 1.1. Discrete random variables 1.2. Discrete random vectors 1.3. Non-discrete random variables and vectors	6
2. Discrete sources and channels without memory. 2.1. Capacity function - cost 2.2. Channel encoding theorem 2.3. Rate function - distortion 2.4. Source encoding theorem 2.5. Gaussian channel 2.6. Gaussian source	6
3. Encoding. 3.1. Linear codes. 3.1.1. Introduction 3.1.2. Decoding syndrome in symmetrical channels 3.1.3. Hamming codes 3.2. Cyclic codes 3.2.1. Introduction 3.2.2. Shift registers 3.2.3. Cyclic Hamming codes 3.3. BCH, Reed Solomon and related codes 3.3.1. BCH Codes 3.3.2. Reed Solomon Codes 3.3.3. Golay 23, 12 Codes 3.4. Convolution codes 3.4.1. State and trellis diagrams 3.4.2. Sequential coding	12
4. Data compression. 4.1. Compression without loss 4.2. Arithmetic coding 4.3. Adaptive methods 4.3.1. Huffman adaptive coding 4.3.2. Gallagher and Knuth methods 4.4. Transformation methods 4.4.1. Sine and cosine transforms 4.4.2. Bi-dimensional transforms	12

Learning activities guided by professor:	Hours 36
1. Thematic exposition by professor	18
2. Discussion presentation and/or plenary guided by professor	6
3. Solution of cases in small groups guided by professor	8
4. Individual activities guided by professor	4

Independent learning activities:	Hours 60
1. Reading of materials selected by professor. • The student must read various reading materials of selected topics to comprehend the various protocols that are used in network architectures. These materials are from chapters 1 through 10 of the Darrel Hankerson text.	20
2. Writing of article or summary of reading materials. • The student must write a technical article where he or she presents an innovative technique or application regarding data encoding. This article must be presented to the group.	8
3. Solving of selected problems. • The student will solve problems from chapters 1 through 10 of the Darrel Hankerson text. These problems must be delivered in the established date.	10
4. Lab work. • The student will apply various data encoding and compression algorithms in the laboratory.	14
5. Research and development of a topic assigned by professor. • Optional activity in which the student may exchange independent work hours for reading and article writing hours.	8

Evaluation procedures and instruments:

The evaluation procedures and instruments are the following:

1. Oral or written exam.
    - The student must prove to the professor via an oral or written exam, the knowledge of the primary course topics.
2. Deliverables.
    - The student must deliver a technical article in which he or she presents a technology or innovative application regarding network security, indicating advantages and technical requirements.
    - The student will deliver a report for each of the selected problems, which must be solved individually.
    - The student will deliver a technical memoir of the integral course project, which must contain the background of the organization, current situation, requirement definition, selected communication network, necessary equipment and considerations, as well as conclusions.

3. Presentations.
    - All students must present the technical article as well as an application case solution, to the group, in the day and hour that is established by the group and professor.
4. Participation in discussion sessions.
    - This will not be subject to evaluation.
5. Participation in lab work sessions.
    - The results of the working programs will be evaluated.

Evaluation criteria:

1. The evaluation instruments and procedures will be centered on the guided and non guided learning activities.
2. The professor will evaluate and assign a grade to each of the evaluation instruments. The grade must be within 0 and 100.
    - Oral or written exam 20 points.
    - Technical article 15 points.
    - Problem solutions 20 points.
    - Presentations 15 points.
    - Lab work participation 30 points.
3. The professor will report to the Graduate College the grade average for all the evaluation instruments obtained by each student.
4. The minimum passing grade is 80 points.
5. A student may not obtain a failing grade due to accumulated non attendance.

Bibliography:

Type	Title	Author	Publisher	Year
Text	Theory of information and encoding	Rober J. McEliece	Cambridge university press	2002
Reference	Introduction to information theory and data compression	Darrel Hankerson	Chapman & Hall / CRC	2003
Reference	Applied encoding information theory for engineers	Richard B. Wells	Prentice Hall	1999
Reference	Elements of information theory	Thomas M. Cover, Jay A. Thomas	Wiley	1991

Course name:	**Course code:**
Network Services Integration	CE 506

Location in curricular map:
Specialization Axis

Course description:
This course covers topics related to network interconnection via telecommunication systems, primarily telephonic, and how to integrate other type of services to computer networks, such as voice services. Current paradigms will be analyzed with regards to current communication services, as well as future expectations. A brief review of LAN and WAN standards will be done, analyzing various service alternatives that communication companies provide. The evolution of network communication services who increase their capacity and continually improve their technology will be studied. Also, how to integrate other services like quality, voice and call centers to the network and how to share a remote link to different types of applications.

Course learning outcomes:
At the end of the course the student will: Know and comprehend the interconnection needs of organizations and the benefits of integrating various services to the same network. Know the tendencies and expectations that the industry has regarding the future of communications networks. Know and comprehend the primary characteristics of services offered by communication companies. Comprehend and apply LAN and WAN commutation technologies for communication, and establish virtual networks through a WAN. Know the characteristics and advantages of various forms of data sending through a telephone network. Comprehend the need to integrate various services unto the same network, and the ways to share a communication line for various services.

Course content:	
Topic	Hours 36
1. Interconnection demands. 1.1. Communication paradigms 1.2. Current networks 1.3. Incorporation of telephone networks characteristics 1.4. Expectations 2. Base networks. 2.1. OSI Model 2.2. LAN Architectures 2.2.1. 802.x Standard 2.2.2. Interconnection devices 2.3. WAN Architectures 2.3.1. Circuit commutation 2.3.2. Package commutation 3. Commutation technology. 3.1. LAN Commutation 3.2. WAN Commutation 3.3. Virtual networks 4. Technologies. 4.1. Traditional access 4.2. T Carriers 4.3. Data sending through telephone systems 4.4. Transport evolution 4.4.1. SONET 4.4.2. Frame relay 4.4.3. ATM 4.4.4. WDM 5. Service convergence 5.1. Services 5.2. Quality service protocols 5.3. Voice over IP 5.4. Call centers 5.5. Commuter integration	4 6 6 10 10

Learning activities guided by professor:	Hours
1. Thematic exposition by professor	18
2. Discussion presentation and/or plenary guided by professor	6
3. Solution of cases in small groups guided by professor	8
4. Individual activities guided by professor	4

Independent learning activities:	Hours 60
1. Reading of materials selected by professor. • The student must read various reading materials of selected topics to comprehend the various protocols that are used in network architectures. These materials are from chapters 1 through 4 of the Darryl Black text and selections from the Steven Sheppard text.	20
2. Writing of article or summary of reading materials. • The student must write a technical article where he or she presents an innovative technique or application regarding wide area networks. This article must be presented to the group.	8
3. Solving of selected problems. • The student will solve problems from the Brad Dunsmore text. These problems must be delivered in the established date.	10
4. Lab work. • The student will configure various interconnection devices for networks in the laboratory. This activity might require previous research and reading of configuration manuals.	8
5. Research and development of a topic assigned by professor. • Optional activity in which the student may exchange independent work hours for reading and article writing hours.	OP
6. Integral course project. • Activity in which the student integrates the knowledge acquired throughout the course with his or her experience regarding networks, in the analysis, design and suggestion of improvements relating the security of an existing network. This will be presented in the last class session.	14

Evaluation procedures and instruments:

The evaluation procedures and instruments are the following:

1. Oral or written exam.
   - The student must prove to the professor via an oral or written exam, the knowledge of the primary course topics.
2. Deliverables.
   - The student must deliver a technical article in which he or she presents a technology or innovative application regarding network security, indicating advantages and technical requirements.
   - The student will deliver a report for each of the selected problems, which must be solved individually.
3. Presentations.
   - All students must present the technical article as well as an application case solution, to the group, in the day and hour that is established by the group and professor.
4. Participation in discussion sessions.

- This will not be subject to evaluation.

Evaluation criteria:

1. The evaluation instruments and procedures will be centered on the guided and non guided learning activities.
2. The professor will evaluate and assign a grade to each of the evaluation instruments. The grade must be within 0 and 100.
    - Oral or written exam 25 points.
    - Technical article 15 points.
    - Problem solutions 15 points.
    - Presentations 15 points.
    - Integral course project 30 points.
3. The professor will report to the Graduate College the grade average for all the evaluation instruments obtained by each student.
4. The minimum passing grade is 80 points.
5. A student may not obtain a failing grade due to accumulated non attendance.

Bibliography:

Type	Title	Author	Publisher	Year
Text	Building Switched Networks	Darryl P. Black	Addison Wesley	1999
Text	Telecommunications convergence	Steven Shepard	McGraw Hill	2002
Reference	Telecommunications technologies reference	Brad Dunsmore, Toby Skandier	Ciscopress	2003
Reference	Broadband telecommunications Handbook	Regis J. Bates	McGraw Hill	2002
Reference	Wide area networks	Patrick Regan	Prentice Hall	2004

Course name:	**Course code:**
Application Project	CS 501

Location in curricular map:
Terminal Axis

Course description:
Throughout the course, the student will develop pan application project that demonstrates the capacity for analysis, team work, interpretation and application of knowledge and tools acquired throughout the masters program

Course learning outcomes:
The student will be capable of applying the knowledge and abilities acquired throughout the courses of the masters program, contributing to the development of practical solutions that benefit the community.

Course Content	**Hours**
1. Definition of application pre-project.	**16**
2. Ethics in professional services.	**4**
3. Project presentation.	**4**
4. Follow up by professor.	**4**
5. Presentation of pre results.	**4**
6. **Presentation of final results.**	**4**

Learning activities:	
• **Guided activities:** - Presentation of subject by professor. - Presentation by guest researchers. - Discussions of subjects and cases. - Final project presentation.	**36**
• **Independent activities:** - Applied research case reading. - Information gathering. - Research reports. - Problem analysis. - Solution design.	**60**

Evaluation criteria and procedures:
The evaluation instruments are the following: Homework and research work Final project research Participation The points distribution for each instrument will be established in accordance with the group in the first class session.

Bibliography

	Type	Title	Author	Publisher	Year
1	None				